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Geochemical Baseline Studies and Relations Between Water Quality and Streamflow in the Upper Blackfoot River Watershed, Montana: Progress Report for July 1997 - March 1998

by

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ABSTRACT

The upper Blackfoot River watershed is the subject of a geochemical baseline study as part of a larger endeavor of the U.S. Geological Survey Mineral Resources Program to determine geochemical baselines on a regional and national scale. This site was chosen due to the possible environmental impacts of the proposed McDonald Gold Mine, which is proposed to be located 8 miles east of Lincoln, Montana, near the confluence of the Landers Fork and Blackfoot River.

Eleven sites in the vicinity of the proposed mine were established for water quality sampling and streamflow measurement. Surface water was sampled at each site, and shallow hyporheic water and ground water seeps were sampled from selected sites. All samples were analyzed for dissolved (<0.2 μm) major and trace cations, selected anions, and inorganic and organic carbon. Water sampling and analysis were conducted using ultra-clean techniques under a strict quality-assurance quality-control program. Discharge measurements were made during each sampling event and were used to ascertain losing and gaining reaches of the streams and to allow for constituent load calculations. At least one shallow piezometer was installed at each site to measure the vertical hydraulic gradient beneath the streambed.

As discharge decreased, dissolved concentrations generally increased and dissolved loads generally decreased in both the Landers Fork and the Blackfoot River. For many dissolved constituents, there was a negative, approximately linear relation between discharge and dissolved concentration through the summer and fall. Samples collected in the winter, when discharge was smallest, indicate that a reversal in the discharge-concentration trends occurred for most of the constituents. The concentrations of many constituents decreased in 1/98 and 3/98, well before the start of spring runoff, and this is possibly due to the streamflows being dominated by early snowmelt. Exceptions to these trends include dissolved As in the Landers Fork and dissolved As, Cr, Cu, Fe, Mn, and Zn in the Blackfoot River. Arsenic concentrations in the Landers Fork are thought to be controlled by inputs from the adjacent aquifer. In the Blackfoot River, As, Cr, Cu, Fe, Mn, and Zn were more highly concentrated during high flows than during low flows, possibly due to input from upstream abandoned mining operations. Streamflow data indicate a dynamic relationship between ground water and surface water, as losing and gaining reaches changed on both streams during the sampling period.

INTRODUCTION

The potential environmental effects of mineral deposits, both those effects that occur naturally prior to mining and those that result from mining and mineral processing, are key issues in national and global mineral-resource development. To quantify and understand these effects, it is necessary to determine natural geochemical baseline conditions that exist regionally in rocks, sediments, soils, ground water, surface water,

vegetation, and other media. Baseline information is important to the establishment of environmental remediation standards for mining and the determination of the extent of environmental effects resulting from mining activity. In addition, such baselines can be used to evaluate the environmental effects of other human activities that may result in the mobilization of elements into the environment and to determine the geologic distribution and environmental mobility of potentially toxic elements.

The Mineral Resources Program of the U.S. Geological Survey (USGS) has identified the determination of geochemical baselines on a regional and national scale as a research priority. One of the areas chosen for study is the Blackfoot River watershed in western Montana (Figure 1). This watershed was chosen primarily because of the proposed McDonald Gold Mine. This mine, located approximately 8 miles east of Lincoln, Montana, near the confluence of the Blackfoot River and Landers Fork, is proposed to be an open-pit operation with ore processed by cyanide heap leaching (Figure 2). The potential impact of this mine on the Blackfoot River and Landers Fork is a dominant environmental issue associated with the ongoing permitting process.

The first stage of the study of the Blackfoot River watershed has concentrated on characterizing the geochemistry of the Blackfoot River and Landers Fork in the vicinity of the proposed mine and on determinating the physical relationships between surface and ground water in the area. The purpose of this report is to 1) describe field and laboratory methods and 2) present the hydrologic and water-quality data collected between July 1997 and March 1998.

METHODS

Eleven sites were established for environmental sampling and physical characterization (Figure 3). Sites were selected upstream, adjacent to, and downstream of the proposed mine site. Surface water was sampled at all of the sites for chemical analysis, and ground water seeps and shallow hyporheic zone water were sampled at selected sites. Discharge measurements also were made at each location during sampling events in order to ascertain losing and gaining reaches of river and to allow for mass-balance calculations. Two and a half centimeter diameter wells were installed at ten of the sites to complement discharge data by allowing for comparison of ground water and surface water potentiometric levels.

During the winter sampling, many sites were frozen to different extents. At sites that appeared frozen, attempts were made to break through the ice to ascertain whether the stream was frozen at the surface only. At sites with surface freezing only, the ice was broken through along the width of the river and streamflow was measured and water quality samples were collected. Sites that did not have any flowing water that could be found beneath the ice are labeled as frozen.

Surface water:

Discharge measurements:

Discharge was measured using a Price AA current meter and Aqua Calc 5000 calculator (Rickly Hydrological Co.) following the manufacturer's instructions. The same meter was used over the entire project period, so as to limit sources of instrument

variability error. Measurements across transects at each surface water sampling site usually were repeated once and sometimes twice in order to define the variability in measurements (Table 1). During the higher flows in July 1997, a bridge crane was used at sites that could not be safely waded and that had bridges crossing them.

At each transect, depth and velocity measurements were made at 5 to 29 stations across the width of the river (Table 1). The total number of stations depended on the width and morphology of the river transect. Using the recommended minimum of 10 stations per transect was not always practical or possible due to the small size of the water channels in the study area (Rantz et al., 1982). The spacing between the stations was intended to capture as much velocity and depth variability as possible, and as a result, the distances between stations were between 20 and 120 cm of river width. Spacing between stations was tighter where there was more streamflow and where the transect morphology changed more strongly. When replicate measurements were made, parallel transects separated by several meters of river length were measured. The good reproducibility of the replicate measurements justify the use of a smaller number of stations per transect on the smaller channels.

At each station, the current meter was adjusted to measure velocity at 60% of the depth of the river at the specific location. River depth was not found to exceed 1 meter in any of the sampling sites, and thus a more detailed vertical profile measurement was not necessary. Velocity data were collected by integrating 40 seconds of velocity measurements using the Aqua Calc 5000. Although the Aqua Calc reports discharge calculations to the hundreth of a ft^3/s, discharge here is reported as rounded to the nearest whole unit, because reproducibility was unsuccessful at a finer scale. For this reason, a difference in discharge of 1 ft^3/s or less is deemed insignificant. The lowest flow measured during the study was at a couple of sites in the winter, when discharge was measured as between 0.5 and 1.4 ft^3/s. These measurements were assigned a value of 1 ft^3/s.

The degree of variability in the discharge measurements was determined on a site-specific basis. At most sites, discharge was measured twice. The variability in duplicate measurements differed with the size of the streamflow. For discharge measurements between 5 and 12 ft^3/s, between 13 and 28 ft^3/s, and between 29 and 40 ft^3/s, the variability was as high as 1 cubic foot per second (ft^3/s), 2 ft^3/s, and 4 ft^3/s, respectively. When discharge was higher than 40 ft^3/s, the variability in replicate discharge measurements was between 0 and 8%. For the lowest flows measured (at 1 ft^3/s), the variability of less than 1 ft^3/s was not significant.

At sites where discharge was measured at least twice, the site-specific replicate measurements were used to represent the variability. For those sites where only one discharge measurement was taken, error bars were applied so that the single value would be given plus or minus the value of the highest variability found within each discharge bracket, as described above. Thus, for measurements of 5 to 12 ft^3/s, a 2 ft^3/s error bar was applied; for measurements of 13 to 28 ft^3/s, a 4 ft^3/s error bar was applied; for measurements of 29 to 40 ft^3/s, a 8 ft^3/s error bar was applied; and for measurements above 40 ft^3/s, a 16% error bar was applied. For example, for a site where discharge was measured once as 20 ft^3/s, its value is reported as 20 (+/-2) ft^3/s; and for a site where discharge was measured to be 100 ft^3/s, its value is reported as 100 (+/-8) ft^3/s.

As long as the range of discharge measurements at two sites did not overlap, their difference in discharge (>1 ft^3/s) was deemed significant. If a site had lower discharge measurements than a site upstream from it, the reach between the sites was classified as a net losing reach. If a site had higher discharge than the site upstream, the reach between them was classified as a net gaining reach. If the variability in discharge measurements at the two sites overlapped, the reach was classified as having no measureable gain nor loss. Downstream from confluences (such as below Copper Creek (C) and Landers Fork Site A (LA)), the lowest discharge measurements from each site were added together for the cumulative low end discharge measurement above the confluence, and this range was compared to the site below their confluence. The same was done with the highest discharge measurements at each site to find the combined high end measurements. Similarly, at sites where several individual surface channels comprised the total surface flow at a site, the maximum variability was used based on the lowest and highest streamflows measured in each channel.

During the latter half of the study period, the water depth at many sites was less than 1.5 feet, a depth below which a correction factor is recommended to be applied to the velocity measurements (Pierce, 1941). However, these correction factors (mostly between 0.99 and 1.01) were not applied because the factors are smaller than the error found from performing replicate transect measurements.

Water Sampling:

Surface water samples were collected from some or all sites on the following dates: July 3-4, 1997, July 20-21, 1997, August 7-8, 1997, September 13-14, 1997, October 19, 1997, October 25, 1997, November 16 and 18, 1997, January 6, 1998, and March 8, 1998.

Three depth-integrated samples were taken when sampling each site. Samples were taken after the discharge measurements were made, and they were taken so as to approximate equal discharge areas of the stream. The samples were numbered 1-3 at each site, with sample 1 taken from the left side of the river (looking upstream), sample 2 from the middle, and sample 3 from the right side. The three samples from each site were analyzed separately to allow for determination of variability across the stream transect.

Measurements of pH, specific conductance, dissolved oxygen concentration, and air and surface water temperature were made in-situ during sampling. The instruments were held in the moving water of the stream, in approximately the same places from where the water quality samples were taken. The pH was measured using an Orion model 230A pH meter; the dissolved oxygen was measured using an Orion model 820 dissolved oxygen meter; the specific conductance was measured with a Hach Conductivity/TDS meter; and temperature was measured using a Barnant 100 Thermocouple Thermometer Model No. 600-2820 (JKT). The pH and dissolved oxygen meters were calibrated at the beginning of the sampling sessions, and their calibration was checked regularly (at least each time a new site was to be sampled), so as to maintain good accuracy and precision (Table 2).

Sampling was completed according to ultra-clean techniques described by Windom et al. (1991), Benoit (1994), and Taylor and Shiller (1995) to minimize sample contamination. All samples were collected in 1-liter Nalgene polyethylene bottles that

were previously cleaned in the laboratory. The ultra-clean washing procedure for the bottles included soaking in a 6N HCl acid bath for at least 2 hours and then in a 1.0 % trace-metal grade nitric acid bath for at least 24 hours. The sample bottles were thoroughly rinsed with Milli-Q deionized water at least three times before and after each of these steps. Following the final rinse, they were filled with Milli-Q water, capped, and stored in double Ziplock plastic bags, in which they remained until moments before sampling.

In the field, both people sampling wore clean surgical gloves which were changed between sites. One person ("dirty hands") held the outside bag and did not make contact with the inside bag and bottle, while the other ("clean hands") handled the inside bag and the sample bottle. The "clean hands" person collected the samples by first emptying out the bottles of the Milli-Q water downstream, and then hand dipping the bottles below the water surface upstream of him or herself, integrating over the depth of the stream. The bottles were rinsed with stream water once before obtaining a sample for analysis. The bottles were filled to capacity, immediately capped, placed back into their double bags, and were stored on ice for transport back to the University of Montana Murdock Environmental Biogeochemistry Laboratory. At least one field blank was carried through the complete acid washing, filtration, preservation, and analytical procedure for each sampling session.

Lab Methods:

Immediately upon returning to the lab, the samples were filtered and preserved for analysis. This procedure was done at the end of each sampling day, except on the 2-day sampling events, when samples were filtered and preserved at the end of the second day. No sample was left unfiltered for more than 30 hours. Studies have shown that field filtration results in high risks of introduction of trace metal contamination into bottles, and that lab filtration, even if not done immediately, does not cause significant sorption onto sample bottles prior to filtration (Struempler, 1973; Benoit, 1994; Taylor and Shiller, 1995). In addition, an experiment was conducted for this project to test whether sorption onto bottles before filtration was a problem. Five replicate samples taken from the Blackfoot River were stored on ice for 2, 12, 41, 65, and 160 hours before being filtered for analysis. Results showed that there was no significant change in dissolved concentrations over the 160 hours. Exceptions to this were Fe and Mn, whose concentrations dropped significantly after 65 hours, a time period longer than the holding times used in this project nonetheless (Table 3).

Using clean surgical gloves, each bottle was removed from its double bag under a class 100 laminar flow hood when the bottle was ready to be filtered. The samples were filtered through Serum Acrodisc 0.2 μm syringe filters with a glass prefilter (Gelman Sciences). The effective pore size of the filter was reduced by exhaustive filtration, thus reducing the amount of colloidal material passing through (Taylor and Shiller, 1995). This entailed the passage of 50 mL of sample through the filter before an analytical aliquot was obtained. The 50 mL was also used to rinse the bottles that the samples would be stored in, as well as the syringe itself. Approximately 60 mL of sample was filtered into an amber glass bottle (which had been cleaned by repeated rinsing with Milli-Q water) with a teflon cap for carbon and anion analysis. These samples were not acidified and were kept chilled until analysis. An additional 100 mL of sample was then

filtered into polyethylene bottles (cleaned in the same ultra-clean manner as the 1-liter sample bottles) and preserved to pH< 2 with ultrapure, double distilled from quartz, Optima (FisherScientific) hydrochloric acid to await trace element and major ion analysis.

Trace element and major ion concentrations were measured using a Thermo Jarrel-Ash ICP (IRIS), using ultrasonic nebulization (Cetac, U-5000AT+). The analysis was conducted according to EPA Method 200.15 (Martin et. al., 1994) , but excluded the addition of nitric acid and hydrogen peroxide to samples and standards solutions. Previous lab work indicated no benefit in analysis with nitric acid, and hydrogen peroxide was not needed because As was analyzed by atomic absorption spectrometry. Consequently, these steps were eliminated to reduce the possiblity of contamination in sample preparation.

Chloride, fluoride, nitrate-nitrogen, nitrite-nitrogen, phosphate, and sulfate were measured within 48 hours of sampling by ion chromatography (IC) according to EPA Method 300.0 (Pfaff, 1993). IC analysis was discontinued after January, 1998 because all constituents were consistently below the detection limit, and sulfate concentrations could be found from sulfur analysis on the ICP. Inorganic carbon was measured within one week of sampling using a Shimadzu Carbon Analyzer according to Standard Method 505A (Franson, 1985). The remaining sample in the glass bottles was acidified with reagent-grade HCl to pH<2, and it was analyzed for organic carbon also according to Standard Method 505A using a Shimadzu Carbon Analyzer (Franson, 1985). Organic carbon analysis on the acidified samples was completed within 1 month of sampling, with the exception of the November 16, 1997 sample event in which analysis was completed two months after sampling.

Arsenic analysis was completed by atomic absorption spectroscopy using hydride generation according to Standard Method 303A (Franson, 1985), with modification to the arsenic reduction method, calibration standard concentrations, and hydride generation reagent concentrations. These modifications were performed according to a method developed at the University of Montana Murdock Environmental Biogeochemical Laboratory (Mickey, written communication, 1997), as described below.

Atomic absorption spectroscopy using hydride generation measures arsenic in its volatile hydride (AsH_3), which is produced intantaneoulsy from $As_{(III)}$ in the presence of sodium borohydride and acid solution. In surface water samples, arsenic exists primarily in the oxidized state $As_{(V)}$ and to a lesser degree $As_{(III)}$. Therefore, in order to measure total inorganic arsenic, it was necessary to first convert all $As_{(V)}$ species to $As_{(III)}$. This was accomplished by adding potassium iodide (KI) and hydrochloric acid (HCl) to all standards and samples to achieve final concentrations of 2% KI and 1M HCl. The addition was completed at least two hours prior to analysis to insure complete arsenic reduction, which is relatively slow at room temperature, and low pH values (<2). Once the arsenic was reduced, arsine gas could be produced within the hydride generator by reacting with a 0.35% sodium borohydride ($NaBH_4$) solution (stabilized with 0.5% NaOH), and 6N HCl, allowing for the determination of As concentrations in the samples.

Table 4 lists sampling dates with the corresponding analysis dates for each analytical instrument.

Piezometers:

At all sites except at Hogum Creek, 2.5 cm diameter steel piezometers were installed into the streambed to depths between approximately 30 and 60 cm. With a bolt plugging the lower end, piezometers were pounded into the streambed using a fence post driver and sledge hammer. Once the desired depth had been reached, the well was twisted and pulled up about 5 cm, releasing the bolt and allowing water to enter the piezometer. The piezometers were used to provide further insight into the physical ground water/ surface water relationships and were not used for water sampling.

The surface water level on the outside of the piezometer and the water level inside the piezometer were both measured using a standard measuring tape. The length of the outside of the pipe above the surface water level was measured directly. The water level inside the piezometer was measured by marking the tape with a washable ink pen and noting the depth from the top of the piezometer at which the ink was washed off. Piezometer measurements are site specific and are to be applied only in the immediate vicinity of the well.

Hyporheic zone:

The geochemistry of selected shallow hyporheic zone sites were sampled in October and November, 1997. Samples up to 85 cm in depth beneath the stream bed were taken at sites LB and LC on the Landers Fork, and at sites BB and BC on the Blackfoot River. At each of these sites, two multi-level sampling clusters were pounded into the stream bed approximately 10-20 m apart. Steel pipe was used to pound in casing into which the clusters were inserted, and the casing was immediately removed upon placement of the tubing so that no metal was known to remain in the borehole. It was not possible to use anything but metal pipe to pound through the streambed due to the coarseness of the streambed and hyporheic zone sediments.

The sampling clusters were made up of 4-5 groups of acid washed 0.64 cm O.D. polycarbonate tubing bound so that each tube was stationed at a different depth beneath the stream bed. With the exception of BC, which was sampled 6 days after the cluster was installed, at least 2 weeks passed before the multi-level wells were sampled. Sampling was performed by extracting samples with syringes washed using ultra-clean techniques. Care was taken to minimize the amount of water extracted in order to reduce the volume of the subsurface space from which the sample was being integrated. At least one tube volume was purged before a sample was taken, and with the small diameter tubing, no more than 30-50 mL was needed for this task. With the help of the second person also wearing clean surgical gloves, the syringe sample was filtered in the field through 0.2 μm Acrodisc filters directly into ultra clean washed 125 mL bottles. These sample bottles were rinsed with approximately 30-50 mL of filtered sample before collecting the sample for analysis. Another aliquot of sample was filtered into a sample-purged 60 mL amber glass bottle for carbon and anion analysis.

Snow:

Two surficial snow samples were collected from the floodplain near the confluence of the Blackfoot River and the Landers Fork (site BD). The samples were collected in ultra-clean 250 mL bottles, by scooping snow up into the bottles directly. They were filtered in the laboratory within a few minutes of the samples having melted

completely in the laboratory at room temperature. The same filtering and analytical procedures were used as described for the surface water samples.

Quality Assurance / Quality Control:

Laboratory analysis was performed under a formal quality control program in accordance with respective EPA methods for each instrument. Therefore, each instrument was calibrated with linearity established between endpoints which bracketed environmental sample concentrations (where appropriate) and was then checked for accuracy and precision Accuracy was evaluated using laboratory reagent blanks, laboratory fortified blanks, laboratory fortified samples, and internal standards. External standards were also employed as a check for accuracy on the AAS, ICAPES, and IC. Precision was evaluated on each instrument using sample replicates and standard replicates. The practical quantification limit (PQL) was determined by the Murdock Environmental Biogeochemistry Laboratory as the threshold at which a sample can be reproduced within a maximum variability of 30% (Table 5)

All mean measured values of external standards and internal standards were within the reported acceptable range or 10%, respectively, with exceptions for Ag, Sr, and As (at the 0.5 μg/L level only) (Tables 6.1-6.3 and 7.1-7.3). Comparison of replicate results indicate that constituent concentrations are precise within a minimum of 5.9% for all elements except As, Cr, and Fe, which are precise within 9.7% (Tables 8.1 and 8.2). Recovery of all fortified elements with concentrations higher than the PQL was between 86.1% to 115% (Tables 8.3 and 8.4).

A combined total of 140 lab blanks were analyzed during the project period, and all elements for all blanks were below their PQLs (Tables 9.1 and 9.3). Fifteen field blanks were analyzed. Concentrations of Ca, Mg, Na, S, and Zn were slightly above the respective PQLs (Tables 9.2 and 9.4). The highest concentrations of Ca, Mg, Na, and S (0.04, 0.02, 0.42, and 0.04 mg/L, respectively) found in the field blanks were generally too low to affect sample concentrations, although they may explain the noise in many of the data for Na (Na concentrations in environmental samples were commonly only 2-8 times the concentration in the blank). In addition, the occurrence of Zn above the PQL of 0.2 μg/L in 4 of the 13 field blanks needs to be considered when examining Zn data. The highest concentration of Zn in a field blank was 3.7 μg/L, which is higher than all of the concentrations in samples from the Landers Fork, and higher than some of the concentrations measured in samples from the Blackfoot River. It is hypothesized that the long residence times (usually several weeks) of the Milli-Q water in the blank bottles may have been the source for Zn in the blanks, whereas environmental samples were in contact with the bottles for much shorter periods of time. Therefore, despite the contamination problem, it should be noted that 75 of the 112 Landers Fork samples had zinc concentrations <0.2 μg/L.

Use of variability/error margins on data:

Error bars applied to the discharge measurements at sites where only one measurement was taken are highly conservative, as they represent twice the total range of variability found at sites with similar streamflows. Error bars at sites where multiple measurements were made represent the full range of measurement variability, also to be highly conservative. This approach has been taken in a rigorous attempt to not

underestimate the measurement errors. However, this project is ongoing, and with a more complete data set in the future, a more thorough error analysis will be performed in order to refine the error bars.

Variability in the geochemical data is defined as the range of values in field replicates. Lab error is inherently encompassed within the measured field variability. For those samples with no field replicates (i.e. many of the hyporheic zone samples), an error bar representing the mean percent difference between laboratory replicates was applied. This value is different for each analyte. (Tables 8.1 and 8.2)

Use of variability/error margins on load calculations:

In order to quantify the amount of dissolved constituents being transported in the rivers, dissolved loads (in grams/ day) were calculated for each sampling date (Tables 10-11). Three values were calculated for each sampling site on each sampling date, based on the three surface water samples taken. The first value was found by multiplying the lowest concentration of the constituent of interest in the triplicate samples by the lowest discharge value at the site; the second was found by multiplying the highest concentration of the constituent by the highest discharge value; and the third was found by multiplying the mean concentration by the mean discharge value. The three values taken together were used to represent the variability of the load measurements. Again, this procedure entails a highly conservative calculation of the variability/error bars on the data, and this is done as an initial approach to limit the possibility of the underestimation of error bars. As the data set will grow in the future, the errors may become finer as they are better defined.

RESULTS

I. Discharge

Streamflow in the study area varied both temporally and spatially, and results indicate a dynamic surface water - ground water relationship (Tables 1 and 12, Figures 4a-g and 5a-h). Overall, discharge decreased over the course of the study period. Discharge relationships among sites on specific sampling dates were more complex. Between many of the sites, net gains, losses, and no relative changes in discharge were found on different sampling dates. Several stretches of the rivers that were gaining during the higher flows had no net gains or losses in the late summer to early fall and became losing reaches during the late fall and winter. One stretch of the Landers Fork, between LB and LC, was gaining on all the dates sampled, and was almost entirely ground water fed by the January and March sampling dates.

A. Landers Fork streamflow

The three stream reaches that were measured for flow gain or loss were: 1) the upper reach between C and LA combined (Copper Creek and Landers Fork A summed) and LB (below their confluence); 2) the middle reach between sites LB and LC; and 3) the lower reach between LC and LD (Figure 3 and Table 11).

The upper reach (between sites C+LA and LB) was gaining on 2 of the 6 measurement dates (7/3/97 and 8/7/97); it had no measureable gain nor loss on another 2

dates (7/20/97 and 9/13/97); and it was losing on the last two dates, 1/6/98 and 3/8/98 (Table 1, Figures 4a-g).

The middle reach (between LB and LC) was the only reach in the project area that was gaining on all of the dates on which it was measured[1] (Table 1, Figures 4a-g). Over the course of the study period, the relative increases in streamflow between sites LB and LC became more pronounced, as input to the reach became more strongly controlled by ground water contributions. During the high flow sampling events of 7/3/97 and 7/20/97, 14-16% of the flow at LC was derived from ground water inputs. Later in the year, as discharge decreased, these percentages grew to 25%, 43%, and 67%, as measured on 8/7/97, 9/13/97, and 11/16/97, respectively (Table 1). On 1/6/98, the Landers Fork was followed upstream approximately 500 feet from LB, and the stream was found to become increasingly small in size, until its flow was lost beneath snow and ice. Water beneath the snow and ice was not found, and it appeared that nearly all the flow (5-6 ft^3/s) at LB had surfaced from seeps in the approximately 500 feet of channel upstream. Discharge at site LC was 26 (+/-0) ft^3/s, indicating that approximately 75% of the flow at LC was supplied by ground water input between sites LB and LC. On 3/8/98, the stretch between LB and LC was found to be more strongly ground water dominated. Discharge at LB was only 1 ft^3/s, but at LC it was 22 (+/-2) ft^3/s. In addition, site LC, unlike many other sites, was not frozen on the surface or with depth on the winter sampling dates.

The lower reach (between sites LC and LD) either had no measureable change in discharge (on 7/21/97, 11/16/97, and 1/6/98), or was a net losing reach (on 8/7/97, 9/13/97, and on 3/8/98) (Table 1, Figures 4a-g).

B. Blackfoot River streamflow

Three reaches on the Blackfoot River were measured for flow gain or loss were: 1) the upper reach between sites BA and BH; 2) the middle reach above and below the entrance of Hogum Creek, between BH and BB; and 3) the lower reach between BB and BC, just above the confluence with the Landers Fork (Figure 3 and Table 12).

The upper reach was measured 5 times, and the differences in discharge between sites BA and BH were either slight or not detectable (Table 1, Figures 5a-h).. On 2 events (7/4/97 and 9/13/97), a 4-18% gain was detected; on one date (8/8/97), an 8% loss was measured; and on 2 dates (7/20/97, 7/21/97) no net loss nor gain was measured.

The middle reach became more strongly losing over the course of the study period, even though Hogum Creek enters the reach (Table 1, Figures 5a-h). The reach did not have measureable gains and losses on 7/4/97 and 7/21/97, but did have a slight (4-6%) gain on 7/20/97. This gain is possibly due to the addition of Hogum Creek, but because it was not measured, it cannot be known for certain. On 8/8/97, 9/13/97, and

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[1] Note: The discharge measurements at LB and LC took place within a few hours of each other so as to minimize the influence of possible diel variability in streamflow. The one exception to this was on the 7/20/97-7/21/97 sampling event, on which LB was measured in the evening of 7/20/97, and LC was measured in the morning of 7/21/97. However, based on discharge and water depth measurements on both dates at other sites, flows in the area were the same or lower on 7/21/97 than on the previous day. This indicated that the increase in streamflow between LB and LC was at least as great as recorded.

11/18/97, the reach was losing 5-33% of its flow between BH and BB. On 1/6/98, the reach was losing more heavily; flow at BH was 20 ft^3/s, but the river was throroughly frozen at BB, indicating that all the flow was transferred to the subsurface in that stretch of river. (On 3/8/98, flow at BH was similar to that measured on 1/6/98; it was 23 ft^3/s, but site BB was not visited on this date.) Hogum Creek's discharge was measured only twice, and both times its 1 ft^3/s flow rate was relatively small (4-5%) compared to the discharge on the Blackfoot River at site BH.

The lower reach, between BB and BC, was gaining on 5 of the 6 times it was measured (Table 1, Figures 5a-h). On 7/20/97 and 7/21/97, BC gained 13-28% of its flow from ground water downstream from BB; it gained 28-37% of its flow from ground water on 8/7/97; and it gained 21-33% of its discharge from ground water on 9/13-14/97. However, on 11/18/98, a net loss of 2-10 ft^3/s was measured along the reach. On 1/6/98, the reach appeared to be gaining again. Site BB was thoroughly frozen, based on visual inspection and futile attempts of breaking through the ice to water, but site BC was flowing in an open channel with no surface freezing, at 14 (+/-0) ft^3/s. On 3/8/97, site BB was not visited, and therefore, the reach could not be evaluated for gains and losses.

C. Confluence

Measurements of discharge below the confluence of the Landers Fork and the Blackfoot River compared to the sum of streamflows above the confluence generally showed some loss of surface water or no detectable gain nor loss (Tables 1 and12). Except for on 7/3/97-7/4/97, when sites LD and BC were not yet established, this was calculated by adding the streamflow at sites LD to site BC, and comparing it to the streamflow at site BD, below the confluence. On 7/3/97 and 7/4/97, the addition of streamflows at sites LC and BB were used to compare to site BD. There were net losses at BD on the 7/3/97-7/4/97 and 8/7/97-8/8/97 sampling events. No detectable gains or losses were measured below the confluence on 7/20/97 and 7/21/97, and on 9/13-14/97.

II. Surface water geochemistry

Concentrations of most dissolved constituents increased as discharge decreased in the both the Landers Fork and the Blackfoot River sites through the summer and fall sampling events (Appedicies A-C). However, in the 11/97, 1/98, and 3/98 samples, most constituents broke from this trend, as concentrations dropped while discharge continued to decrease .

Some elements did not follow this pattern at all sites. In the Landers Fork, As concentrations varied with discharge in a different pattern from the other elements (Apendix A-1.6, 2.6, 3.6, 4.6, 5.6). In the Blackfoot River, Cu, Fe, Mn, and Zn were more highly concentrated during the higher flows than during the lower flows (Appendix B-1, B-2, B-3, B-4). Dissolved oxygen and pH generally had no significant changes with discharge (Appendicies A and B: 1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1, 5.2).

Overall, the Blackfoot River had higher concentrations of organic carbon, SO_4^{2-}, Cu, Fe, K, Mn, Na, S, Si, and Sr; lower concentrations of inorganic carbon, Ba, and Ca; and similar concentrations of Mg, As, and Li in comparison to the Landers Fork (Appendix C). The dissolved chemistry of the Blackfoot River and of the Landers Fork surface water indicates the rivers are clean compared to many others and fall well within water quality standards (Table 13).

No field collected samples were found to have measurable (above PQL) concentrations of Ag, Al, Be, Cd, Co, Mo, Ni, Pb, Ti, and V (Table 5). For the anions, no detectable levels of Cl, NO_3^--N, NO_2^--N, and PO_4^{2-} were found.

A. Landers Fork

1. Dissolved chemistry relative to discharge:

Most of the dissolved constituents exhibited an increase in concentration with decrease in discharge (Appendix A). The temporal trends show negative and approximately linear relationships between discharge and concentration for most of the elements over the sampling period through 11/97. The January and March samples show a break in this trend, with the concentrations of many of the elements (primarily Ba, Ca, Mg, S, Si, Sr) decreasing with decreasing discharge (Appendix A). Although discharge at the Landers Fork sites decreased by approximately 10-15 fold (and up to 332-fold at LB), over the course of the sampling period, the corresponding dissolved concentrations increased by no more than approximately 50% for all dissolved constituents measured (Table 1, Appendicies A and C).

Arsenic exhibited a trend different from the others. At sites LC and LD it decreased in concentration with decrease in discharge over the first three sampling events, and then it reversed its trend and increased in concentration with decrease in discharge (Appendix A-4.6, 5.6). At sites C, LA, and LB, As decreased with decreasing discharge, and did not reverse its trend (Appendix A-1.6, 2.6, 3.6). However, it should be noted that site LA was not measured in 11/97, 1/98, and 3/98, and site C was not measured in 11/97 and 3/98.

2. Dissolved chemistry relative to site locations:

Differences in dissolved concentrations between sites on specific dates were generally small or insignificant, although the stretch between sites LB and LC did have some significant increases in dissolved concentrations of many constituents (Table 14). (Statistical significance is defined as having a p-value of <0.01 using a two-tailed t-test.) On 7/20/97-7/21/97, dissolved inorganic carbon, Ba, Ca, K, Li, Mg, Si, and Sr were significantly different between the sites; the concentrations were higher at LC. The same pattern was found on 8/7/97, with the exception that differences in Ca were no longer significant. On 9/13/97, dissolved sulfate, Ba, K, Li, Mg, S, and Si were significantly different (higher) at LC than at LB, and on 11/16/97, dissolved As, Ba, K, Li, Si, and Sr were different (higher at LC). On 1/6/98, dissolved As, Cr, S, and Si were significantly higher at LC, and on 3/8/98, dissolved As, Ba, S, Si, and Sr were higher. There were no significant differences in dissolved concentrations on 7/3/97.

For dissolved As, the differences between sites LB and LC became stronger with decrease in discharge (Table 14). With decreased discharge, the reach became more strongly controlled by ground water input, as shown by the discharge measurements, and the ground water seep sampled at LC had a dissolved As concentration of 0.9 (+/- 1) µg/L (Appendix C-4.5, 4.6). On the 7/97, 8/97, and 9/97 sampling dates, dissolved As concentrations between LB and LC were not statistically different. However, on 11/16/97, the dissolved arsenic concentration was 0.3 (+/-0.1) µg/L at LB but changed to

0.6 (+/-0.1) µg/L at LC, and on 1/6/98, LB still had 0.3 (+/-0.1) µg/L As, while LC concentrations increased to 0.8 (+/-0.1) µg/L. On 3/8/98, the As concentration at LB remained at 0.3 (+/-0.1) µg/L, but the concentration at LC rose to 1 µg/L.

3. Estimated ground water chemistry between sites LB and LC:

Differences in discharge and dissolved concentrations between LB and LC were assumed to be controlled by ground water inputs, because no other surface water inputs were found, and because the stretch of the Landers Fork between sites LB and LC gained significant amounts of ground water on all sampling dates. An estimate of ground water dissolved chemistry was back calculated from the chemistry and discharge data (Table 15). These calculations estimate the concentrations of dissolved constituents in the ground water, assuming that they behaved conservatively as they moved across the ground water- surface water boundary. Therefore, the calculations may underestimate the ground water concentrations of those constituents which may have precipitated out or otherwise reacted upon contact with surface water. Nevertheless, they are a useful approximation of the dissolved chemistry in the ground water affecting the dissolved chemistry in the surface water.

On 11/16/97, several locations of ground water seeps were found to be flowing from the east bank of the Landers Fork into the surface water, approximately 100 meters upstream of the Highway 200 bridge (site LC), (Figure 3). The water coming out of the seeps was sampled on 11/16/98, 1/6/98, and 3/8/98.

The dissolved concentrations of constituents found in the samples were compared to the back calculated ground water concentrations, and with one exception, no statistical differences between them were found using a two tailed t-test with p-values <0.01 (Table 15). The one exception, Si, was slightly more highly concentrated in the seep samples than predicted from the mixing equations. Because the calculated ground water chemistry was generally not different from that found in the seep samples, the seep samples are assumed to represent the chemistry of the ground water contributing to the reach between sites LB and LC.

4. Dissolved loads:

Dissolved loads (in grams/day) decreased with decreases in discharge, despite the increase in dissolved concentrations (Table 10, and Appendix D).

Differences in loads between sampling sites were found on each sampling date (Table 10). The largest differences were found between LB and LC, although some changes were found between the other sites as well, as described below. Significance was determined using two tailed t-tests, with p-values <0.01.

a) Load changes between C and LA (combined) and LB:

On 7/3/97, when the stretch between C and LA (combined) and LB was gaining, the largest differences in loads were found between the sites above and below the confluence than on any other date (Table 10, and Appendix D). Dissolved inorganic carbon, sulfate, K, Li, Mg, and Sr loads were all significantly higher at LB than at C and LA combined. On 7/20/97, when the stretch had a constant discharge, only the K and Mn loads were significantly different at LB. On 8/7/97, when a slight net gain was again detected, dissolved inorganic carbon, K, Li, S, and Si loads were higher at LB. On

9/13/97, when there was no relative discharge difference, only K and Li loads were significantly higher at LB. Sites LA and C were not sampled on 11/16/97, and on 1/6/98 site LA was frozen. A comparison of C with LB on 1/6/98 shows that dissolved loads of inorganic carbon, sulfate, As, Ba, Ca, Cr, Fe, K, Li, Mg, Na, S, Si, and Sr were all significantly different, but this time they were all lower at LB. As noted in the discharge results, it appeared that most or all of the water at LB was coming from ground water inputs on this date, and that Copper Creek did not appear to be connected, possibly explaining the difference in load chemistry. Neither site C nor site LA was sampled on 3/8/98.

b) Load changes between LB and LC:

Differences in load chemistry between sites were most common and significant between sites LB and LC (Table 10, and Appendix D). In general, loads increased significantly (p-value <0.01) between the sites on all dates for most or all constituents measured. The largest exception to this was on 7/3/97, which is also when one of the smallest relative increases in discharge was measured between the sites. On this date, dissolved sulfate, As, Cr, Fe, K, Li, Mg, Na, S, and Si loads were not significantly different between sites, although dissolved inorganic carbon, Ba, Ca, Mn and Sr loads were. On 7/20/97-7/21/97, only dissolved As, Cr, Fe, and Na loads were not significantly different, and on 9/13/97, all but the dissolved Na load was significantly higher at LC. On 8/7/97, 11/16/97, and 1/6/98, the load increased significantly for all constituents measured above detection: inorganic carbon, sulfate, As, Ba, Ca, Cr, Fe, K, Li, Mg, Mn, Na, S, Si, and Sr. The same was true for 3/8/98, with the exception that Cr, Fe, and Mn were below detection, and thus their loads were not quantifiable.

c) Load changes between LC and LD:

Between sites LC and LD, load differences were smaller than between sites LB and LC. LD was not sampled on 7/3/97, but on 7/20/97-7/21/97, only the dissolved Li and Mn loads were different between the sites (Table 10, and Appendix D). On 8/7/97 and 9/13/97-9/14/97,when the stretch was a net losing reach, dissolved inorganic carbon, sulfate, Ba, Ca, K, Li, Mg, Mn, Si, and Sr loads were significantly lower at LD. On 11/16/97 and 1/6/98, there were no significant load changes between the sites. On 3/8/98, disolved inorganic carbon, As, Ba, Ca, K, Li, Mg, Na, S, Si, and Sr loads were all significantly lower at LD than at LC.

B. Blackfoot River

1. Dissolved chemistry relative to discharge:

A general pattern of increases in dissolved concentrations with decreases in discharge was observed on the Blackfoot River sites for inorganic carbon, Ba, Ca, K, Li, Mg, Na, Si, S, sulfate, and Sr (Appendix B). These constituents were found to increase in concentration by no more than approximately 30% with the 4- to 7-fold decrease in discharge measured over the period of sampling. (Table 1, Appendicies B-C) However, for those sites sampled in 11/97, 1/98, and 3/98, a reversal in this trend was typically observed, as concentrations dropped with the decreasing winter discharge (Appendix B-

2,3,4, and Appendix C-8.5, 8.6, 8.7, 9.6, 10.5, 10.6, 10.7). This pattern is similar to that seen for the same constituents in the Landers Fork.

Several dissolved constituents, namely As, Cu, Fe, Mn, and Zn, did not follow the approximately negative linear correlation between discharge and concentration (Appendix B-1.6, 1.9, 1.10, 1.14, 1.19, 2.6, 2.9, 2.10, 2.14, 2.19, 3.6, 3.9, 3.10, 3.14, 3.19, 4.6, 4.9, 4.10, 4.14, 4.19). These constituents generally decreased in concentration with decrease in discharge. Arsenic decreased from approximately 0.4-0.5 µg/l during the high flows to 0.2-0.3 µg/l during the lower flows. An exception to this occured with the samples from 7/20/97, which were collected following a rainstorm. The concentrations of these elements were at their highest measured, although it was the second to highest streamflow measured. After 7/20/97, Cu, Fe, and Mn concentrations decreased with decrease in discharge during the sampling period. Zinc concentrations were not different on the 7/3/97-7/4/97 and 7/20/97 sampling dates, but its concentrations generally decreased beyond those dates.

2. Dissolved chemistry relative to site location:

There were few statistically significant (p-values <0.01) differences between sites BA and BH for most of the dissolved constituents on most of the dates (Table 16). There were no statistically different concentrations except for As and Fe on 7/20/97 (when they were higher at BH), and Mn in 8/97 and 9/97 (when it was lower at BH). Differences between sites BH and BB, and between sites BB and BC were greater (Table 16).

Between BH and BB, above and below the confluence of Hogum Creek, significant differences were detected in several of the constituents measured (Table 16). Stastically significant increases in Sr were found on all but one of the sampling dates, and this can be explained by the relatively high Sr concentrations found in Hogum Creek (434-438 µg/L in 11/97 and 1/98, compared with 106-113 µg/L on the Blackfoot at Hogum Creek Road on the same dates). Magnesium and S concentrations were significantly lower at BB compared to BH on several sampling dates. Based on the two sampling dates on which Hogum Creek was measured, both elements were lower in concentration in Hogum Creek than on the Blackfoot River above Hogum Creek.

Concentrations at site BC were significantly lower compared to concentrations at site BB for several elements (Table 16). On 7/20/97, this was the case for Mn; on 8/7/97-8/8/97 for Fe; and on 9/13-14/97 for Fe and Mn (whose concentrations dropped by 50% at BC). On 11/16/97, sulfate, Ca, Fe, K, Mg, Mn, S, and Si were significantly lower at BC, and Sr was significantly higher.

On the 1/98 and 3/98 sampling dates, BB was not sampled because it was either frozen or not visited. However, a comparison of concentrations between BH, above Hogum Creek, and site BC on those dates again show decreases in Mn and increases in Sr concentrations downstream (Table 16).

3. Dissolved loads relative to site location:

Changes in dissolved loads with site location generally were insignificant among sites BA, BH, and BB, but significant between BB and BC (Table 11 and Appendix E).

Between sites BB and BC, most constituents were statistically different (p-value<0.01) on all sampling dates. In general, the loads between the sites increased at BC compared to BB on the 7/20/97, 8/7/97, and 9/13/97-9/14/97 sampling dates. Exceptions

were Cu, Fe, Mn, and Zn loads, which were either not significantly different or decreased between the sites. The loads of most constituents then decreased across the reach on 11/16/97. Because site BB was not sampled on 1/6/98 nor on 3/8/98, the specific stretch between sites BB and BC could not be evaluated for load changes. However, the total stretch between BH and BC had a decreasing load downstream on 1/6/98 of inorganic carbon, sulfate, Fe, Li, Mg, Mn, S, and Si; and on 3/8/98 of Ca, Mg, and Mn.

C. Confluence of the Landers Fork and Blackfoot River

Samples taken several hundred meters below the confluence of the rivers were generally found to be carrying dissolved loads whose variability overlapped with the range of values found by the addition of loads at the Blackfoot River and Landers Fork sites upstream of the confluence (Tables 10 and 11). For some elements (e.g. Ba and Ca,) the sums of the dissolved loads at LD and BC were slightly (<10%) higher than their values at BD, indicating some loss in the vicinity of the confluence.

III. Piezometer Measurements

Piezometer measurements varied with surface water discharge (Tables 17.1 and 17.2). Commonly, surface water level changed more sharply than did piezometer heads. In general, piezometers at sites located within reaches of river that were gaining ground water, (as indicated by discharge measurements), showed closer relationships between surface water elevations and piezometer heads than did piezometers within losing reaches. The only piezometers showing positive hydraulic gradients toward the surface water were the east bank piezometer at site LC and the south bank piezometer at site BB. Piezometers at sites C, LA (upstream of bridge), LB, LC (west bank), BB (south bank), and BD (south bank) had water levels <9 cm below the level of surface water. Piezometers at LA (under bridge), LD (northwest bank), BH, BC, and BD (north bank) had water levels that were 13-106 cm lower than the surface water level, showing stronger negative hydraulic gradients. One piezometer at LD (southeast well), and both piezometers at BA were dry on all sampling events, indicating that the potentiometric head was at least 61 cm below the streambed surface near one piezometer at LD, and at least 46 cm below the streambed surface at both piezometers at BA.

IV. Shallow hyporheic zone

At Site LB, only one of the two muli-level clusters was sampled, and this was done on 11/18/97. The sampled cluster, located closer to the southern bank of the river, drew water from approximately 10, 20, 40, and 85 cm of depth beneath the stream bed. In comparison with surface water chemistry taken from samples collected 2 days prior, there was no difference between surface water and hyporheic zone water chemistry at 10, 20, and 40 cm (Appendix C-3.5, 3.8). However, the sample drawn from 85 cm depth did appear to be slighlty different. During installation of the multi-level sampling cluster, it was noted that the sediment at this depth was very fine grained, in contrast to the very coarse grained nature of the overlying sediments. Inorganic carbon, sulfate, Ba, Ca, Cr, Fe, K, Li, Mg, Mn, Si, and Sr were all slightly higher at the 85 cm depth sample compared to the others and to the surface water (Appendix C-3.5, 3.8). Most different was Mn, whose concentration jumped from <0.3 µg/l in the surface water and in the 3 higher hyporheic zone samples, to 35.5 (+/-2.1) µg/l at the 85 cm depth sample.

At Site LC, sampled on 10/19/97, the two hyporheic zone sampling clusters showed no changes in water chemistry with depth (Appendix C-4.13, 4.14). The first cluster was used to sample from approximately 5, 15, 35, 55, and 82 cm, and the second was used to sample from approximately 10, 20, 40, 60, and 80 cm. However, concentrations of Ba, Ca, K, Li, Mg, and Sr were higher in the hyporheic zone samples as a group than their concentrations in the surface water (Appendix C-4.5, 4.13, 4.14). The concentrations of these elements in the 5 hyporheic zone water samples were significantly lower than in the 3 surface water samples at a p-value of <0.01 in each cluster (p-values calculated using two sample t-tests.)

At Blackfoot Site B, both hyporheic zone sampling clusters were sampled on 10/25/97. One cluster, with well openings at approximately 10, 20, 40, 60 and 74 cm beneath the stream bed, showed that dissolved organic carbon, Cr, and Cu concentrations increased and that Fe and Mn decreased with depth (Appendix C-9.7). Barium increased at 10, 20, 40, and 60 cm compared to the surface water and then decreased at 74 cm (Appendix C-9.5, 9.7). The second hyporheic cluster at BB drew water from approximately 10, 20, 35, 55, and 85 cm beneath the stream bed. The surface water chemistry was not different from the chemistry measured at 10, 20, 35, and 55 cm, with the exception of SO_4^{2-}, Ba, Ca, Mg, and Sr, which were slightly higher in the hyporheic zone (different at a p-value of <0.005, using a two tailed t-test), (Appendix C-9.5, 9.8). The drop in Fe and Mn and the increase in Cu concentrations with depth found at the first hyporheic cluster at BB was found in the second as well. The sample drawn from 85 cm was found to contain higher sulfate, Cu, Na, and S concentrations, but lower Ba, Fe, Li, Mn, and Si concentrations than the other hyporheic zone samples.

At site BC, only one hyporheic zone cluster, with openings at approximately 10, 30 and 74 cm depths, was sampled. The hyporheic zone chemistry was no different from the surface water, with the possible exception of Mn and Na at the 74 cm level (Appendix C-10.4, 10.8). Mn fell below the PQL of 0.3 µg/l, although it was found to be at 0.8 (+/- 0.1) µg/l in the surface water,and at 10 and 30 cm. The Na concentration at 74 cm was 5.48 (+/-0.29) mg/l, compared to 2.77 (+/-0.21) in the surface water and other hyporheic zone samples.

V. Snow samples

The two snow samples were found to have below PQL levels of all constituents measured, with the exceptions of 0.2 mg/l Mg, 0.23 and 0.40 mg/l Na, and 0.02 and 0.03 mg/l S, making them comparable to the field blanks (Table 18).

DISCUSSION

1. Discharge

Streamflow measurements indicate that the measured reaches on both the Landers Fork and Blackfoot River have dynamic relationships with their adjacent ground water systems. During the higher summer flows, ground water contributions were measureable on many reaches, indicating that spring runoff not only brought more surface flow, but rose the water levels in the adjacent ground water systems as well. Later in the year as discharge decreased, several of the reaches made transitions to losing, indicating that lack of snowmelt and limited precipitation also affected water levels in the valley aquifer.

This was futher evidenced by the dropping water levels in the in-stream piezometers. However, streamflow at LC was typically a constant 20-30 ft^3/s higher than at site LB, indicating that there the connection between the stream and the adjacent ground water system remained relatively constant over the range of surface flows sampled in the study period. The contribution of warmer ground water to the surface water appeared to be also responsible for keeping the surface water flowing in the winter by increasing the temperature of the water, especially along the LB to LC stretch on the Landers Fork and along the BB to BC stretch on the Blackfoot River.

2. Surface water geochemistry: dissolved concentrations

The generally negative, linear relationship between discharge and dissolved concentrations seen in the Landers Fork and Blackfoot River in the summer and fall (except for As, Cu, Fe, Mn, and Zn) is to be expected in streams whose spring high flow is largely a product of snowmelt. High flows in the spring and summer are thought to control dilution of the surface waters, whereas during low flows, ground water inputs become more significant and contribute water more highly concentrated with dissolved metals. This scenario is clearly seen at site LC, where concentrations of most constituents were lowest during the highest discharge, and steadily increased with the decreasing streamflow. The site gained ground water on all dates, as evidenced by the increased streamflow compared to site LB upstream, the ground water seeps found in the winter months, the shallow hyporheic zone water being stastically different from the surface water, and the positive hydraulic gradient found in one of the site's shallow piezometers. This contribution by the ground water, which was found from the seep samples and mixing equations to generally be more highly concentrated in the measured constituents than the surface water, can explain the concentration-discharge relationships.

However, the increasing proportion of baseflow in the stream channel was not the only control on the geochemistry during lower flows. This is seen on 11/97, 1/98 and 3/98 sampling dates, when the concentrations began to fall for most constituents in both the Landers Fork and the Blackfoot River, although streamflow still was decreasing. This might be an indication that winter snowmelt was having a significant dilution effect on the stream chemistry even before spring runoff started with its higher flows. The two snow samples showed that the snow contained no elements at levels different from field blanks, indicating its potential to be a diluting agent. Thus, it is possible that during the winter sampling events, there was enough ground water influx to keep many portions of the streams flowing, while a limited amount of snowmelt kept concentrations in the channels low.

The behavior of As, Cu, Fe, Mn, and Zn on the Blackfoot River does not follow the general discharge-concentration relationship, likely due to effects of upstream defunct mining operations. Approximately 25 kilometers upstream of the study area at the headwaters of the Blackfoot River, there are a series of retention ponds, tailings piles, and former mine adits from the Mike Horse and other mine operations, which extracted Ag, Au, Pb, Zn, and Cu from sulfide ore deposits until 1953 (McCulley, Fick, and Gilman, 1994; Moore et al, 1991.) The remains of the old mining operation, which has been undergoing reclamation in the last several years, are the possible sources for the increased loading of metals to the river during the higher flows. It is possible that increased surface runoff or higher ground water in contact with the waste rock, and/or overflowing

retention ponds were mobilizing the elements into the river headwaters, accounting for the increased concentrations in the stream at the study sites. Production of acid mine drainage in the old mine area may have also contributed to the drop of approximately 0.5 pH units on the Blackfoot on 7/20/97 (Appendix B-1.1,2.1,3.1,4.1), which corresponded with some of the highest concentrations of As, Fe, Cu, and Mn measured in the river during this study. Other studies have also reported metals behaving differently from the standard dilution-controlled, discharge-concentration relationships in streams, citing soil, rock, and anthropogenic weathering processes as potential causes for the variability (Edwards, 1973; Walling and Foster, 1975; Sanden et al., 1997).

Differences in dissolved chemistry from site to site on specific sampling dates can be explained by ground water contributions and/or in-stream chemical processes. For example, ground water contributions can explain the increase in both discharge and concentrations on the Landers Fork stretch between LB and LC. However, on the Blackfoot Rivers stretch between BB and BC, decreases in Fe, Mn, and Zn concentrations can be attributed to dilution by cleaner ground water and by precipitation reactions as the water moves further away from the contaminant sources upstream. Some dilution by ground water was likely occurring, because many generally conservative elements (e.g. Ca, Mg) dropped in concentration along the reach as well . Decreases in Cu, Fe, Mn, and Zn could be expected because with the neutral pH and high dissolved oxygen values in the rivers at the time, the metals likely would be more stable in their solid forms and may have precipitated out as iron oxyhydroxide complexes as they were transported downstream (Filipek et al., 1987; Davis, 1991; Smith et al., 1992).

3. Loads

Load calculations demonstrate that during higher flows, the load of metals transported in the dissolved phase is greater than during lower flows. Because concentrations of most constituents were typically lowest during the highest flows, the load trends demonstrate that discharge is a stronger control than dissolved concentrations on determining the metal loading in the streams.

As the Landers Fork passed by the McDonald ore body, the loads of several constituents (particularly As) increased significantly, suggesting that the ore body was having an effect on the surface water chemistry. Despite the increased concentrations between sites LB and LC, however, the concentrations of metals and As at site LC were still relatively low compared to water quality standards. This suggests that the undeveloped ore body is not adversely affecting the quality of the adjacent surface water, which is fed by ground water moving from the area where the mineralized zone is located.

4. Hyporheic zone water:

The results of the hyporheic zone water sample analyses suggest that the shallow area beneath the streambed is in general very similar to that of the surface water. At some sites, however, differences between hyporheic zone water and surface water were significant, indicating that ground water was moving up into the stream in these zones, or that surface water was reacting with hyporheic zone sediments.

SUMMARY AND CONCLUSIONS

The Landers Fork and the Blackfoot River were found to have dynamic relationships with their adjacent ground water systems, with gaining and losing reaches changing over the course of the sampling period. Several reaches which were gaining or exhibiting no change in discharge during the earlier part of the study period (when discharge was highest) were later found to change to losing reaches during lower flows. The stretch between sites LB and LC was gaining on all sampling dates, and it became dominated by ground water input on the November, January, and March sampling dates. The stretches above LB and below LC went from either gaining to having no change in discharge during the higher flows to losing reaches during the lower flows. The upper Blackfoot stretches (between BA, BH, and BB) were typically losing reaches, although the stretch between BB and BC was found to be gaining on most of the sampling dates.

The dissolved chemistry of the Landers Fork and Blackfoot River were different for many of the constituents measured. Comparisons of dissolved concentrations show that the Blackfoot generally had higher concentrations of organic carbon, sulfate, Cu, Fe, K, Mn, Na, S, Si, Sr, and Zn, lower concentrations of inorganic carbon, Ba, Ca, and similar concentrations of Mg, As, Cr, Li than the Landers Fork. Discharge at the Landers Fork sites decreased by approximately 10-15 fold (and by 332-fold at LB), and discharge in the Blackfoot decreased by approximately 4-7 fold over the course of the sampling period, but dissolved concentrations increased by no more than 50% for the dissolved constituents measured in both rivers.

Dissolved loads generally decreased with decrease in discharge, while dissolved concentrations generally increased with decrease in discharge. Changes in discharge appeared to have a stronger control on the loads than did changes in dissolved concentrations. Discharge and dissolved concentration had negative, approximately linear relationships for many of the constituents measured on both rivers in the summer and fall months. Exceptions to this trend are As, Cu, Fe, Mn, and Zn on the Blackfoot River, where their concentrations were highest during the larger flows. It is hypothesized that releases from the former Mike Horse mine site were the source for the increased loading of metals into the river during the higher flows. During the winter months, concentrations decreased with decreasing discharge for most constituents, possibly due to dilution by snowmelt.

Dissolved As concentrations in the Landers Fork were affected by ground water input. As the reach between sites LB and LC became strongly supplied by ground water in the fall and winter, As concentrations increased, possibly suggesting a geochemical signal and hydrologic connection between the Landers Fork and the adjacent As-rich McDonald ore body.

Piezometers open at approximately 0.5-1.0 meter beneath the stream bed provided site specific information on whether there were upward or downward gradients between the surface water and below the stream bed. Head was typically several centimeters below the surface water level at many of the sites, although it was found to be higher at one piezometer at LC on most of the sampling dates and once at a piezometer at BB.

The dissolved chemistry of several shallow hyporheic zone profiles at LB, LC, BB and BC was measured as well. At LB, the hyporheic profile sampled had slightly higher dissolved inorganic carbon, sulfate, Ba, Ca, Cr, Fe, K, Li, Mg, Mn, Si, and Sr at the 85 cm depth. At LC, there were no changes in chemistry with depth, although the

hyporheic zone samples as a group differed from the surface water chemistry at a p-value of <0.01. At BB, Fe and Mn were found to increase and Cu concentrations were found to decrease with depth in the two hyporheic samplers. At BC, only one sampler with three depths was measured, and little change was found, with the exception of a decrease in Mn and increase in Na in the lowest depth (74 cm). Differences between hyporheic and surface water chemistry indicate physical and/or chemical interactions with the hyporheic zone sediments and/or adjacent groundwater system.

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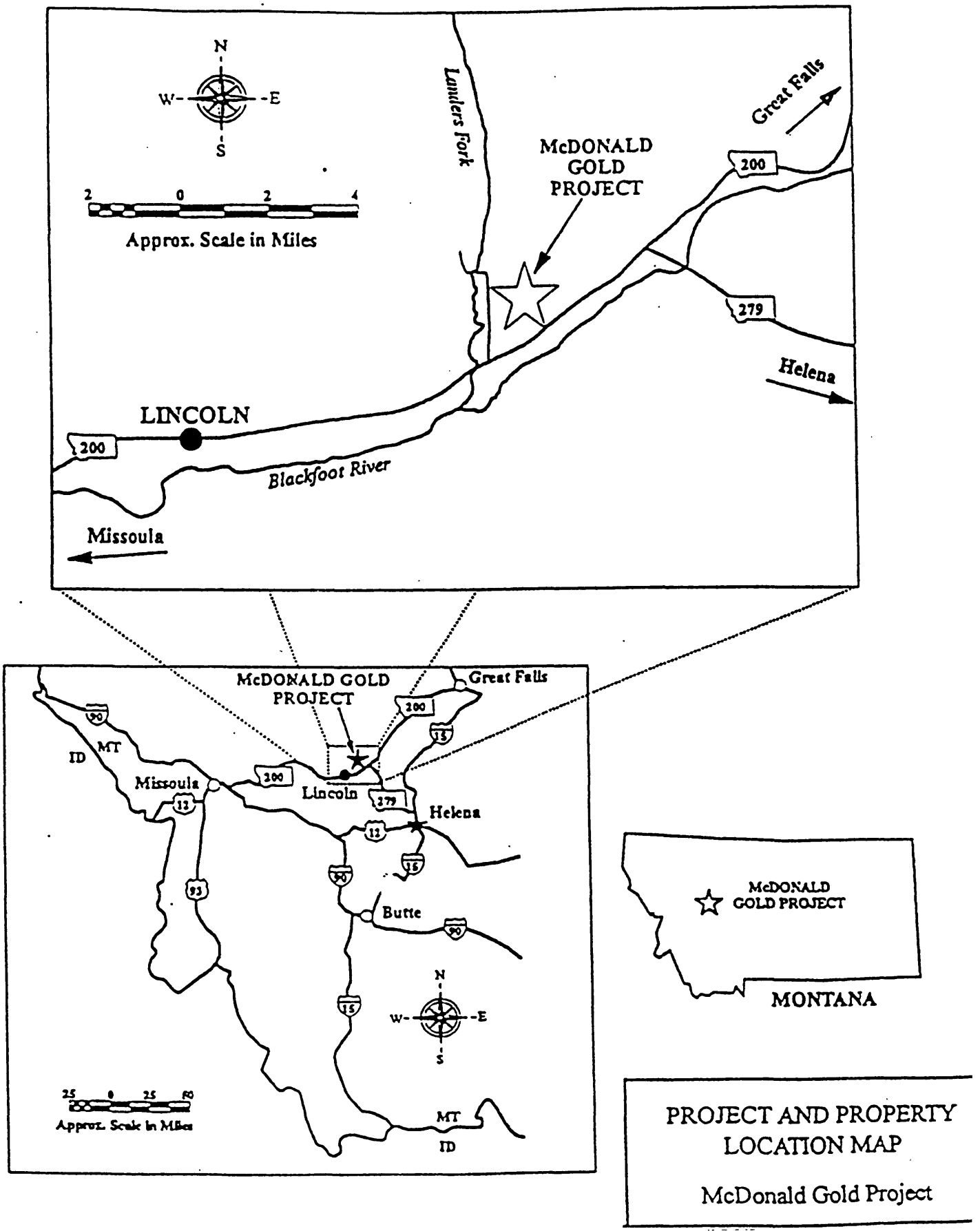


Figure 1. McDonald Gold Project location map (McDonald Alternative Development Report, 1997).

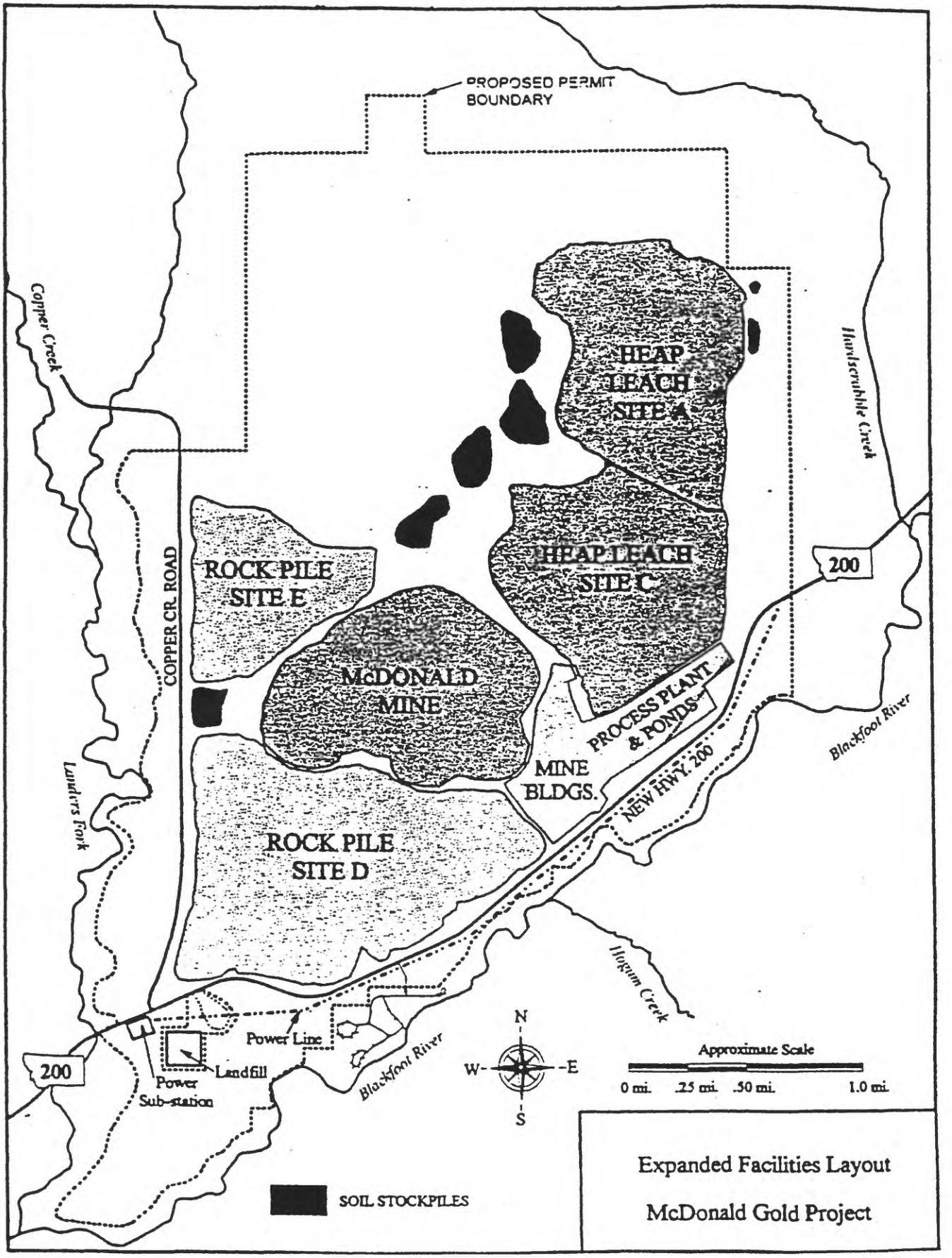


Figure 2. Proposed mine facilities layout (McDonald Alternative Development Report, 1997).

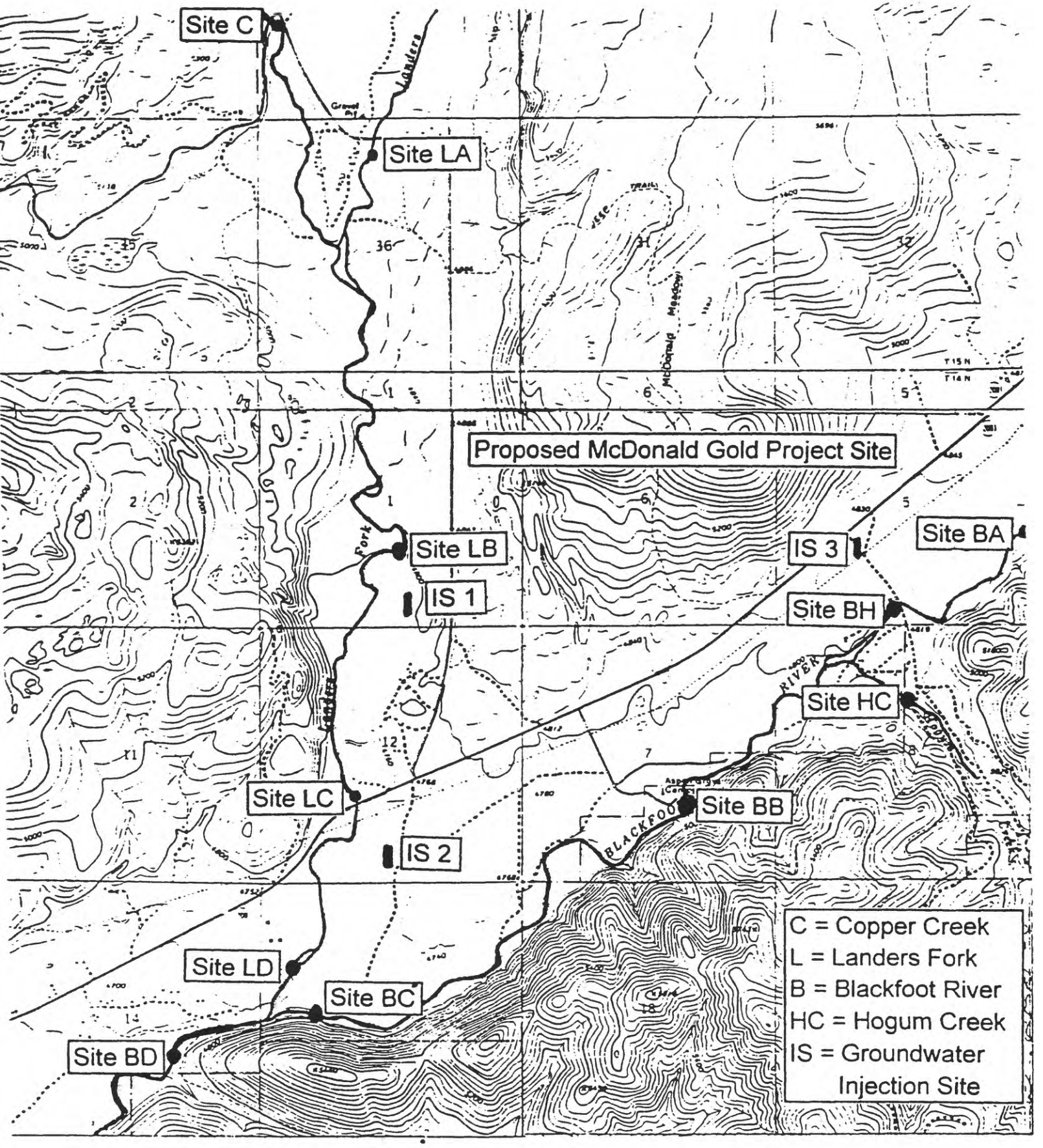


Figure 3. Map showing sample sites and ground water injection locations currently in use.

Figure 4a
Discharge in the Landers Fork
on 7/3/97-7/4/97

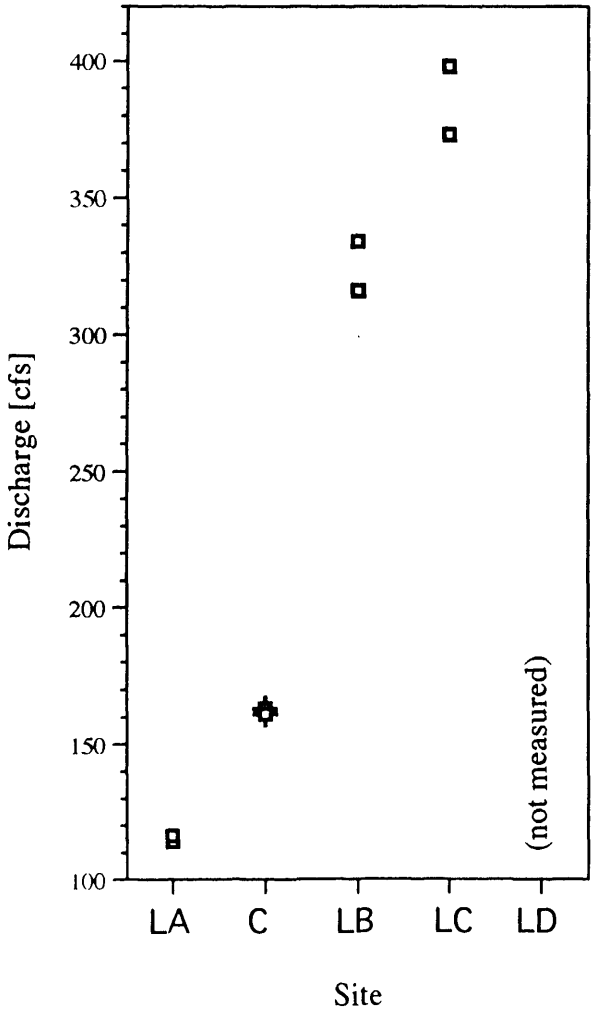


Figure 4b
Discharge in the Landers Fork
on 7/20/97-7/21/97

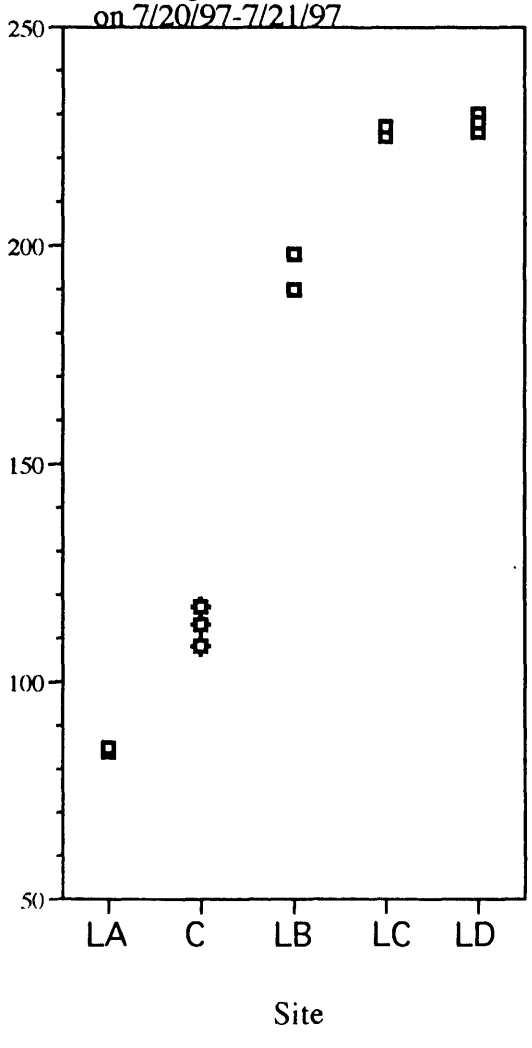


Figure 4c
Discharge in the Landers Fork
on 8/7/97

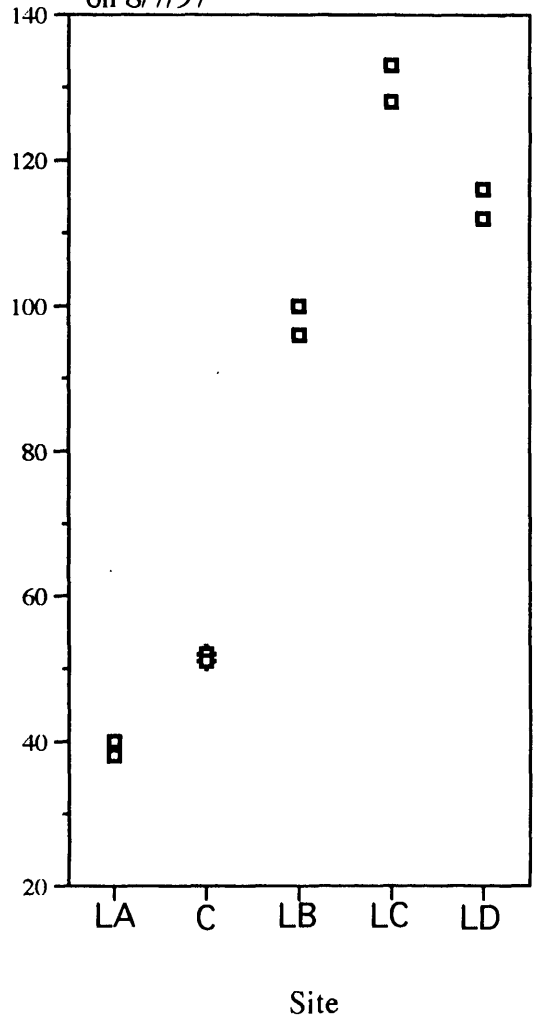


Figure 4d
Discharge in the Landers Fork
on 9/13/97-9/14/97

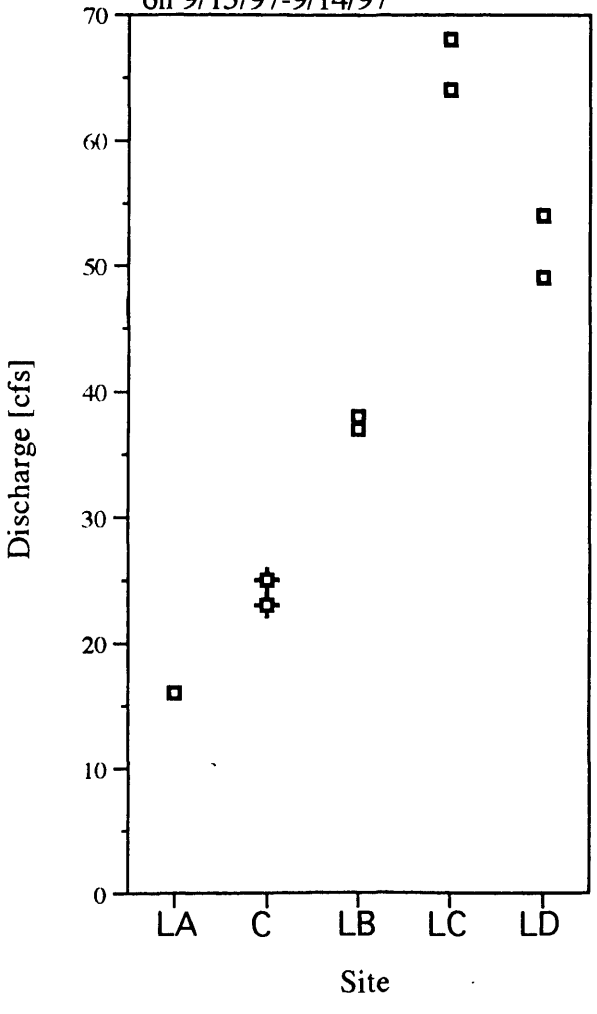


Figure 4e
Discharge in the Landers Fork
on 11/16/97

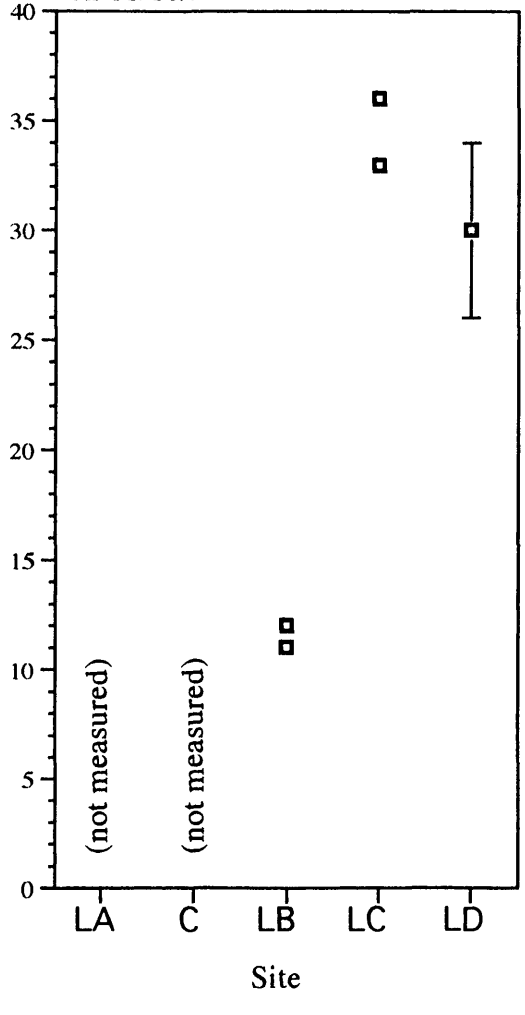


Figure 4f
Discharge in the Landers Fork
on 1/6/98

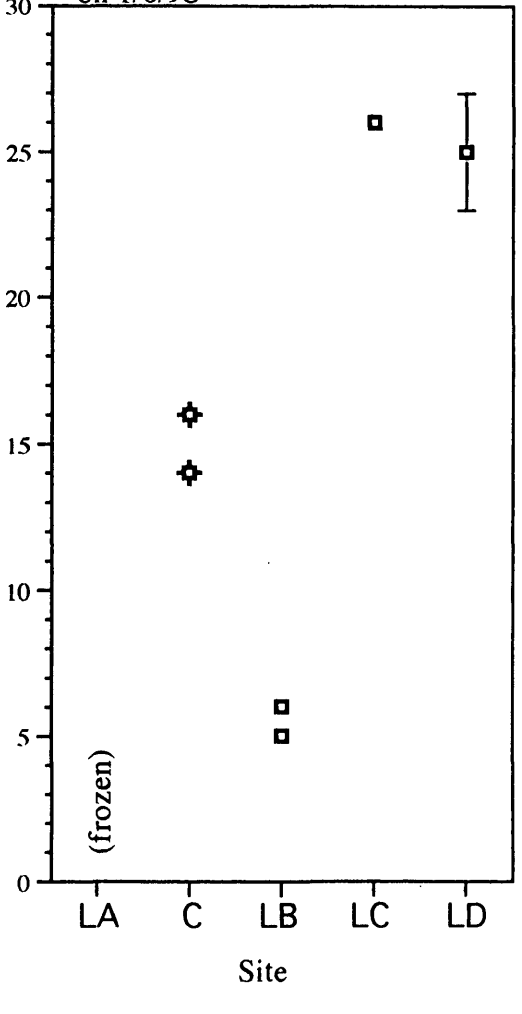


Figure 4g
Discharge in the Landers Fork
on 3/8/98

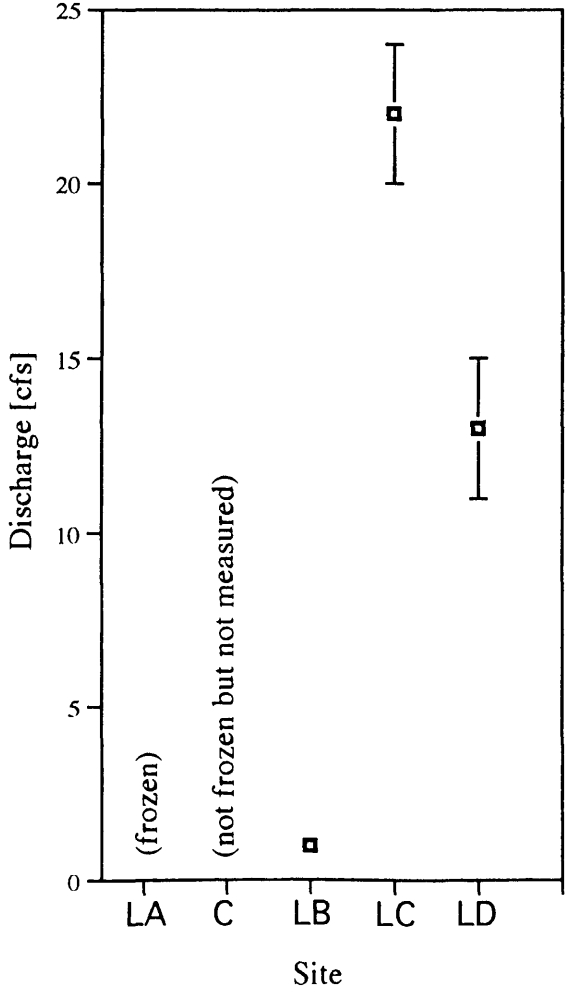


Figure 5a
Discharge in the Blackfoot River
on 7/3/97-7/4/97

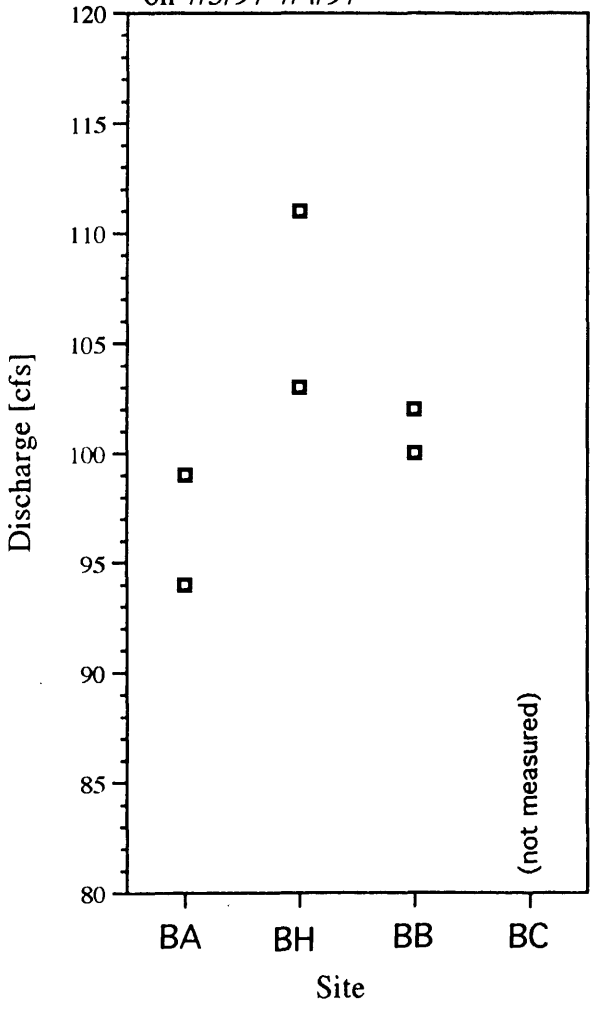


Figure 5b
Discharge in the Blackfoot River
on 7/20/97

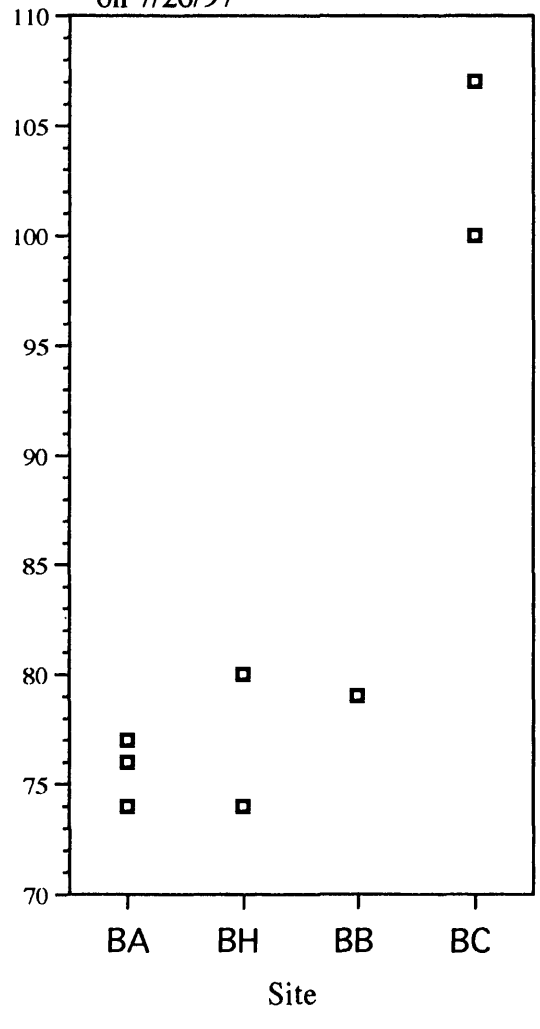


Figure 5c
Discharge in the Blackfoot River
on 7/21/97

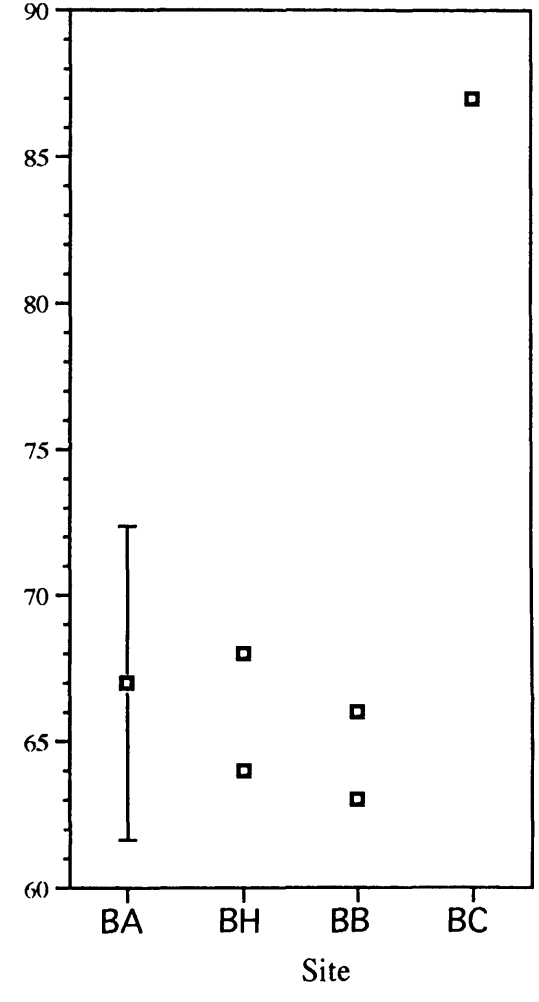


Figure 5d
Discharge on the Blackfoot River
on 8/7/97-8/8/97

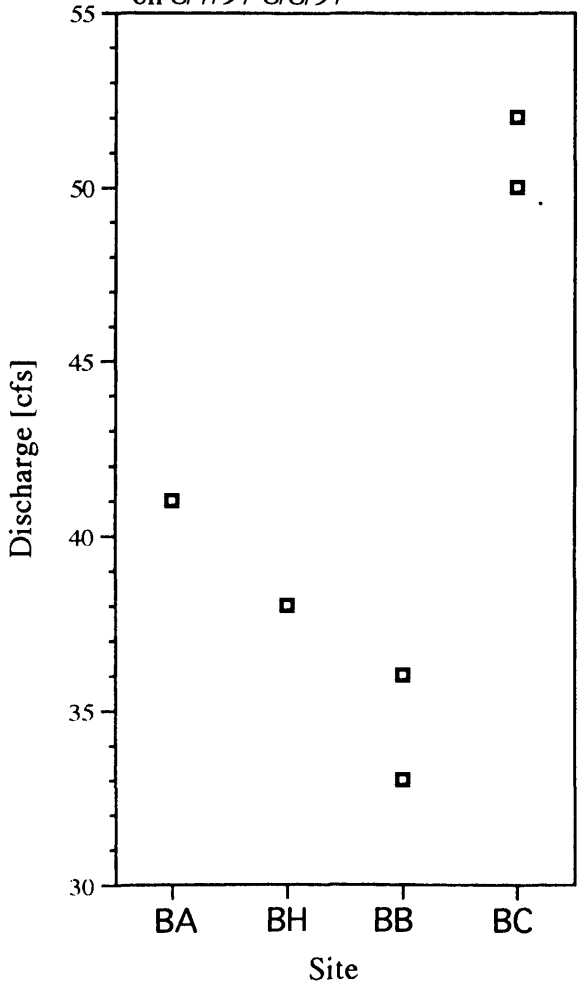


Figure 5e
Discharge on the Blackfoot River
on 9/13/97-9/14/97

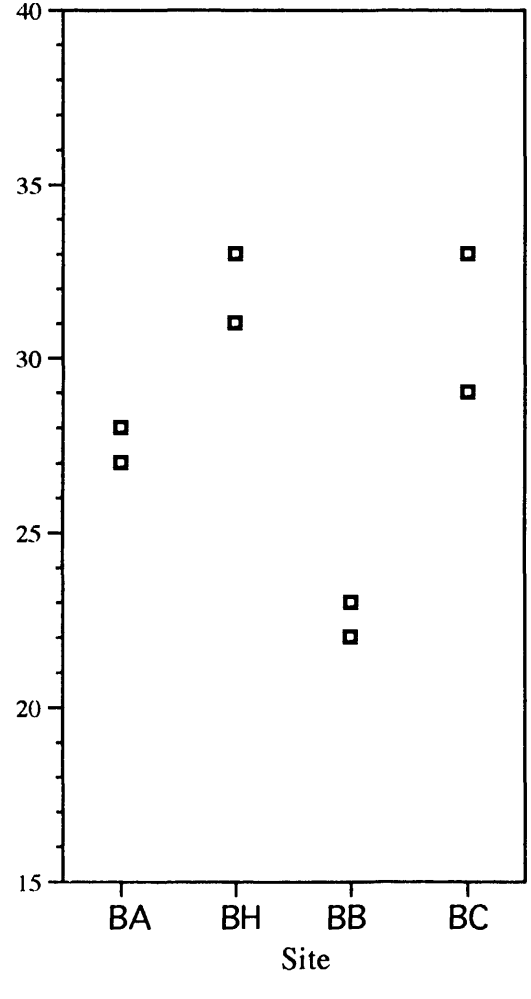


Figure 5f
Discharge on the Blackfoot River
on 11/16/97, 11/18/97

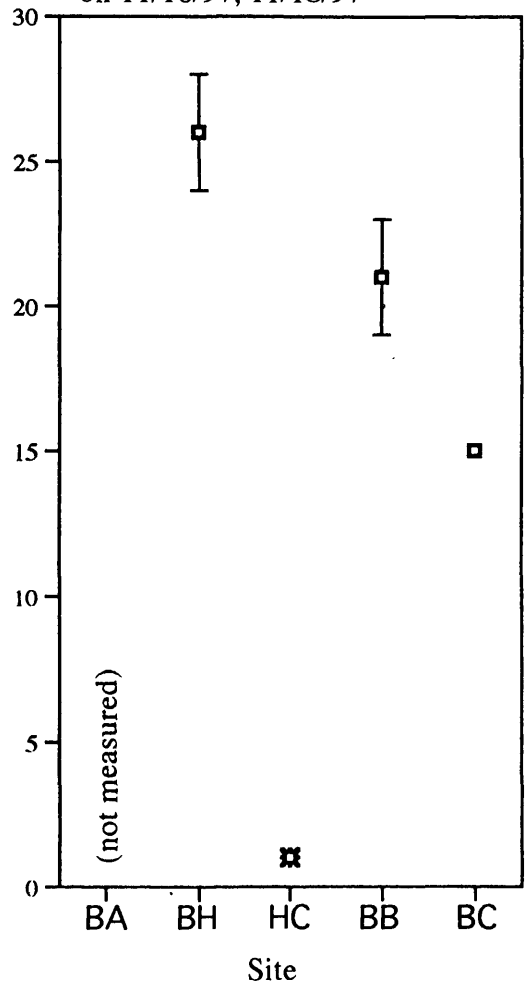


Figure 5g
Discharge on the Blackfoot River
on 1/6/98

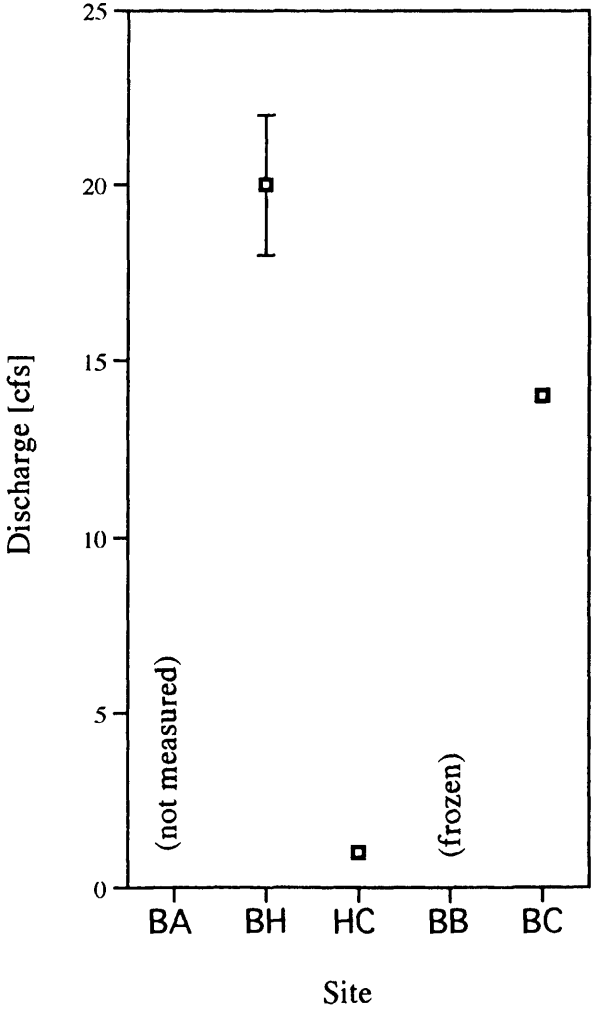


Figure 5h
Discharge on the Blackfoot River
on 3/8/98

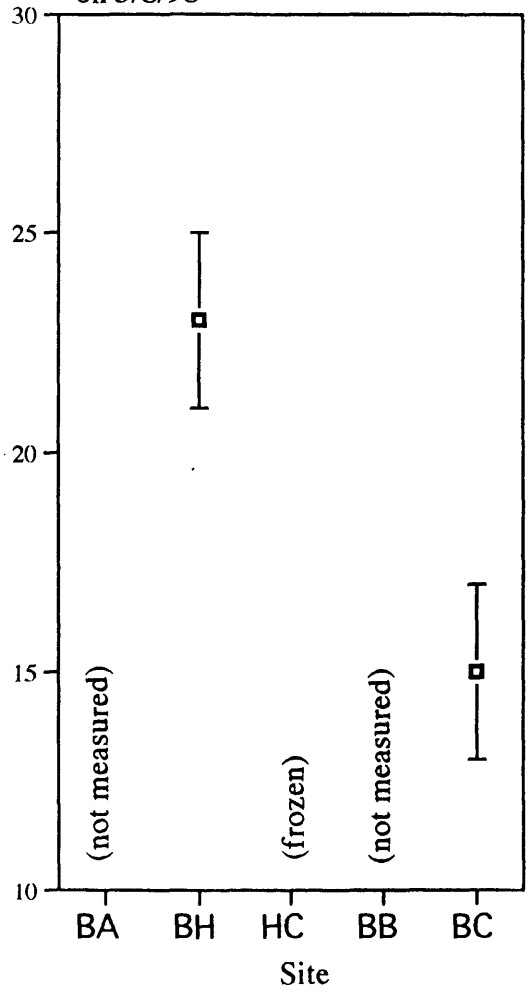


Table 1: DISCHARGE MEASUREMENTS [cubic feet per second]

*NM=Not measured; NR= Not recorded

in italics: sample not taken with Q measurement

	Sampling date								
SITE	7/3/97-7/4/97	7/20/97	7/21/97	8/7/97-8/8/97	9/6/97	9/13/97-9/14/97	11/16/97-11/18/97	1/6/98	3/8/98
Copper Creek ("C")									
Q measurements	163; 161	117; 108; 113	*99*	52; 51	(NM)	25; 23	(NM)	14; 16	(frozen)
Mean velocity (ft/ sec)	3.6	2.7; 2.5; 2.6	*2.5*	1.8; 1.8		1.3; 1.2		1.1; 1.2	
Number of stations	18; 17	14; 14; 14	*(NR)*	15; 14		14; 14		10; 9	
River width (feet)	32; 31	34; 34; 34	*35*	33; 33		29.5; 29.5		16.5; 16.5	
Lander's Fork A ("LA")									
Q measurements	114; 116	84; 85	*(NM)*	38; 40	(NM)	16; 16	(NM)	(frozen)	(frozen)
Mean velocity	2.3	2.3; 2.3		1.7; 1.8		1.1; 1.1			
Number of stations	22; 22	15; 15		14; 13		16; 16			
River width	43.5; 43.5	40; 40		32; 32		30; 30			
Lander's Fork B ("LB")	*(Tot. Q= 303 to 332)*	*(Tot. Q= 191 to 198)*	*(main channel only)*	*(Tot. Q= 95 to 102)*		*(Tot. Q= 38 to 39)*			
Q meas. ((main)+(side) channels)	(213; 226) + (98)	(122; 124) + (69; 74)	*117 + (NM)*	(86; 91)+(4; 5)+(6; 5)	*47; 50*	(38; 37)+(1; 1)	11; 12	6; 5	1
Mean velocity ((main) + (side))	*(main)* 3.1, 2.9	(2.2; 2.2) + (1.5; 1.5)	*2.2; (NM)*	(1.8; 1.9)+(1.3; 1.4)+(0.6; 0.5)	*2.02; 1.50*	(0.9; 0.9)+(0.8;0.5)	0.8; 0.9	0.7; 0.6	0.2
No. of stations ((main)+(side))	*(main)* 20; 16	(15; 15) + (12; 12)	*15; (NM)*	(16;14)+(8; 8)+(8; 8)	*13; 15*	(15; 15)+(5; 5)	14; 15	11; 9	7
River width ((main)+(side))	*(main)* 51	(45; 45) + (35; 35)	*45; (NM)*	(38; 38)+(13;13)+(11;11)	*23; 35*	(37; 37)+(5; 5.5)	25; 25	21; 21	19
Lander's Fork C ("LC")									
Q measurements	398; 373		227; 225; 227	133; 128	*77*	64; 68	36; 33	26; 26	22
Mean velocity	3.4; 3.2		2.4; 2.4; 2.3	1.5; 1.4	*1.01*	0.9; 0.9	0.6; 0.6	0.6; 0.6	0.6
Number of stations	18; 18		18; 23; 19	20; 19	*16*	16; 16	18; 16	13; 14	11
River width	53; 53		50; 50; 50	48; 48	*43*	43; 43	41; 41	33; 34	32
Lander's Fork D ("LD")									
Q measurements	(NM)	226; 230	*228*	116; 112	(NM)	54; 49	30	25	13
Mean velocity		2.8; *(NR)*	*2.9*	2.1; 2.1		1.7; 1.7	1.32	1.4	1
Number of stations		22; 19	*15*	15; 15		16; 17	11	10	8
River width		48; 48	*48*	43; 43		31; 31	29	27	23
Blackfoot River A ("BA")									
Q measurements	99; 94	74; 80	*67*	41; 41	(NM)	28; 27	(NM)	(NM)	(NM)
Mean velocity	1.8; 1.8	1.4; 1.5	*1.46*	1.0; 1.0		0.8; 0.8			
Number of stations	17; 17	18; 14	*14*	13; 13		17; 15			
River width	(NR)	34.5; 34.5	*33*	34; 34		31.5; 31.5			
Hogum Creek ("HC")									
Q measurements	(NM)	(NM)	(NM)	(NM)	(NM)	(NM)	1; 1	1; 1	(frozen)
Mean velocity							0.7; 0.7	0.8; 0.6	
Number of stations							5; 5	6; 6	
River width							3.5; 3.5	4.5; 4.5	
Blackfoot River H ("BH")									
Q measurements	103; 111	77; 74; 76	*64; 68*	38; 38	(NM)	33; 31	26	20	23
Mean velocity	1.2; 1.4	1.0; 0.9; 0.9	*1.0; 1.1*	0.7; 0.8		0.5; 0.5	2.0	0.9	1.6
Number of stations	17; 17	20; 17; 17	*11; 12*	13; 13		13; 11	10	9	11
River width	(NR)	49; 49; 49	*35.5; 35.5*	38; 38		30; 30	23	18	21
Blackfoot River B ("BB")									
Q measurements	102, 100	79; 79	*63; 66*	36; 33	(NM)	23, 22	21	(frozen)	(NM)
Mean velocity	1.7; 1.7	1.3; 1.3	*1.3; 1.3*	0.9; 0.8		1.0; 0.9	0.6		
Number of stations	20; 20	22; 23	*12; 12*	13; 13		17; 20	19		
River width	(NR)	56; 56	*40; 40*	40; 40		53; 53	36		
Blackfoot River C ("BC")									
Q measurements	(NM)	100; 107	*87; 87*	52; 50	(NM)	29; 33; 29	15; 15	14; 14	15
Mean velocity		(NR)	*1.8; 1.7*	1.4; 1.4		1.0; 1.1; 1.0	0.7; 0.7	0.7; 0.7	0.8
Number of stations		15; 13	*15; 13*	14; 14		16; 17; 20	13; 15	13; 13	9
River width		42; 42	*42; 42*	41; 41		39; 39; 39	33.5; 33.5	36; 36	34
Blackfoot River D ("BD")									
Q measurements	434	319; 325	*299; 301*	151	(NM)	78; 81	(NM)	(NM)	(NM)
Mean velocity	3.1	2.8; 2.8	*2.6; 2.7*	1.9		2.1; 2.1			
Number of stations	19	21; 23	*24; 18*	20		29; 26			
River width	(NR)	65; 65	*65; 65*	63		54; 54			

Table 2: pH meter and dissolved oxygen meter calibrations

Summary: pH meter calibration standard checks			D.O. meter
	7.00 standard	10.00 standard	calibration slopes
Total number of standard checks	53	53	mean =0.97
Mean reading	7.01	10.01	stdev =0.05
Standard Deviation	0.02	0.03	
Minimum reading	6.96	9.93	(reported acceptable
Maximum reading	7.09	10.09	slope range: 0.7-1.2)

Table 3: Results of experiment testing changes in dissolved concentrations over various time periods in sample bottles prior to filtration

Sample name: BH-4, collected on 7/20/98

Time after collection, before filtration	**Ba**	**Ca**	**Cu**	**Fe**	**K**	**Li**	**Mg**	**Mn**	**Na**	**S**	**Si**	**Sr**
2 hours	193	22.5	0.9	32	0.72	1.92	10.41	4.3	1.96	21.3	5.63	84
12 hours	192	21.9	0.9	29	0.71	1.93	10.26	4.3	1.98	21.5	5.67	81
41 hours	194	22.4	0.8	31	0.72	1.97	10.55	4.2	2.29	21.9	5.75	84
65 hours	194	22.4	0.8	27	0.73	1.98	10.49	4.2	1.99	21.6	5.71	83
160 hours	191	22.3	0.8	24	0.70	1.93	10.46	3.7	2.02	21.5	5.67	83
*Error: plus or minus	8	0.8	0.1	3	0.02	0.06	0.25	0.2	0.13	1.3	0.17	3

The following elements were below detection for all samples: Ag, Al, As, Be, Cd, Co, Cr, Mo, Ni, Pb, Ti, V, Zn

**Error is based on the mean percent difference between duplicate pairs run on the ICAPES (See Table 8)*

Table 4: Sample analysis dates

Sample Date	Ion Chromatography Analysis date	Inorganic Carbon Analysis date	Organic Carbon Analysis date	Arsenic by AAS Analysis date	ICAPES Analysis date
7/3/97, 7/4/97	7/6/97	7/9/97	7/25/97, 7/31/97	7/29/97	8/13/97-8/15/97
7/20/97, 7/21/97	7/22/97	7/22/97	7/25/97, 7/31/97	7/29/97	8/13/97-8/15/97
8/7/97, 8/8/97	8/9/97	8/13/97	(Not analyzed)	8/14/97	8/13/97-8/15/97
9/13/97, 9/14/97	9/15/97-9/16/97	9/15/97-9/16/97	9/23/97	10/31/97	10/23/97
10/19/97	10/20/97	10/20/97	10/28/97-10/29/97	10/31/97	10/23/97
10/25/97	10/26/97	10/27/97	10/28/97-10/29/97	10/31/97	10/30/97
11/16/97	11/18/97	11/17/97	1/16/98, 1/17/98	12/30/97	12/31/97
11/18/97	11/20/97	11/20/97	1/16/98, 1/17/98	12/30/97	12/31/97
1/6/98	1/8/98	1/7/98	1/16/98, 1/17/98	1/12/98	1/14/98
3/8/98	(Not analyzed)	3/18/98	(Not analyzed)	6/15/98	6/23/98

Table 5

Practical Quantification Limits (PQLs)

Analyte	PQL
Inorganic carbon	1 mg/L
Organic carbon	1 mg/L
F	0.05 mg/L
Cl	2 mg/L
Nitrate-N	0.2 mg/L
Nitrite-N	0.02 mg/L
Phosphate-P	0.2 mg/L
Sulfate	1.00 mg/L
As	0.2 µg/L
Ag	1 µg/L
Al	5 µg/L
Ba	1 µg/L
Be	0.05 µg/L
Ca	0.01 mg/L
Cd	0.5 µg/L
Co	0.5 µg/L
Cr	1 µg/L
Cu	0.3 µg/L
Fe	5 µg/L
K	0.10 mg/L
Li	0.5 µg/L
Mg	0.01 mg/L
Mn	0.3 µg/L
Mo	1 µg/L
Na	0.15 mg/L
Ni	2 µg/L
Pb	6 µg/L
S	0.01 mg/L
Si	0.02 mg/L
Sr	2 µg/L
Ti	2 µg/L
V	2 µg/L
Zn	0.2 µg/L

Quality Assurance/ Quality control evaluation: External and Internal Standards Measurements

Table 6.1

Summary: External standards measured on AAS
Concentrations in μ g/L.

Standard	Reported value (Range)*	Measured values or mean (std. dev.)	Measured values within Report. Range?
USGS T-107 (n=1)	10.8 (4.2)	9.4	Yes
USGS T-119 (n=3)	4.2 (0.57)	4.0 (0.5)	Yes
USGS T-121 (n=2)	8 (2.2)	8.0, 8.0	Yes
USGS T-143 (n=2)	15.2 (2.4)	16.1 (15.5)	
USGS T-145 (n=9)	9.88 (2.08)	9.2 (1.1)	Yes
USGS T-113 (n=6)	23.8 (3.0)	24.7 (0.8)	Yes

*Reported Range is 2 pseudosigmas from the mean

Note: USGS Standards T-121, T-143, and T-113 were diluted to 10%, and USGS Standards T107, T-119, and T-145 were diluted by 50% for analysis in order to fall within the range of calibration of the AAS.

Table 6.2

Summary: External standard "QC SPEX" measured on IC
(Concentrations in mg/L)

Analyte	Reported Mean (Range)*	Measured Mean (Stand. Dev.)	Measured Mean w/in Reported Range?
Fluoride (n=10)	3.0 (0.47)	2.8 (0.1)	Yes
Chloride (n=8)	30.0 (2.62)	28.8 (1.0)	Yes
Nitrate-N (n=10)	5.0 (0.84)	4.9 (0.2)	Yes
Nitrite-N (n=10)	2.0 (0.21)	1.9 (0.1)	Yes
Phosphate-P (n=10)	1.0 (0.29)	1.0 (0.1)	Yes
Sulfate (n=10)	30.0 (5.27)	29.6 (2.2)	Yes

*Reported Range is the 95% Confidence Interval

Table 6.3

Summary: Internal standards (fortified lab blanks) measured on AAS, Carbon Analyzer, and IC

Standard	Mean % difference of fortified lab blank and measured concentration	Standard Deviation of mean % differences
Arsenic =0.5 μg/L (n=21)	12.6	6.3
Arsenic >0.5 μg/L (n=81)	3.4	3.1
Inorganic C (n=101)	2.5	2.4
Organic C (n=49)	7.2	6.0
Fluoride (n=99)	3.6	4.4
Chloride (n=79)	7.0	10.6
Nitrate-N (n=82)	7.1	10.6
Nitrite-N (n=90)	3.5	4.7
Phosphate-P (n=83)	6.4	10.3
Sulfate (n=99)	3.1	4.1

Tables 7.1-7.3: Summary of USGS standards measured on ICAPES during sample analyses.

Table 7.1

Summary: USGS Standard T-107 measured on ICAPES
(n=30)

Element	Units	Reported Mean (Range)*	Measured Mean (Std. Dev.)	Measured Mean w/in Reported Range?
Ag	µg/L	12.3 (4.4)	13.4 (0.9)	Yes
Al	µg/L	220 (90)	203 (6)	Yes
Ba	µg/L	192 (22)	173 (8)	Yes
Be	µg/L	11 (2.2)	10.6 (0.3)	Yes
Ca	mg/L	11.7 (1.4)	10.45 (0.41)	Yes
Cd	µg/L	14.3 (4.2)	12.4 (0.5)	Yes
Co	µg/L	11 (2.8)	10.4 (0.8)	Yes
Cr	µg/L	13 (4.2)	11.0 (0.5)	Yes
Cu	µg/L	30 (4.6)	26.0 (0.84)	Yes
Fe	µg/L	52 (14)	54 (4)	Yes
K	mg/L	0.84 (0 3)	0 74 (0.02)	Yes
Li	µg/L	193 (28)	193.6 (3.8)	Yes
Mg	mg/L	2.1 (0.26)	1.95 (0.05)	Yes
Mn	µg/L	45 (12)	40 7 (1.3)	Yes
Mo	µg/L	15 (3.8)	12.1 (0.5)	Yes
Na	mg/L	20.7 (2.2)	20.54 (0.49)	Yes
Ni	µg/L	28.1 (7.8)	23 (1)	Yes
Pb	µg/L	26 (8)	25 (1)	Yes
S	mg/L	(Not reported)	-	-
Si	mg/L	3.6 (0.468)	3.27 (0.22)	Yes
Sr	µg/L	61 (8)	51 (2)	No
Ti	µg/L	(Not reported)	-	-
V	µg/L	14 (5.6)	13 (1)	Yes
Zn	µg/L	75.8 (19.8)	68.9 (3.3)	Yes

*Reported Range is 2 pseudosigmas from the mean

Table 7.2

Summary: USGS Standard T-143 measured on ICAPES
(n=30)

Element	Units	Reported Mean (Range)*	Measured Mean (Std. Dev.)	Measured Mean w/in Reported Range?
Ag	µg/L	19.6 (2.8)	24.6 (1.8)	No
Al	µg/L	22.1 (16.6)	22.9 (2.0)	Yes
Ba	µg/L	81.9 (9)	76.2 (4.0)	Yes
Be	µg/L	8.5 (1.32)	8.5 (0.3)	Yes
Ca	mg/L	53.7 (4.4)	52.28 (2.97)	Yes
Cd	µg/L	19.1 (3)	17.3 (0.7)	Yes
Co	µg/L	17 (2.4)	15.6 (0.5)	Yes
Cr	µg/L	37 (5.2)	33 (1)	Yes
Cu	µg/L	22.3 (3.8)	22.4 (0.3)	Yes
Fe	µg/L	222 (28)	223 (12)	Yes
K	mg/L	2.5 (0.42)	2.54 (0.11)	Yes
Li	µg/L	18 (4.2)	17.8 (1.0)	Yes
Mg	mg/L	10.4 (1)	10.61 (0.23)	Yes
Mn	µg/L	18.2 (3.8)	16.57 (0.54)	Yes
Mo	µg/L	36.1 (8.6)	31.9 (1.2)	Yes
Na	mg/L	34 (3.2)	35.66 (0.86)	Yes
Ni	µg/L	71 (10)	61.5 (2.0)	Yes
Pb	µg/L	83.4 (14.2)	83.7 (3.7)	Yes
S	mg/L	(Not reported)	-	-
Si	mg/L	10.94 (1.64)	11.51 (0.32)	Yes
Sr	µg/L	306 (30)	265 (9)	No
Ti	µg/L	(Not reported)	-	-
V	µg/L	30 (6)	26.8 (1 7)	Yes
Zn	µg/L	20 (4.4)	18.5 (1.3)	Yes

*Reported Range is 2 pseudosigmas from the mean

Table 7.3

Summary: USGS Standard T-145 measured on ICAPES
(n=28)

Element	Units	Reported Mean (Range)*	Measured Mean (Std. Dev.)	Measured Mean w/in Reported Range?
Ag	µg/L	7.55 (1.84)	9.5 (1.1)	No
Al	µg/L	67.6 (22)	70.7 (4.4)	Yes
Ba	µg/L	37.1 (3.8)	35.3 (1.8)	Yes
Be	µg/L	9.04 (1.4)	8.9 (0.3)	Yes
Ca	mg/L	30.7 (2.6)	30.10 (1.59)	Yes
Cd	µg/L	9.33 (1.64)	8.6 (0.4)	Yes
Co	µg/L	10 (1.8)	9.4 (0.4)	Yes
Cr	µg/L	15.3 (2.8)	13.4 (0.7)	Yes
Cu	µg/L	11 (2.8)	11.1 (0.1)	Yes
Fe	µg/L	101 (16)	106 (7)	Yes
K	mg/L	2.13 (.32)	2.09 (0.05)	Yes
Li	µg/L	27.3 (5)	26.7 (1.4)	Yes
Mg	mg/L	8.68 (0.9)	8.66 (0.15)	Yes
Mn	µg/L	20.9 (3)	19.2 (0.9)	Yes
Mo	µg/L	9.23 (2.58)	7.7 (0.5)	Yes
Na	mg/L	41.2 (3.8)	43.68 (1.52)	Yes
Ni	µg/L	11 (2.6)	9.2 (0.5)	Yes
Pb	µg/L	12.7 (2.4)	12.4 (0.8)	Yes
S	mg/L	(Not reported)	-	-
Si	mg/L	5 28 (0.66)	5.71 (0.18)	Yes
Sr	µg/L	203 (18)	176 (7)	No
Ti	µg/L	(Not reported)	-	-
V	µg/L	11 7 (3.4)	10.6 (0.6)	Yes
Zn	µg/L	10 (4.8)	8 9 (0.6)	Yes

*Reported Range is 2 pseudosigmas from the mean

Quality Assurance/Quality Control evaluation: Duplicates and Spike Recoveries

Table 8.1

Summary: ICAPES duplicate comparisons of water samples			
Element	Number of dupl. pairs above PQL	Mean % difference of dupl. pairs	Stand. dev. of mean of % difference of dupl. pairs
Ag	0	-	-
Al	0	-	-
Ba	33	4.0	4.0
Be	0	-	-
Ca	33	3.4	3.6
Cd	0	-	-
Co	0	-	-
Cr	29	9.7	7.5
Cu	12	3.6	4.0
Fe	30	9.1	10.7
K	32	3.1	2.9
Li	33	2.9	2.5
Mg	33	2.4	2.6
Mn	25	5.8	6.5
Mo	0	-	-
Na	33	5.7	7.1
Ni	0	-	-
Pb	0	-	-
S	33	5.9	7.8
Si	33	3.1	4.3
Sr	33	4.0	4.4
Ti	0	-	-
V	0	-	-
Zn	22	6.4	7.4

Table 8.2

Summary: AAS, Carbon Analyzer, and IC Replicate Comparisons			
Analyte	Number of replicate sets above PQL	Mean % difference or % RSD of replicate sets	Stand. dev. of mean of % diff./%RSD of replicate pairs
Arsenic =<0.5 ppb	32	7.6	6.8
Arsenic >0.5 ppb	25	3.8	3.6
Inorganic C	51	2.40	3.2
Organic C	11	5.7	5.1
Fluoride	55	3.0	4.3
Chloride	0	-	-
Nitrate-N	0	-	-
Nitrite-N	0	-	-
Phosphate-P	0	-	-
Sulfate	63	1.5	2.2

PQL= Practical Quantifiable Limit

%RSD= Percent relative standard deviation

Table 8.3

Summary: ICAPES Spike (fortified sample) recoveries					
Element	Unit	Spike values	Number of samples above PQL	Mean percent recovery	Stand. dev. of mean percent recovery
Ag	µg/L	20	0	-	-
Al	µg/L	10	0	-	-
Ba	µg/L	200	33	96.0	10.9
Be	µg/L	-	0	-	-
Ca	mg/L	20 and 30	33	99.1	8.1
Cd	µg/L	10	0	-	-
Co	µg/L	-	0	-	-
Cr	µg/L	10	3	88.9	9.8
Cu	µg/L	10 and 20	13	108.7	5.2
Fe	µg/L	20 and 30	30	100.2	17.5
K	mg/L	2 and 2.5	33	103.0	5.3
Li	µg/L	10	30	106.6	4.9
Mg	mg/L	5 and 10	33	104.4	6.8
Mn	µg/L	10	24	91.9	4.7
Mo	µg/L	-	0	-	-
Na	mg/L	2.5 and 10	33	98.0	5.6
Ni	µg/L	20	0	-	-
Pb	µg/L	80	0	-	-
S	mg/L	5	30	115.6	7.0
Si	mg/L	5	30	115.2	8.7
Sr	µg/L	50	30	89.0	9.2
Ti	µg/L	-	0	-	-
V	µg/L	-	0	-	-
Zn	µg/L	20	24	106	9.7

Table 8.4

Summary: AAS, Carbon Analyzer, and IC Spike (fortified sample) recoveries					
Analyte	Unit	Spike Value	Number of samples above PQL	Mean percent recovery	Stand. dev. of mean percent recovery
Arsenic	µg/L	1.0	23	107.7	6.3
Inorganic C	mg/L	-	-	-	-
Organic C	mg/L	0.5, 2.0	14	96.6	22.9
Fluoride	mg/L	0.1	22	86.1	16.0
Chloride	mg/L	0.2	0	-	-
Nitrate-N	mg/L	0.025	0	-	-
Nitrite-N	mg/L	0.025	0	-	-
Phosphate-P	mg/L	0.025	0	-	-
Sulfate	mg/L	0.5, 1.5, 3.0	26	111.3	20.9

Tables 8.1-8.4: Summary of duplicates and spike recoveries measured on all instruments used for analysis of water samples.

Quality Assurance/ Quality Control Evaluation: Laboratory and Field Blanks

Table 9.1

Summary:ICAPES measurement of Lab Blanks				
Element	Units	PQL	Total number of blanks	Number of blanks below PQL
Ag	µg/L	1	29	29
Al	µg/L	5	29	29
Ba	µg/L	1	29	29
Be	µg/L	0.05	29	29
Ca	mg/L	0.01	29	29
Cd	µg/L	0.5	29	29
Co	µg/L	0.5	29	29
Cr	µg/L	0.5	29	29
Cu	µg/L	0.3	29	29
Fe	µg/L	5	29	29
K	mg/L	0.10	29	29
Li	µg/L	0.5	29	29
Mg	mg/L	0.01	29	29
Mn	µg/L	0.3	29	29
Mo	µg/L	1	29	29
Na	mg/L	0.15	29	29
Ni	µg/L	2	29	29
Pb	µg/L	6	29	29
S	mg/L	0.01	29	29
Si	mg/L	0.02	29	29
Sr	µg/L	2	29	29
Ti	µg/L	2	29	29
V	µg/L	2	29	29
Zn	µg/L	0.2	29	29

PQL= Practical Quantifiable Limit

BPQL= Below Practical Quantifiable Limit

Table 9.2

Summary: ICAPES measurement of Field Blanks					
Element	Units	PQL	Total number of blanks	Number of of blanks below PQL	Highest Conc. found
Ag	µg/L	1	15	15	*BPQL*
Al	µg/L	5	15	15	*BPQL*
Ba	µg/L	1	15	15	*BPQL*
Be	µg/L	0.05	15	15	*BPQL*
Ca	mg/L	0.01	15	6	0.04
Cd	µg/L	0.5	15	15	*BPQL*
Co	µg/L	0.5	15	15	*BPQL*
Cr	µg/L	0.5	15	15	*BPQL*
Cu	µg/L	0.3	15	15	*BPQL*
Fe	µg/L	5	15	15	*BPQL*
K	mg/L	0.10	15	15	*BPQL*
Li	µg/L	0.5	15	15	*BPQL*
Mg	mg/L	0.01	15	10	0.02
Mn	µg/L	0.3	15	15	*BPQL*
Mo	µg/L	1	15	15	*BPQL*
Na	mg/L	0.15	15	8	0.42
Ni	µg/L	2	15	15	*BPQL*
Pb	µg/L	6	15	15	*BPQL*
S	mg/L	0.01	15	10	0.04
Si	mg/L	0.02	15	15	*BPQL*
Sr	µg/L	2	15	15	*BPQL*
Ti	µg/L	2	15	15	*BPQL*
V	µg/L	2	15	15	*BPQL*
Zn	µg/L	0.2	15	10	3.7

Table 9.3

Summary: Laboratory blanks measured on AAS, Carbon Analyzer, and IC				
Analyte	Units	PQL	Total number of blanks	Number of blanks BPQL
Arsenic	µg/L	0.2	41	41
Inorganic C	mg/L	1.0	27	27
Organic C	mg/L	1.0	22	22
Fluoride	mg/L	0.05	23	23
Chloride	mg/L	2	23	23
Nitrate-N	mg/L	0.2	23	23
Nitrite-N	mg/L	0.02	23	23
Phosphate-P	mg/L	0.2	23	23
Sulfate	mg/L	1.00	23	23

Table 9.4

Summary: Field Blanks measured on AAS, Carbon Analyzer, and IC				
Analyte	Units	PQL	Total number of blanks	Number of blanks BPQL
Arsenic	µg/L	0.2	16	16
Inorganic C	mg/L	1.0	20	20
Organic C	mg/L	1.0	12	12
Fluoride	mg/L	0.05	13	13
Chloride	mg/L	2	13	13
Nitrate-N	mg/L	0.2	13	13
Nitrite-N	mg/L	0.02	13	13
Phosphate-P	mg/L	0.2	13	13
Sulfate	mg/L	1.00	13	13

Tables 9.1-9.4: Summary of laboratory and field bank concentrations measured on all instruments used for analysis of water samples.

Table 10

DISSOLVED LOADS IN THE LANDERS FORK (IN GRAMS PER DAY) and STATISTICAL COMPARISONS BETWEEN SITES

(Statistical comparisons performed using a two-tailed t-test)

Sample name	Sample date	Discharge	Q [l/s]		Inorg.C	Sulfate	As	Ba	Ca	Cr	Fe	K	Li	Mg	Mn	Na	S	Sl	Sr
C	7/3/97	161	4559	*min*	7.84E+06	7.13E+05	2.4E+02	6.42E-04	8.55E+06	*(BPQL)*	2.0E-03	9.1E-04	3.2E-02	3.11E+06	2.0E+02	2.0E+05	2.4E+05	1.0E+06	1.3E+04
C	7/3/97	163	4616	*max*	7.96E+06	7.38E+05	2.4E+02	6.82E-04	8.99E+06	*(BPQL)*	2.0E-03	9.6E-04	3.2E-02	3.23E+06	2.4E+02	2.3E+05	2.5E+05	1.1E+06	1.4E+04
C	7/3/97			*mean*	7.90E+06	7.28E+05	2.4E+02	6.58E+04	8.73E+06	*(BPQL)*	2.0E-03	9.2E+04	3.2E+02	3.16E+06	2.2E+02	2.1E+05	2.4E+05	1.1E+06	1.4E+04
mean		*162*	*4587*																
LA	7/3/97	114	3228	*min*	6.76E+06	6.86E+05	1.7E+02	3.54E+04	7.44E+06	*(BPQL)*	1.4E-03	1.1E+05	5.9E+02	2.73E+06	8.4E+01	1.4E+05	2.3E+05	7.3E+05	9.8E+03
LA	7/3/97	116	3285	*max*	6.90E+06	7.07E+05	1.7E+02	3.72E+04	7.86E+06	*(BPQL)*	1.7E-03	1.1E+05	6.0E+02	2.86E+06	8.5E+01	1.6E+05	2.5E+05	7.7E+05	1.0E+04
LA	7/3/97			*mean*	6.83E+06	6.96E+05	1.7E+02	3.65E+04	7.66E+06	*(BPQL)*	1.6E-03	1.1E+05	5.9E+02	2.79E+06	8.4E+01	1.5E+05	2.4E+05	7.5E+05	1.0E+04
mean		*115*	*3256*																
C-LA				*min*	1.46E+07	1.40E+06	4.0E-02	9.96E-04	1.60E+07	*(BPQL)*	3.4E-03	2.0E-05	9.0E+02	5.84E+06	2.8E+02	3.4E-05	4.7E+05	1.8E+06	2.3E+04
C-LA				*max*	1.49E+07	1.44E+06	4.1E-02	1.05E-05	1.69E+07	*(BPQL)*	3.7E-03	2.1E-05	9.2E+02	6.09E+06	3.2E+02	3.9E-05	5.0E-05	1.9E+06	2.4E+04
C-LA				*mean*	1.47E+07	1.42E+06	4.1E+02	1.02E+05	1.64E+07	*(BPQL)*	3.6E+03	2.0E+05	9.1E+02	5.95E+06	3.1E+02	3.6E+05	4.8E-05	1.8E+06	2.4E+04
LB	7/3/97	303	8580	*min*	1.73E+07	1.68E+06	3.7E+02	1.19E+05	1.90E+07	*(BPQL)*	3.7E-03	2.5E+05	1.1E+03	6.90E+06	3.0E+02	3.7E+05	5.6E+05	2.0E+06	2.7E+04
LB	7/3/97	332	9401	*max*	1.97E+07	1.93E+06	4.9E-02	1.38E+05	2.20E+07	*(BPQL)*	4.9E-03	3.0E+05	1.3E+03	7.92E+06	3.2E+02	5.6E+05	6.4E+05	2.4E+06	3.1E+04
LB	7/3/97			*mean*	1.85E+07	1.79E+06	4.4E+02	1.27E+05	2.04E+07	*(BPQL)*	4.4E+03	2.7E+05	1.2E+03	7.34E+06	3.1E+02	4.5E+05	6.0E+05	2.2E+06	2.9E+04
mean		*318*	*8991*																
LC	7/3/97	398	11270	*min*	2.18E+07	2.08E+06	5.5E+02	1.53E+05	2.44E+07	*(BPQL)*	5.5E+03	3.1E+05	1.5E+03	8.47E+06	3.7E+02	4.4E+05	6.8E+05	2.6E+06	3.5E+04
LC	7/3/97	373	10562	*max*	2.34E+07	2.25E+06	5.8E-02	1.68E+05	2.63E+07	*(BPQL)*	5.8E-03	3.6E+05	1.7E+03	9.42E+06	3.9E+02	5.8E-05	8.0E+05	2.9E+06	3.8E+04
LC	7/3/97			*mean*	2.26E+07	2.17E+06	5.7E+02	1.62E+05	2.54E+07	*(BPQL)*	5.7E+03	3.4E+05	1.5E+03	8.98E+06	3.8E+02	5.2E+05	7.5E+05	2.8E+06	3.6E+04
mean		*386*	*10916*																
p values (from 2 tailed t test)																			
Prob. that C+LA is diff. from LB					***0.005***	***0.007***	*0.485*	*0.012*	*0.011*	*(BPQL)*	*0.091*	***0.008***	***0.006***	***0.009***	*0.712*	*0.158*	*0.012*	*0.017*	***0.006***
Prob. that LB is diff. from LC					***0.008***	*0.013*	*0.020*	***0.0096***	***0.009***	*(BPQL)*	*0.020*	*0.039*	*0.011*	*0.018*	***0.004***	*0.485*	*0.031*	*0.013*	***0.006***
C	7/20/97	108	3058	*min*	6.32E+06	5.31E+05	1.6E+02	5.05E+04	6.10E+06	*(BPQL)*	1.6E+03	6.6E+04	2E+02	2.25E+06	1.3E+02	1.4E+05	1.7E+05	7.6E+05	1.0E+04
C	7/20/97	117	3313	*max*	6.93E+06	6.70E+05	2.0E+02	5.52E+04	6.63E+06	*(BPQL)*	1.7E+03	7.2E+04	3E+02	2.45E+06	1.4E+02	1.8E+05	2.0E+05	8.2E+05	1.1E+04
C	7/20/97	113	3200	*mean*	6.63E+06	5.88E+05	1.8E+02	5.28E+04	6.37E+06	*(BPQL)*	1.7E+03	6.9E+04	3E+02	2.36E+06	1.4E+02	1.6E+05	1.9E+05	7.9E+05	1.1E+04
mean		*113*	*3190*																
LA	7/20/97	84	2379	*min*	5.9E+06	5.6E+05	8.2E+01	2.9E+04	5.7E+06	*(BPQL)*	1.2E+03	8.4E+04	4.7E+02	2.2E+06	8.2E+01	1.3E+05	1.8E+05	5.6E+05	8.0E+03
LA	7/20/97	85	2407	*max*	6.0E+06	6.0E+05	1.2E+02	3.0E+04	5.8E+06	*(BPQL)*	1.2E+03	8.5E+04	5.0E+02	2.2E+06	8.3E+01	1.6E+05	1.9E+05	5.7E+05	8.1E+03
LA	7/20/97			*mean*	6.0E+06	5.8E+05	9.6E+01	3.0E-04	5.7E+06	*(BPQL)*	1.2E+03	8.5E+04	4.9E+02	2.2E+06	8.3E+01	1.4E+05	1.9E+05	5.7E+05	8.1E+03
mean		*85*	*2393*																
C-LA				*min*	1.22E+07	1.09E+06	2.4E+02	7.97E+04	1.18E+07	*(BPQL)*	2.8E+03	1.5E+05	7.1E+02	4.4E+06	2.1E+02	2.7E+05	3.6E+05	1.3E+06	1.8E+04
C-LA				*max*	1.29E+07	1.27E+06	3.3E+02	8.52E+04	1.24E+07	*(BPQL)*	3.0E+03	1.6E+05	7.9E+02	4.6E+06	2.3E+02	3.4E+05	3.9E+05	1.4E+06	1.9E+04
C-LA				*mean*	1.26E+07	1.17E+06	2.8E+02	8.24E+04	1.21E+07	*(BPQL)*	2.9E+03	1.5E+05	7.5E+02	4.5E+06	2.2E+02	3.0E+05	3.8E+05	1.4E+06	1.9E+04
LB	7/20/97	191	5409	*min*	1.33E+07	1.17E+06	2.8E+02	8.46E+04	1.26E+07	*(BPQL)*	2.8E+03	1.7E+05	7.9E+02	4.66E+06	1.9E+02	3.0E+05	3.9E+05	1.4E+06	1.9E+04
LB	7/20/97	198	5607	*max*	1.38E+07	1.34E+06	2.9E+02	8.91E+04	1.30E+07	*(BPQL)*	2.9E+03	1.7E+05	8.2E+02	4.86E+06	1.9E+02	3.8E+05	4.1E+05	1.4E+06	2.0E+04
LB	7/20/97			*mean*	1.35E+07	1.25E+06	2.9E+02	8.69E+04	1.28E+07	*(BPQL)*	2.9E+03	1.7E+05	8.1E+02	4.76E+06	1.9E+02	3.4E+05	4.0E+05	1.4E+06	2.0E+04
mean		*195*	*5508*																
LC	7/21/97	227	6428	*min*	1.65E+07	1.50E+06	3.3E+02	1.09E+05	1.57E+07	*(BPQL)*	3.3E+03	2.1E+05	1.0E+03	5.77E+06	1.7E+02	3.9E+05	4.9E+05	1.8E+06	2.4E+04
LC	7/21/97	225	6371	*max*	1.67E+07	1.57E+06	3.9E+02	1.11E+05	1.61E+07	*(BPQL)*	3.9E+03	2.2E+05	1.1E+03	5.87E+06	1.7E+02	4.7E+05	5.0E+05	1.8E+06	2.4E+04
LC	7/21/97	227	6428	*mean*	1.66E+07	1.54E+06	3.5E+02	1.10E+05	1.59E+07	*(BPQL)*	3.7E-03	2.2E+05	1.1E+03	5.83E+06	1.7E+02	4.3E+05	5.0E+05	1.8E+06	2.4E+04
mean		*226*	*6409*																
LD	7/20/97	226	6400	*min*	1.62E+07	1.41E+06	3.3E+02	1.08E+05	1.54E+07	*(BPQL)*	3.3E+03	2.2E+05	1.0E+03	5.66E+06	3.3E+02	3.4E+05	4.8E+05	1.7E+06	2.4E+04
LD	7/20/97	230	6513	*max*	1.69E+07	1.64E+06	3.4E+02	1.11E+05	1.58E+07	*(BPQL)*	3.4E+03	2.2E+05	1.0E+03	5.79E+06	3.4E+02	4.2E+05	5.0E+05	1.8E+06	2.4E+04
LD	7/20/97	228	6456	*mean*	1.66E+07	1.51E+06	3.3E+02	1.09E+05	1.56E+07	*(BPQL)*	3.3E+03	2.2E+05	1.0E+03	5.72E+06	3.3E+02	3.8E+05	4.9E+05	1.8E+06	2.4E+04
mean		*228*	*6456*																
p-values (from 2 tailed t-test)																			
Prob. that C+LA is diff. from LB					*0.019*	*0.356*	*0.894*	*0.097*	*0.041*	*(BPQL)*	*0.509*	***0.002***	*0.057*	*0.054*	***0.002***	*0.259*	*0.093*	*0.113*	*0.107*
Prob. that LB is diff. from LC					***0.000***	***0.006***	*0.015*	***0.000***	***0.000***	*(BPQL)*	*0.011*	***0.000***	***0.000***	***0.000***	***0.000***	*0.053*	***0.000***	***0.000***	***0.000***
Prob. that LC is diff. from LD					*0.865*	*0.827*	*0.272*	*0.489*	*0.105*	*(BPQL)*	*0.180*	*0.219*	***0.001***	*0.106*	***0.000***	*0.210*	*0.520*	*0.467*	*0.061*
C	8/7/97	51	1444	*min*	3.4E+06	3.0E+05	5.0E+01	3.1E+04	3.7E+06	*(BPQL)*	9E-02	3.9E+04	1.6E+02	1.4E+06	5.0E+01	9.0E+04	8.4E+04	4.0E+05	2.4E+03
C	8/7/97	52	1472	*max*	3.5E+06	3.1E+05	6.4E+01	3.4E+04	4.0E+06	*(BPQL)*	9E-02	4.3E+04	1.7E+02	1.5E+06	6.4E+01	1.0E+05	8.9E+04	4.1E+05	6.6E+03
C	8/7/97			*mean*	3.4E+06	3.1E+05	5.9E+01	3.2E+04	3.9E+06	*(BPQL)*	9E+02	4.1E+04	1.6E+02	1.5E+06	5.5E+01	9.5E+04	8.6E+04	4.0E+05	5.1E+03
mean		*52*	*1458*																
LA	8/7/97	38	1076	*min*	2.9E+06	2.9E+05	3.7E+01	1.5E+04	3.0E+06	*(BPQL)*	6E+02	4.0E+04	2.5E+02	1.1E+06	(BPQL)	7.4E+04	1.0E+05	2.8E+05	4.2E+03
LA	8/7/97	40	1133	*max*	3.1E+06	3.2E+05	3.9E+01	1.6E+04	3.2E+06	*(BPQL)*	7E+02	4.3E+04	2.6E+02	1.2E+06	(BPQL)	8.8E+04	1.1E+05	3.0E+05	4.5E+03
LA	8/7/97			*mean*	3.0E+06	3.0E+05	3.8E+01	1.6E+04	3.1E+06	*(BPQL)*	6E+02	4.1E+04	2.6E+02	1.2E+06	(BPQL)	8.1E+04	1.0E+05	2.9E+05	4.4E+03
mean		*39*	*1104*																
C-LA				*min*	6.31E+06	5.85E+05	8.7E+01	4.55E+04	6.65E+06	*(BPQL)*	1E+03	7.9E+04	4.1E+02	2.5E+06	5.1E+01	1.6E+05	1.8E+05	6.8E+05	6.6E+03
C-LA				*max*	6.65E+06	6.29E+05	1.0E+02	5.01E+04	7.16E+06	*(BPQL)*	2E+03	8.6E+04	4.3E+02	2.7E+06	(NA)	1.9E+05	2.0E+05	7.1E+05	1.1E+04
C-LA				*mean*	6.46E+06	6.06E+05	9.7E+01	4.78E+04	6.93E+06	*(BPQL)*	1E+03	8.2E+04	4.2E+02	2.6E+06	(NA)	1.8E+05	1.9E+05	7.0E+05	9.5E+03
LB	8/7/97	95	2690	*min*	7.2E+06	6.6E+05	9.3E+01	5.0E-04	7.2E+06	*(BPQL)*	2E+03	9.5E+04	4.9E+02	2.7E+06	9.3E+01	1.9E+05	2.2E+05	7.7E+05	1.1E+04
LB	8/7/97	102	2888	*max*	7.8E+06	7.1E+05	1.0E+02	5.5E+04	8.0E+06	*(BPQL)*	2E+03	1.0E+05	5.2E+02	2.9E+06	1.0E+02	2.2E+05	2.5E+05	8.4E+05	1.2E+04
LB	8/7/97			*mean*	7.5E+06	6.8E+05	9.6E+01	5.2E+04	7.6E+06	*(BPQL)*	2E+03	1.0E+05	5.1E+02	2.8E+06	9.6E+01	2.1E+05	2.4E+05	8.1E+05	1.1E+04
mean		*99*	*2789*																
LC	8/7/97	128	3625	*min*	9.92E+06	9.18E+05	1.3E+02	7.36E+04	1.01E+07	*(BPQL)*	2E+03	1.4E+05	6.9E+02	3.70E+06	1.6E+02	2.5E+05	3.1E+05	1.1E+06	1.6E+04
LC	8/7/97	133	3766	*max*	1.04E+07	9.96E+05	1.3E+02	7.81E+04	1.06E+07	*(BPQL)*	3E+03	1.5E+05	7.5E+02	3.86E+06	1.6E+02	2.8E+05	3.4E+05	1.2E+06	1.7E+04
LC	8/7/97			*mean*	1.02E+07	9.55E+05	1.3E+02	7.57E+04	1.03E+07	*(BPQL)*	2E+03	1.4E+05	7.2E+02	3.78E+06	1.6E+02	2.6E+05	3.2E+05	1.1E+06	1.6E+04
mean		*131*	*3695*																
LD	8/7/97	112	3172	*min*	8.63E+06	7.95E+05	1.4E+02	6.41E+04	8.97E+06	*(BPQL)*	2E+03	1.2E+05	6.0E+02	3.24E+06	1.4E+02	2.2E+05	2.6E+05	9.6E+05	1.3E+04
LD	8/7/97	116	3285	*max*	9.17E+06	8.51E+05	1.4E+02	6.70E+04	9.37E+06	*(BPQL)*	2E+03	1.3E+05	6.2E+02	3.37E+06	1.4E+02	2.5E+05	2.7E+05	1.0E+06	1.4E+04
LD	8/7/97			*mean*	8.92E+06	8.27E+05	1.4E+02	6.55E+04	9.16E+06	*(BPQL)*	2E+03	1.3E+05	6.1E+02	3.30E+06	1.4E+02	2.3E+05	2.7E+05	9.9E+05	1.4E+04
mean		*114*	*3228*																
p-values (from 2 tailed t-test)																			
Prob. that C+LA is diff. from LB					***0.007***	*0.021*	*0.882*	*0.067*	*0.054*	*#DIV/0!*	*0.025*	***0.007***	***0.002***	*0.092*	*(NA)*	*0.050*	***0.006***	***0.007***	*0.153*
Prob. that LB is diff. from LC					***0.000***	***0.001***	***0.000***	***0.000***	***0.000***	*#DIV/0!*	***0.005***	***0.000***	***0.000***	***0.000***	***0.000***	***0.009***	***0.001***	***0.000***	***0.000***
Prob. that LC is diff. from LD					***0.004***	***0.009***	***0.004***	***0.003***	***0.004***	*#DIV/0!*	*0.025*	***0.002***	***0.004***	***0.001***	***0.001***	*0.069*	***0.001***	***0.001***	***0.003***
C	9/13/97	23	651	*min*	1.7E+06	1.4E+05	2.8E+01	1.5E+04	1.8E+06	*(BPQL)*	3.9E+02	2.0E+04	7.9E+01	6.7E+05	1.7E+01	6.9E+04	5.5E+04	2.1E+05	2.8E+03
C	9/13/97	25	708	*max*	1.8E+06	1.8E+05	3.1E+01	1.7E+04	2.0E+06	*(BPQL)*	4.3E+02	2.2E+04	9.2E+01	7.5E+05	1.8E+01	8.9E+04	6.2E+04	2.3E+05	3.1E+03
C	9/13/97			*mean*	1.7E+06	1.6E+05	2.9E+01	1.6E+04	1.9E+06	*(BPQL)*	4.1E+02	2.1E+04	8.4E+01	7.1E+05	1.8E+01	8.0E+04	5.9E+04	2.2E+05	3.0E+03
mean		*24*	*680*																
LA	9/13/97	16	453	*min*	1.4E+06	1.3E+05	1.2E+01	7.5E+03	1.5E+06	*(BPQL)*	2.7E+02	1.9E+04	1.3E+02	5.6E+05	BPQL	4.7E+04	5.1E+04	1.3E+05	2.1E+03
LA	9/13/97	16	453	*max*	1.4E+06	1.4E+05	1.6E+01	7.6E+03	1.6E+06	*(BPQL)*	2.7E+02	2.0E+04	1.3E+02	5.6E+05	BPQL	6.2E+04	5.3E+04	1.3E+05	2.2E+03
LA	9/13/97			*mean*	1.4E+06	1.3E+05	1.3E+01	7.5E+03	1.6E+06	*(BPQL)*	2.7E+02	1.9E+04	1.3E+02	5.6E+05	BPQL	5.5E+04	5.2E+04	1.3E+05	2.1E+03
mean		*16*	*453*																
C-LA				*min*	3.01E+06	2.78E+05	4.0E+01	2.25E+04	3.37E+06	*(BPQL)*	6.7E+02	3.9E+04	2.1E+02	1.2E+06	1.9E+01	1.2E+05	1.1E+05	3.4E+05	4.9E+03
C-LA				*max*	3.21E+06	3.13E+05	4.6E+01	2.41E+04	3.57E+06	*(BPQL)*	7.0E+02	4.2E+04	2.2E+02	1.3E+06	(NA)	1.5E+05	1.1E+05	3.6E+05	5.3E+03

Sample name	Sample date	Discharge	Q [l/s]		Inorg.C	Sulfate	As	Ba	Ca	Cr	Fe	K	Li	Mg	Mn	Na	S	Si	Sr
C+LA				*mean*	3.11E+06	2.96E+05	4.2E+01	2.33E+04	3.48E+06	*(BPQL)*	6.9E+02	4.1E+04	2.1E+02	1.3E+06	(NA)	1.3E+05	1.1E+05	3.5E+05	5.1E+03
LB	9/13/97	38	1076	*min*	3.2E+06	2.6E+05	2.8E+01	2.4E+04	3.4E+06	*(BPQL)*	5.6E+02	4.6E+04	2.3E+02	1.2E+06	2.8E+01	1.2E+05	1.0E+05	3.5E+05	4.9E+03
LB	9/13/97	39	1104	*max*	3.3E+06	2.8E+05	3.8E+01	2.5E+04	3.6E+06	*(BPQL)*	6.7E+02	5.0E+04	2.4E+02	1.3E+06	2.9E+01	1.5E+05	1.1E+05	3.7E+05	5.2E+03
LB	9/13/97			*mean*	3.2E+06	2.7E+05	3.5E+01	2.5E+04	3.5E+06	*(BPQL)*	6.3E+02	4.8E+04	2.4E+02	1.2E+06	2.8E+01	1.4E+05	1.1E+05	3.6E+05	5.1E+03
mean		*39*	*1090*																
LC	9/13/97	64	1812	*min*	5.4E+06	4.8E+05	7.8E+01	4.6E+04	5.6E+06	*(BPQL)*	7.8E+02	8.6E+04	4.1E+02	2.0E+06	4.7E+01	1.6E+05	2.2E+05	6.5E+05	8.8E+03
LC	9/13/97	68	1926	*max*	5.8E+06	5.2E+05	8.3E+01	5.0E+04	6.2E+06	*(BPQL)*	1.0E+03	9.5E+04	4.3E+02	2.1E+06	5.0E+01	2.2E+05	2.6E+05	7.0E+05	9.6E+03
LC	9/13/97			*mean*	5.6E+06	5.0E+05	8.1E+01	4.8E+04	5.9E+06	*(BPQL)*	8.6E+02	9.1E+04	4.2E+02	2.1E+06	4.8E+01	2.0E+05	2.4E+05	6.7E+05	9.3E+03
mean		*66*	*1869*																
LD	9/14/97	54	1529	*min*	4.0E+06	3.6E+05	6.0E+01	3.5E+04	4.4E+06	*(BPQL)*	6.0E+02	6.6E+04	3.0E+02	1.5E+06	3.6E+01	1.2E+05	1.6E+05	5.0E+05	6.7E+03
LD	9/14/97	49	1388	*max*	4.5E+06	4.1E+05	6.6E+01	4.0E+04	4.9E+06	*(BPQL)*	7.9E+02	7.5E+04	3.6E+02	1.7E+06	4.0E+01	1.7E+05	2.0E+05	5.5E+05	7.7E+03
LD	9/14/97			*mean*	4.3E+06	3.8E+05	6.E+01	3.7E+04	4.6E+06	*(BPQL)*	6.7E+02	7.1E+04	3.3E+02	1.6E+06	3.8E+01	1.4E+05	1.9E+05	5.2E+05	7.2E+03
mean		*52*	*1458*																
p values (from 2-tailed t test)																			
Prob. that C+LA is diff. from LB					*0.152*	*0.132*	*0.058*	*0.125*	*0.481*	*(BPQL)*	*0.117*	**0.003**	**0.007**	*0.412*	*(NA)*	*0.916*	*0.180*	*0.307*	*0.962*
Prob. that LB is diff. from LC					**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	*(BPQL)*	*0.020*	**0.000**	**0.000**	**0.000**	**0.000**	*0.042*	**0.000**	**0.000**	**0.000**
Prob. that LC is diff. from LD					**0.003**	**0.003**	**0.001**	**0.005**	**0.004**	*(BPQL)*	*0.085*	**0.006**	**0.007**	**0.002**	**0.001**	0.088	*0.035*	**0.003**	**0.006**
LB	11/16/97	11	311	*min*	9.6E+05	8.0E+04	5.4E+00	6.6E-03	9.3E-05	2.6E-01	1.6E-02	1.4E-04	5.9E-01	3.5E-05	(BPQL)	2.5E-04	3.0E-04	9.7E-04	1.4E-03
LB	11/16/97	12	340	*max*	1.1E+06	9.0E+04	8.8E-00	7.3E+03	1.0E+06	3.2E-01	1.8E-02	1.5E+04	6.5E+01	3.8E+05	(BPQL)	3.3E-04	3.3E-04	1.1E-05	1.6E-03
LB	11/16/97			*mean*	1.0E+06	8.5E+04	7.5E+00	7.0E+03	9.8E+05	2.9E-01	1.7E-02	1.5E+04	6.2E+01	3.7E+05	(BPQL)	2.9E+04	3.2E-04	1.0E-05	1.5E-03
mean		*12*	*326*																
LC	11/16/97	33	934	*min*	2.8E+06	2.4E+05	4.8E+01	2.1E+04	2.8E+06	8.5E+01	4.8E+02	4.3E+04	1.9E+02	1.0E+06	(BPQL)	7.8E+04	8.8E+04	3.3E+05	4.5E+03
LC	11/16/97	36	1019	*max*	3.1E+06	2.7E+05	5.3E+01	2.4E+04	3.0E+06	1.0E-02	5.3E+02	4.7E+04	2.0E+02	1.1E+06	(BPQL)	9.9E-04	1.0E-05	3.7E-05	5.0E+03
LC	11/16/97			*mean*	2.9E+06	2.6E+05	5.1E+01	2.3E+04	2.9E+06	9.4E+01	5.1E+02	4.5E+04	1.9E+02	1.1E+06	(BPQL)	8.8E-04	9.4E+04	3.5E+05	4.8E+03
mean		*35*	*977*																
LD	11/16/97	30	850	*min*	2.4E+06	2.0E+05	4.1E+01	1.8E+04	2.3E+06	6.9E+01	4.1E+02	3.6E+04	1.6E+02	8.7E+05	(BPQL)	6.4E+04	7.5E+04	2.8E+05	3.8E+03
LD	11/16/97	28	793	*max*	2.7E+06	2.4E+05	5.5E+01	2.1E+04	2.7E+06	8.9E+01	4.7E+02	4.2E+04	1.8E+02	1.0E+06	(BPQL)	9.4E+04	8.6E+04	3.2E+05	4.4E+03
LD	11/16/97	32	906	*mean*	2.5E+06	2.2E+05	4.9E+01	1.9E+04	2.5E+06	7.9E+01	4.4E+02	3.9E+04	1.7E+02	9.4E+05	(BPQL)	7.6E+04	8.0E+04	3.0E+05	4.1E+03
mean		*30*	*850*																
p-values (from 2-tailed t-test)																			
Prob. that LB is diff. from LC					**0.006**	**0.006**	**0.004**	**0.006**	**0.006**	*(BPQL)*	*0.005*	**0.005**	**0.004**	**0.006**	*#DIV/0!*	*0.031*	**0.009**	**0.005**	**0.006**
Prob. that LC is diff. from LD					*0.049*	*0.040*	*0.601*	*0.044*	*0.042*	*0.127*	*0.036*	*0.058*	*0.036*	*0.042*	*(NA)*	*0.380*	*0.045*	*0.035*	*0.038*
C	1/6/98	14	396	*min*	9.1E-05	1.0E+05	1.7E+01	8.7E+03	1.0E-06	3.9E-01	2.1E+02	1.3E+04	4.8E+01	4.1E+05	(BPQL)	3.4E-04	3.2E+04	1.3E+05	1.6E-03
C	1/6/98	16	453	*max*	1.1E+06	1.2E+05	2.0E+01	1.0E-04	1.2E-06	4.7E-01	2.3E+02	1.5E+04	5.5E+01	4.8E+05	(BPQL)	4.1E-04	3.8E+04	1.5E+05	1.9E+03
C	1/6/98			*mean*	9.9E+05	1.1E+05	1.8E+01	9.5E+03	1.1E+06	4.3E+01	2.2E+02	1.4E+04	5.1E+01	4.4E+05	(BPQL)	3.7E+04	3.5E+04	1.4E+05	1.8E+03
mean		*15*	*425*																
LB	1/6/98	5	142	*min*	4.1E+05	3.8E+04	3.7E+00	2.9E+03	4.3E+05	1.2E+01	7.3E+01	6.9E+03	2.8E+01	1.6E+05	(BPQL)	1.2E+04	1.2E+04	4.4E+04	6.4E+02
LB	1/6/98	6	170	*max*	5.1E+05	4.7E+04	4.4E+00	3.6E+03	5.2E+05	1.6E+01	8.8E+01	8.5E+03	3.4E+01	1.9E+05	(BPQL)	1.5E+04	1.5E+04	5.3E+04	7.8E+02
LB	1/6/98			*mean*	4.6E+05	4.3E+04	4.0E+00	3.2E+03	4.8E+05	1.4E+01	8.1E+01	7.7E+03	3.1E+01	1.8E+05	(BPQL)	1.3E+04	1.4E+04	4.8E+04	7.0E+02
mean		*6*	*156*																
LC	1/6/98	26	736	*min*	2.1E+06	2.1E+05	4.5E+01	1.5E+04	2.0E+06	7.8E+01	3.8E+02	3.2E+04	1.4E+02	7.5E+05	(BPQL)	6.0E+04	7.0E+04	2.6E+05	3.3E+03
LC	1/6/98	26	736	*max*	2.1E+06	2.2E+05	5.1E+01	1.7E+04	2.1E+06	8.0E+01	3.8E+02	3.3E+04	1.4E+02	7.8E+05	(BPQL)	6.4E+04	7.3E+04	2.6E+05	3.5E+03
LC	1/6/98			*mean*	2.1E+06	2.1E+05	4.9E+01	1.6E+04	2.0E+06	7.9E+01	3.8E+02	3.2E+04	1.4E+02	7.7E+05	(BPQL)	6.2E+04	7.1E+04	2.6E+05	3.4E+03
mean		*26*	*736*																
LD	1/6/98	25	708	*min*	1.9E+06	1.9E+05	3.9E+01	1.5E+04	1.8E+06	7.3E+01	3.4E+02	3.0E+04	1.2E+02	6.8E+05	(BPQL)	5.3E+04	6.2E+04	2.3E+05	3.1E+03
LD	1/6/98	23	651	*max*	2.2E+06	2.2E+05	5.3E+01	1.7E+04	2.2E+06	9.3E+01	4.0E+02	3.5E+04	1.5E+02	8.1E+05	(BPQL)	7.9E+04	7.5E+04	2.7E+05	3.7E+03
LD	1/6/98	27	765	*mean*	2.1E+06	2.1E+05	4.5E+01	1.6E+04	2.0E+06	8.2E+01	3.7E+02	3.2E+04	1.4E+02	7.4E+05	(BPQL)	6.3E+04	6.8E+04	2.5E+05	3.4E+03
mean		*24*	*708*																
p-values (from 2-tailed t-test)																			
Prob. that C is diff. from LB					**0.001**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.001**	**0.000**	*(NA)*	**0.000**	**0.000**	**0.000**	**0.000**
Prob. that LB is diff. from LC					**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	*(NA)*	**0.000**	**0.000**	**0.000**	**0.000**
Prob. that LC is diff. from LD					*0.727*	*0.519*	*0.614*	*0.982*	*0.629*	*0.560*	*0.435*	*0.988*	*0.774*	*0.624*	*(NA)*	*0.702*	*0.484*	*0.374*	*0.972*
LB-1	3/8/98	1	28	*min*	8.2E+04	*(NA)*	7.3E-01	5.7E+02	8.2E+04	*(BPQL)*	*(BPQL)*	1.5E+03	5.6E+00	3.1E+04	*(BPQL)*	3.8E+03	2.6E+03	9.0E+03	1.2E+02
LB-2	3/8/98	2	57	*max*	1.7E+05	*(NA)*	1.5E+00	1.1E+03	1.6E+05	*(BPQL)*	*(BPQL)*	3.1E+03	1.2E+01	6.3E+04	*(BPQL)*	8.4E+03	5.2E+03	1.8E+04	2.5E+02
LB-3	3/8/98	1.5	42	*mean*	1.3E+05	*(NA)*	1.1E+00	8.6E+02	1.2E+05	*(BPQL)*	*(BPQL)*	2.3E+03	8.8E+00	4.7E+04	*(BPQL)*	5.8E+03	3.9E+03	1.4E+04	1.9E+02
LC-1	3/8/98	20	566	*min*	1.6E+06	*(NA)*	4.9E+01	1.3E+04	1.6E+06	*(BPQL)*	*(BPQL)*	2.8E+04	1.1E+02	6.2E+05	*(BPQL)*	7.6E+04	5.6E+04	1.8E+05	2.5E+03
LC-2	3/8/98	24	680	*max*	2.0E+06	*(NA)*	5.9E+01	1.6E+04	2.0E+06	*(BPQL)*	*(BPQL)*	3.4E+04	1.3E+02	7.5E+05	*(BPQL)*	1.1E+05	6.9E+04	2.2E+05	3.0E+03
LC-3	3/8/98	22	623	*mean*	1.8E+06	*(NA)*	5.4E+01	1.4E+04	1.8E+06	*(BPQL)*	*(BPQL)*	3.1E+04	1.2E+02	6.9E+05	*(BPQL)*	1.0E+05	6.3E+04	2.0E+05	2.7E+03
LD-1	3/8/98	11	311	*min*	9.0E+05	*(NA)*	2.4E+01	7.1E+03	8.8E+05	*(BPQL)*	*(BPQL)*	1.6E+04	5.9E+01	3.4E+05	*(BPQL)*	4.1E+04	3.0E+04	9.9E+04	1.4E+03
LD-2	3/8/98	15	425	*max*	1.2E+06	*(NA)*	3.3E+01	9.8E+03	1.2E+06	*(BPQL)*	*(BPQL)*	2.2E+04	8.1E+01	4.7E+05	*(BPQL)*	7.2E+04	4.2E+04	1.4E+05	1.9E+03
LD-3	3/8/98	13	368	*mean*	1.1E+06	*(NA)*	2.9E+01	8.3E+03	1.1E+06	*(BPQL)*	*(BPQL)*	1.8E+04	7.0E+01	4.1E+05	*(BPQL)*	6.3E+04	3.5E+04	1.2E+05	1.6E+03
p-values (from 2-tailed t-test)																			
Prob. that LB is diff. from LC					**0.000**	*(NA)*	**0.000**	**0.000**	**0.000**	*(BPQL)*	*(BPQL)*	**0.000**	**0.000**	**0.000**	*(BPQL)*	**0.001**	**0.000**	**0.000**	**0.000**
Prob. that LC is diff. from LD					**0.007**	*(NA)*	**0.003**	**0.006**	**0.007**	*(BPQL)*	*(BPQL)*	**0.006**	**0.005**	**0.006**	*(BPQL)*	*0.055*	**0.006**	**0.006**	**0.005**

Table 11

DISSOLVED LOADS IN THE BLACKFOOT RIVER (IN GRAMS PER DAY) and STATISTICAL COMPARISONS BETWEEN SITES

(Statistical comparisons performed using a two-tailed t-test)

Sample name	Sample date	Q [cfs]	Q [l/s]		Inorg. C	Sulfate	As	Ba	Ca	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
BA	7/4/97	94	2662	*min*	4.7E+06	2.5E+06	9.2E+01	4.5E+04	5.1E+06	1.8E+02	9.2E+03	1.4E+05	4.1E+02	2.2E+06	1.7E+03	3.8E+05	8.9E+05	1.3E+06	1.7E+04	5.8E+03
BA	7/4/97	99	2803	*max*	5.0E+06	2.6E+06	9.7E+01	4.9E+04	5.5E+06	2.2E+02	1.1E+04	1.5E+05	4.4E+02	2.4E+06	1.8E+03	4.3E+05	9.6E+05	1.4E+06	1.9E+04	7.0E+03
BA	7/4/97			*mean*	4.8E+06	2.6E+06	9.4E+01	4.7E+04	5.3E+06	2.0E+02	1.0E+04	1.4E+05	4.2E+02	2.3E+06	1.7E+03	4.1E+05	9.3E+05	1.3E+06	1.8E+04	6.5E+03
mean		*96.5*	2733																	
BH	7/4/97	103	2917	*min*	5.1E+06	2.7E+06	7.6E+01	5.1E+04	5.7E+06	2.0E+02	1.1E+04	1.5E+05	4.5E+02	2.4E+06	1.7E+03	4.1E+05	1.0E+06	1.4E+06	2.0E+04	5.1E+03
BH	7/4/97	111	3143	*max*	5.5E+06	2.9E+06	1.1E+02	5.6E+04	6.4E+06	2.4E+02	1.2E+04	1.7E+05	5.2E+02	2.7E+06	1.9E+03	4.9E+05	1.1E+06	1.6E+06	2.2E+04	7.7E+03
BH	7/4/97			*mean*	5.3E+06	2.8E+06	9.6E+01	5.4E+04	6.1E+06	2.2E+02	1.1E+04	1.6E+05	4.9E+02	2.6E+06	1.8E+03	4.5E+05	1.1E+06	1.5E+06	2.1E+04	6.7E+03
mean		*107*	3030																	
BB	7/4/97	100	2832	*min*	4.9E+06	2.6E+06	1.5E+02	4.4E+04	5.1E+06	1.7E+02	9.3E+03	1.5E+05	4.9E+02	2.3E+06	1.4E+03	4.4E+05	8.3E+05	1.4E+06	2.2E+04	2.7E+03
BB	7/4/97	102	2888	*max*	5.0E+06	2.6E+06	1.5E+02	4.7E+04	5.4E+06	1.7E+02	1.1E+04	1.6E+05	5.2E+02	2.3E+06	1.5E+03	4.7E+05	9.2E+05	1.5E+06	2.3E+04	5.5E+03
BB	7/4/97			*mean*	5.0E+06	2.6E+06	1.5E+02	4.6E+04	5.3E+06	1.7E+02	1.0E+04	1.5E+05	5.1E+02	2.3E+06	1.4E+03	4.5E+05	8.8E+05	1.4E+06	2.3E+04	3.8E+03
mean		*101*	2860																	
p-values (from 2-tailed t-test)																				
Prob. that BA is diff. from BH					0.031	0.023	0.921	0.028	0.027	0.243	0.081	0.042	0.033	0.029	0.370	0.212	0.023	0.028	0.019	0.916
Prob. that BH is diff. from BB					0.048	0.022	**0.005**	0.017	0.025	0.018	0.087	0.215	0.349	0.028	**0.004**	0.846	**0.0097**	0.188	0.086	0.085
BA	7/20/97	74	2095	*min*	4.1E+06	1.9E+06	5.4E+01	3.6E+04	3.8E+06	1.6E+02	1.0E+04	1.4E+05	3.3E+02	1.7E+06	1.7E+03	3.2E+05	7.6E+05	1.1E+06	1.5E+04	5.3E+03
BA	7/20/97	77	2180	*max*	4.3E+06	2.0E+06	5.7E+01	3.8E+04	4.0E+06	1.9E+02	1.1E+04	1.5E+05	3.6E+02	1.8E+06	1.8E+03	3.8E+05	8.1E+05	1.1E+06	1.6E+04	5.7E+03
BA	7/20/97	76	2152	*mean*	4.2E+06	2.0E+06	5.6E+01	3.7E+04	3.9E+06	1.7E+02	1.1E+04	1.4E+05	3.5E+02	1.8E+06	1.8E+03	3.4E+05	7.9E+05	1.1E+06	1.6E+04	5.5E+03
mean		*75.7*	*2143*																	
BH	7/20/97	74	2095	*min*	4.1E+06	1.9E+06	9.1E+01	3.6E+04	3.9E+06	1.8E+02	1.2E+04	1.4E+05	3.3E+02	1.8E+06	1.7E+03	3.2E+05	7.8E+05	1.1E+06	1.5E+04	2.8E+03
BH	7/20/97	80	2265	*max*	4.5E+06	2.1E+06	9.8E+01	4.0E+04	4.2E+06	2.0E+02	1.4E+04	1.5E+05	3.7E+02	1.9E+06	1.9E+03	3.8E+05	8.7E+05	1.2E+06	1.7E+04	5.4E+03
BH	7/20/97			*mean*	4.3E+06	2.0E+06	9.4E+01	3.8E+04	4.0E+06	1.9E+02	1.3E+04	1.4E+05	3.5E+02	1.9E+06	1.8E+03	3.4E+05	8.2E+05	1.1E+06	1.6E+04	3.9E+03
mean		*77.0*	*2180*																	
BB	7/20/97	79	2237	*min*	4.4E+06	2.0E+06	9.7E+01	3.7E+04	4.0E+06	1.5E+02	1.0E+04	1.4E+05	4.1E+02	1.8E+06	1.4E+03	3.8E+05	7.8E+05	1.2E+06	2.0E+04	2.9E+03
BB	7/20/97	79	2237	*max*	4.6E+06	2.1E+06	9.7E+01	3.7E+04	4.0E+06	1.7E+02	1.3E+04	1.5E+05	4.1E+02	1.8E+06	1.6E+03	4.0E+05	7.9E+05	1.2E+06	2.0E+04	3.7E+03
BB	7/20/97			*mean*	4.4E+06	2.1E+06	9.7E+01	3.7E+04	4.0E+06	1.7E+02	1.1E+04	1.4E+05	4.1E+02	1.8E+06	1.5E+03	3.9E+05	7.8E+05	1.2E+06	2.0E+04	3.2E+03
mean		*79.0*	*2237*																	
BC	7/20/97	100	2832	*min*	5.8E+06	2.6E+06	1.2E+02	4.7E+04	5.2E+06	2.0E+02	1.1E+04	1.9E+05	5.4E+02	2.3E+06	1.3E+03	4.8E+05	9.6E+05	1.5E+06	2.6E+04	1.4E+03
BC	7/20/97	107	3030	*max*	6.2E+06	2.8E+06	1.3E+02	5.1E+04	5.6E+06	2.1E+02	1.3E+04	2.0E+05	6.0E+02	2.5E+06	1.4E+03	5.7E+05	1.0E+06	1.6E+06	2.8E+04	2.9E+03
BC	7/20/97			*mean*	6.0E+06	2.7E+06	1.3E+02	4.9E+04	5.4E+06	2.0E+02	1.2E+04	1.9E+05	5.7E+02	2.4E+06	1.3E+03	5.3E+05	1.0E+06	1.5E+06	2.7E+04	2.0E+03
mean		*103.5*	*2931*																	
p-values (from 2-tailed t-test)																				
Prob. that BA is diff. from BH					0.482	0.429	**0.000**	0.525	0.354	0.184	0.028	0.684	0.702	0.325	0.946	0.875	0.254	0.381	0.364	0.121
Prob. that BH is diff. from BB					0.234	0.787	0.313	0.369	0.760	0.031	0.305	0.749	0.014	0.375	**0.005**	0.093	0.183	0.132	**0.001**	0.369
Prob. that BB is diff. from BC					**0.000**	**0.001**	**0.000**	**0.000**	**0.000**	**0.006**	0.527	**0.000**	**0.001**	**0.000**	0.012	**0.005**	**0.001**	**0.000**	**0.000**	0.078
BA	8/8/97	41	1161	*min*	2.6E+06	1.1E+06	3.0E+01	2.3E+04	2.6E+06	6.0E+01	4.0E+03	7.3E+04	2.2E+02	1.2E+06	4.8E+02	2.2E+05	3.9E+05	6.3E+05	9.6E+03	8.2E+02
BA	8/8/97	41	1161	*max*	2.7E+06	1.1E+06	3.0E+01	2.3E+04	2.6E+06	7.0E+01	4.2E+03	7.5E+04	2.3E+02	1.2E+06	5.0E+02	2.2E+05	4.0E+05	6.4E+05	9.8E+03	1.1E+03
BA	8/8/97			*mean*	2.6E+06	1.1E+06	3.0E+01	2.3E+04	2.6E+06	6.7E+01	4.1E+03	7.4E+04	2.3E+02	1.2E+06	4.9E+02	2.2E+05	4.0E+05	6.3E+05	9.7E+03	9.4E+02
mean		*41.0*	*1161*																	
BH	8/8/97	38	1076	*min*	2.4E+06	9.7E+05	3.7E+01	2.2E+04	2.4E+06	5.6E+01	3.7E+03	6.9E+04	2.1E+02	1.1E+06	3.3E+02	2.0E+05	3.7E+05	5.9E+05	9.1E+03	3.6E+02
BH	8/8/97	38	1076	*max*	2.4E+06	9.8E+05	3.7E+01	2.2E+04	2.4E+06	5.6E+01	3.9E+03	6.9E+04	2.1E+02	1.1E+06	3.3E+02	2.0E+05	3.8E+05	5.9E+05	9.2E+03	1.2E+03
BH	8/8/97			*mean*	2.4E+06	9.8E+05	3.7E+01	2.2E+04	2.4E+06	5.6E+01	3.8E+03	6.9E+04	2.1E+02	1.1E+06	3.3E+02	2.0E+05	3.7E+05	5.9E+05	9.2E+03	6.7E+02
mean		*38.0*	*1076*																	

Sample name	Sample date	Q [cfs]	Q [l/s]		Inorg. C	Sulfate	As	Ba	Ca	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
BB	8/7/97	33	934	*min*	2.0E+06	8.1E+05	3.2E+01	1.8E+04	1.9E+06	4.0E+01	3.3E+03	6.4E+04	2.1E+02	8.7E+05	2.1E+02	1.8E+05	3.0E+05	5.2E+05	9.8E+03	3.3E+02
BB	8/7/97	36	1019	*max*	2.2E+06	9.0E+05	3.5E+01	2.0E+04	2.2E+06	5.3E+01	3.9E+03	7.0E+04	2.5E+02	9.6E+05	1.2E+03	2.1E+05	3.4E+05	5.8E+05	1.2E+04	4.8E+02
BB	8/7/97			*mean*	2.1E+06	8.6E+05	3.4E+01	1.9E+04	2.1E+06	4.8E+01	3.6E+03	6.7E+04	2.3E+02	9.1E+05	5.3E+02	1.9E+05	3.2E+05	5.5E+05	1.1E+04	4.0E+02
mean		*34.5*	*977*																	
BC	8/7/97	50	1416	*min*	3.1E+06	1.2E+06	4.9E+01	2.8E+04	3.1E+06	4.9E+01	3.4E+03	1.0E+05	3.4E+02	1.4E+06	2.2E+02	2.9E+05	4.5E+05	8.1E+05	1.6E+04	2.9E+02
BC	8/7/97	52	1472	*max*	3.3E+06	1.3E+06	5.1E+01	3.2E+04	3.5E+06	7.6E+01	3.7E+03	1.1E+05	3.7E+02	1.5E+06	2.5E+02	3.1E+05	5.0E+05	8.5E+05	1.8E+04	5.2E+02
BC	8/7/97			*mean*	3.2E+06	1.3E+06	5.0E+01	3.0E+04	3.3E+06	5.8E+01	3.5E+03	1.0E+05	3.5E+02	1.4E+06	2.3E+02	3.0E+05	4.8E+05	8.3E+05	1.7E+04	4.0E+02
mean		*51.0*	*1444*																	
p-values (from 2-tailed t-test)																				
Prob. that BA is diff. from BH					**0.000**	**0.000**	**(<0.01)**	**0.001**	**0.000**	0.028	0.016	**0.001**	**0.014**	**0.000**	**0.000**	**0.000**	**0.004**	**0.000**	**0.001**	0.495
Prob. that BH is diff. from BB					**0.007**	**0.009**	0.016	0.015	0.012	0.073	0.280	0.275	0.277	**0.003**	0.343	0.446	**0.008**	0.081	0.039	0.244
Prob. that BB is diff. from BC					**0.000**	**0.000**	**0.000**	**0.001**	**0.001**	0.184	0.850	**0.000**	**0.001**	**0.001**	0.230	**0.000**	**0.001**	**0.000**	**0.001**	0.973
BA	9/13/97	27	765	*min*	1.8E+06	9.6E+05	2.0E+01	1.8E+04	1.9E+06	2.0E+01	2.1E+03	6.0E+04	1.7E+02	8.3E+05	2.8E+02	1.8E+05	3.8E+05	4.6E+05	7.7E+03	7.9E+01
BA	9/13/97	28	793	*max*	2.0E+06	1.0E+06	2.7E+01	1.9E+04	2.0E+06	4.1E+01	2.3E+03	6.4E+04	1.8E+02	8.8E+05	2.9E+02	1.9E+05	4.2E+05	4.8E+05	7.9E+03	1.7E+02
BA	9/13/97			*mean*	1.9E+06	9.9E+05	2.2E+01	1.9E+04	1.9E+06	2.9E+01	2.2E+03	6.2E+04	1.8E+02	8.6E+05	2.8E+02	1.8E+05	4.0E+05	4.7E+05	7.8E+03	1.1E+02
mean		*27.5*	*779*																	
BH	9/13/97	31	878	*min*	2.0E+06	1.1E+06	2.3E+01	2.0E+04	2.2E+06	3.0E+01	2.3E+03	6.8E+04	2.0E+02	9.6E+05	2.1E+02	2.1E+05	4.2E+05	5.3E+05	8.1E+03	7.6E+01
BH	9/13/97	33	934	*max*	2.3E+06	1.2E+06	2.4E+01	2.2E+04	2.4E+06	4.0E+01	2.5E+03	7.3E+04	2.2E+02	1.0E+06	2.4E+02	2.4E+05	4.8E+05	5.7E+05	9.4E+03	8.9E+01
BH	9/13/97			*mean*	2.1E+06	1.1E+06	2.3E+01	2.1E+04	2.3E+06	3.7E+01	2.4E+03	7.1E+04	2.1E+02	1.0E+06	2.3E+02	2.3E+05	4.5E+05	5.5E+05	8.8E+03	8.4E+01
mean		*32.0*	*906*																	
BB	9/13/97	22	623	*min*	1.5E+06	7.6E+05	2.2E+01	1.4E+04	1.6E+06	1.6E+01	1.8E+03	4.7E+04	1.5E+02	6.5E+05	8.6E+01	1.5E+05	2.7E+05	3.8E+05	6.8E+03	5.4E+01
BB	9/13/97	23	651	*max*	1.6E+06	7.9E+05	2.3E+01	1.5E+04	1.7E+06	2.8E+01	2.0E+03	5.0E+04	1.6E+02	6.8E+05	9.6E+01	1.7E+05	2.9E+05	4.0E+05	7.2E+03	1.0E+02
BB	9/13/97			*mean*	1.5E+06	7.7E+05	2.2E+01	1.4E+04	1.6E+06	2.2E+01	1.9E+03	4.8E+04	1.5E+02	6.6E+05	9.2E+01	1.6E+05	2.8E+05	3.9E+05	7.0E+03	7.2E+01
mean		*22.5*	*637*																	
BC	9/14/97	29	821	*min*	2.0E+06	9.6E+05	2.1E+01	1.7E+04	2.1E+06	*(BPQL)*	1.3E+03	6.0E+04	2.1E+02	8.5E+05	6.4E+01	1.9E+05	3.3E+05	5.0E+05	9.0E+03	2.2E+02
BC	9/14/97	33	934	*max*	2.3E+06	1.1E+06	3.2E+01	2.0E+04	2.4E+06	2.4E+01	1.5E+03	6.9E+04	2.3E+02	9.7E+05	7.3E+01	2.3E+05	4.0E+05	5.8E+05	1.0E+04	2.9E+02
BC	9/14/97	29	821	*mean*	2.1E+06	1.0E+06	2.6E+01	1.8E+04	2.2E+06	2.2E+01	1.4E+03	6.3E+04	2.2E+02	8.9E+05	6.7E+01	2.0E+05	3.5E+05	5.3E+05	9.5E+03	2.5E+02
mean		*30.3*	*859*																	
p-values (from 2-tailed t-test)																				
Prob. that BA is diff. from BH					0.060	**0.004**	0.910	0.025	0.012	0.449	0.130	0.013	0.015	**0.006**	**0.004**	0.012	0.044	**0.005**	0.060	0.233
Prob. that BH is diff. from BB					**0.002**	**0.000**	0.045	**0.001**	**0.001**	0.039	**0.004**	**0.000**	**0.001**	**0.000**	**0.000**	**0.003**	**0.000**	**0.000**	**0.0097**	0.644
Prob. that BB is diff. from BC					0.006	**0.004**	0.233	**0.007**	**0.003**	0.817	**0.007**	**0.006**	**0.002**	**0.003**	**0.003**	0.018	0.013	**0.005**	**0.003**	**0.002**
BH	11/18/97	24	680	*min*	1.6E+06	8.9E+05	1.8E+01	1.3E+04	1.6E+06	1.8E+01	9.4E+02	4.9E+04	1.2E+02	7.4E+05	2.0E+02	1.4E+05	3.2E+05	3.8E+05	6.2E+03	1.4E+02
BH	11/18/97	28	793	*max*	1.9E+06	1.1E+06	2.1E+01	1.6E+04	1.8E+06	2.1E+01	1.1E+03	5.8E+04	1.5E+02	8.6E+05	2.4E+02	1.7E+05	3.8E+05	4.5E+05	7.3E+03	6.5E+02
BH	11/18/97	26	736	*mean*	1.7E+06	9.7E+05	1.9E+01	1.5E+04	1.7E+06	1.9E+01	1.0E+03	5.3E+04	1.4E+02	8.0E+05	2.2E+02	1.5E+05	3.5E+05	4.2E+05	6.7E+03	3.7E+02
mean		*26.0*	*736*																	
HC	11/18/97	1	28	*min*	5.6E+04	2.0E+04	4.9E-01	3.6E+02	5.4E+04	*(BPQL)*	1.6E+02	2.1E+03	1.1E+01	1.9E+04	5.0E+01	1.3E+04	6.7E+03	2.1E+04	1.1E+03	5.6E+00
HC	11/18/97	1	28	*max*	5.7E+04	2.0E+04	7.3E-01	3.6E+02	5.4E+04	*(BPQL)*	1.7E+02	2.1E+03	1.1E+01	1.9E+04	5.1E+01	1.4E+04	6.8E+03	2.1E+04	1.1E+03	6.4E+00
HC	11/18/97			*mean*	5.7E+04	2.0E+04	6.5E-01	3.6E+02	5.4E+04	*(BPQL)*	1.6E+02	2.1E+03	1.1E+01	1.9E+04	5.0E+01	1.4E+04	6.7E+03	2.1E+04	1.1E+03	5.9E+00
mean		*1.0*	*28*																	
BH+HC				*min*	1.7E+06	9.1E+05	1.8E+01	1.4E+04	1.6E+06	1.8E+01	1.1E+03	5.1E+04	1.3E+02	7.6E+05	2.5E+02	1.5E+05	3.3E+05	4.1E+05	7.3E+03	1.5E+02
BH+HC				*max*	1.9E+06	1.1E+06	2.1E+01	1.6E+04	1.9E+06	2.1E+01	1.3E+03	6.0E+04	1.6E+02	8.8E+05	2.9E+02	1.8E+05	3.8E+05	4.7E+05	8.3E+03	6.6E+02

Sample name	Sample date	Q [cfs]	Q [l/s]		Inorg. C	Sulfate	As	Ba	Ca	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
BH+HC				*mean*	1.8E+06	9.9E+05	2.0E+01	1.5E+04	1.8E+06	1.9E+01	1.2E+03	5.5E+04	1.5E+02	8.2E+05	2.7E+02	1.7E+05	3.5E+05	4.4E+05	7.8E+03	3.8E+02
BB	11/16/97	19	538	*min*	1.3E+06	7.3E+05	1.4E+01	1.1E+04	1.3E+06	1.4E+01	6.5E+02	4.2E+04	1.1E+02	6.1E+05	1.6E+02	1.2E+05	2.5E+05	3.2E+05	5.9E+03	9.3E+01
BB	11/16/97	23	651	*max*	1.7E+06	8.9E+05	2.3E+01	1.3E+04	1.6E+06	2.3E+01	8.4E+02	5.1E+04	1.4E+02	7.4E+05	2.0E+02	1.6E+05	3.2E+05	3.9E+05	7.1E+03	3.4E+02
BB	11/16/97	21	595	*mean*	1.5E+06	8.1E+05	1.7E+01	1.2E+04	1.4E+06	1.7E+01	7.5E+02	4.7E+04	1.2E+02	6.8E+05	1.8E+02	1.4E+05	2.9E+05	3.6E+05	6.5E+03	2.0E+02
mean		*21.0*	*595*																	
BC	11/16/97	15	425	*min*	1.0E+06	5.2E+05	1.1E+01	8.3E+03	9.9E+05	*(BPQL)*	3.7E+02	3.1E+04	9.2E+01	4.5E+05	2.6E+01	9.0E+04	1.9E+05	2.5E+05	4.9E+03	6.6E+01
BC	11/16/97	15	425	*max*	1.1E+06	5.3E+05	1.1E+01	8.4E+03	1.0E+06	2.2E+01	3.7E+02	3.1E+04	9.2E+01	4.5E+05	2.6E+01	1.0E+05	1.9E+05	2.5E+05	4.9E+03	1.7E+02
BC	11/16/97			*mean*	1.0E+06	5.2E+05	1.1E+01	8.3E+03	1.0E+06	*(BPQL)*	3.7E+02	3.1E+04	9.2E+01	4.5E+05	2.6E+01	9.8E+04	1.9E+05	2.5E+05	4.9E+03	1.2E+02
mean		*15.0*	*425*																	
p-values (from 2-tailed t-test)																				
Prob. that BH+HC is diff. from BB					0.071	0.051	0.526	0.035	0.056	0.667	**0.004**	0.081	0.083	0.054	**0.006**	0.142	0.054	0.046	0.046	0.325
Prob. that BB is diff. from BC					0.010	**0.004**	0.052	**0.008**	**0.006**	na	**0.002**	**0.004**	**0.0096**	**0.004**	**0.000**	0.026	**0.007**	**0.005**	0.012	0.296
BH	1/6/98	18	510	*min*	1.2E+06	6.2E+05	1.3E+01	9.2E+03	1.1E+06	*(BPQL)*	4.8E+02	3.3E+04	9.2E+01	5.2E+05	1.1E+02	9.8E+04	1.9E+05	2.7E+05	4.7E+03	1.2E+02
BH	1/6/98	22	623	*max*	1.5E+06	7.6E+05	2.2E+01	1.2E+04	1.4E+06	*(BPQL)*	6.5E+02	4.3E+04	1.1E+02	6.7E+05	1.5E+02	1.3E+05	2.3E+05	3.4E+05	6.1E+03	2.2E+02
BH	1/6/98	20	566	*mean*	1.3E+06	6.9E+05	1.6E+01	1.1E+04	1.3E+06	*(BPQL)*	5.7E+02	3.8E+04	1.0E+02	5.9E+05	1.3E+02	1.1E+05	2.1E+05	3.0E+05	5.4E+03	1.7E+02
mean		*20.0*	*566*																	
HC	1/6/98	1	28	*min*	7.0E+04	2.5E+04	4.9E-01	3.4E+02	5.3E+04	*(BPQL)*	1.4E+02	1.9E+03	1.1E+01	1.8E+04	4.0E+01	1.3E+04	7.1E+03	2.0E+04	1.1E+03	2.2E+00
HC	1/6/98	1	28	*max*	7.3E+04	2.5E+04	7.3E-01	3.4E+02	5.4E+04	7.3E-01	1.4E+02	1.9E+03	1.1E+01	1.9E+04	4.0E+01	1.3E+04	7.2E+03	2.0E+04	1.1E+03	6.6E+00
HC	1/6/98			*mean*	7.1E+04	2.5E+04	6.5E-01	3.4E+02	5.4E+04	*(BPQL)*	1.4E+02	1.9E+03	1.1E+01	1.9E+04	4.0E+01	1.3E+04	7.2E+03	2.0E+04	1.1E+03	4.1E+00
mean		*1.0*	*28*																	
BH+HC				*min*	1.2E+06	6.4E+05	1.4E+01	9.6E+03	1.2E+06	*(BPQL)*	6.2E+02	3.5E+04	1.0E+02	5.4E+05	1.5E+02	1.1E+05	1.9E+05	2.9E+05	5.8E+03	1.2E+02
BH+HC				*max*	1.5E+06	7.8E+05	2.2E+01	1.2E+04	1.5E+06	7.3E-01	7.9E+02	4.5E+04	1.2E+02	6.9E+05	1.9E+02	1.4E+05	2.4E+05	3.6E+05	7.2E+03	2.3E+02
BH+HC				*mean*	1.4E+06	7.1E+05	1.7E+01	1.1E+04	1.3E+06	*(BPQL)*	7.1E+02	4.0E+04	1.1E+02	6.1E+05	1.7E+02	1.2E+05	2.2E+05	3.2E+05	6.4E+03	1.7E+02
BC	1/6/98	14	396	*min*	9.4E+05	5.1E+05	1.0E+01	7.5E+03	9.3E+05	*(BPQL)*	3.1E+02	2.8E+04	8.6E+01	4.1E+05	1.4E+01	8.4E+04	1.5E+05	2.2E+05	4.7E+03	6.9E+01
BC	1/6/98	14	396	*max*	9.4E+05	5.2E+05	1.4E+01	7.6E+03	9.4E+05	*(BPQL)*	3.1E+02	2.8E+04	8.6E+01	4.2E+05	1.4E+01	9.5E+04	1.5E+05	2.2E+05	4.7E+03	1.4E+02
BC	1/6/98			*mean*	9.4E+05	5.2E+05	1.3E+01	7.6E+03	9.3E+05	*(BPQL)*	3.1E+02	2.8E+04	8.6E+01	4.1E+05	1.4E+01	8.9E+04	1.5E+05	2.2E+05	4.7E+03	1.1E+02
mean		*14.0*	*396*																	
p-values (from 2-tailed t-test)																				
Prob. that BH+HC is diff. from BC					0.006	**0.009**	0.112	0.012	0.013	*(NA)*	**0.001**	0.014	**0.0098**	**0.009**	**0.000**	0.016	**0.009**	**0.005**	0.011	0.153
BH-1	3/8/98	21	595	*min*	1.4E+06		1.5E+01	1.1E+04	1.3E+06	(BPQL)	4.1E+02	4.3E+04	1.0E+02	6.6E+05	2.0E+02	1.1E+05	4.1E+05	3.1E+05	5.9E+03	(BPQL)
BH-2	3/8/98	25	708	*max*	1.7E+06		2.4E+01	1.3E+04	1.6E+06	(BPQL)	4.9E+02	5.3E+04	1.2E+02	7.9E+05	2.4E+02	1.4E+05	4.9E+05	3.7E+05	7.0E+03	3.7E+01
BH-3	3/8/98	23	651	*mean*	1.5E+06		1.7E+01	1.2E+04	1.5E+06	(BPQL)	4.5E+02	4.7E+04	1.1E+02	7.2E+05	2.1E+02	1.3E+05	4.4E+05	3.4E+05	6.4E+03	3.4E+01
BC-1	3/8/98	13	368	*min*	8.7E+05		9.5E+00	6.6E+03	8.3E+05	(BPQL)	(BPQL)	2.5E+04	7.3E+01	3.9E+05	1.9E+01	7.4E+04	2.6E+05	1.9E+05	4.4E+03	6.4E+00
BC-2	3/8/98	17	481	*max*	1.2E+06		1.2E+01	8.9E+03	1.1E+06	(BPQL)	(BPQL)	3.5E+04	9.6E+01	5.2E+05	2.5E+01	1.0E+05	3.5E+05	2.6E+05	5.9E+03	(BPQL)
BC-3	3/8/98	15	425	*mean*	1.0E+06		1.1E+01	7.7E+03	9.6E+05	(BPQL)	(BPQL)	3.0E+04	8.4E+01	4.5E+05	2.2E+01	8.6E+04	3.0E+05	2.2E+05	5.1E+03	(BPQL)
p-values (from 2-tailed t-test)																				
Prob. that BH is diff. from BC					0.012		0.054	0.011	**0.0096**	(BPQL)	(BPQL)	0.012	0.031	**0.008**	**0.000**	0.027	0.016	0.012	0.070	(BPQL)

Table 12: Streamflow gains and losses along measured stream reaches

	Stream reach					
	Landers Fork			*Blackfoot River*		
Sampling date	C+LA--> LB	LB --> LC	LC -->LD	BA --> BH	BH --> BB	BB --> BC
7/3/97-7/4/97	+	+	(NM)	+	o	(NM)
7/20/97	o	+	o	o	o	+
7/21/97	(NM)	+	o	o	+	+
8/7/97-8/8/97	+	+	-	-	-	+
9/6/97	(NM)	+	(NM)	(NM)	(NM)	(NM)
9/13/97-9/14/97	o	+	-	+	-	+
11/16/97, 11/18/97	(NM)	+	o	(NM)	-	-
1/6/98	-	+	o	(NM)	-	+
3/8/98	-	+	-	(NM)	(NM)	(NM)

Legend:
"+" = net gaining reach
"-" = net losing reach
"o" = no measureable gain/loss
(NM) = not measured

Table 13. Comparison of water quality standards and sample concentrations (all values are in μg/L unless otherwise indicated).

			EPA Drinking Water	Montana Human	Montana Aquatic Life Standards (1)	
Element	Landers Fork	Blackfoot River	Standards (2)	Health Standards (3)	Acute (4)	Chronic (5)
Arsenic	0.2-1.0	0.2-0.7	50	20	340	150
Barium	130-296	180-276	2,000	2,000	not adopted	not adopted
Beryllium	<0.05	<0.05	4	4	not adopted	not adopted
Cadmium	<0.5	<0.5	5	5	4.1 @ 50mg/L Hardness	1.4 @ 50 mg/L Hardness
Chromium (total)	<1.0-1.3	<1.0-1.4	100	100	16(III), 1,700(IV)	11(III), 210(IV)
Copper	<0.3	<0.3-1.0	1,300	1,300	7.3 @ 50 mg/L Hardness	5.2 @ 50 mg/L Hardness
Iron	<5-7	<5-67	300 (6)	300 (7)	not adopted	100
Fluoride	<0.05-0.07	<0.05-0.08	4,000	4,000	not adopted	not adopted
Lead	<6	<6	15	15	82 @ 100 mg/L Hardness	3.2 @ 100 mg/L Hardness
Manganese	<0.3-0.6	0.4-9.7	50 (6)	50 (7)	not adopted	not adopted
Nickel	<2	<2	100	100	261 @ 50 mg/L Hardness	29 @ 50 mg/L Hardness
Nitrate (as N)	<1,000	<1,000	10,000	10,000	not adopted	not adopted
Zinc	<0.2-1.7	<0.2-29.9	5,000	2,100 (8)	67 @ 50 mg/L Hardness	67 @ 50 mg/L Hardness

(1) Calculated using an average hardness of 100 mg/L.

(2) Maximum contaminant level unless otherwise indicated (EPA, 1996).

(3) Maximum contaminant level for surface water unless otherwise indicated (Montana DEQ, 1998).

(4) No sample shall exceed these concentrations at 100 mg/L hardness(Montana DEQ, 1998).

(5) No four-day (96-hour) or longer period average concentration shall exceed these values at 100 mg/L hardness(Montana DEQ, 1998)

(6) Secondary maximum contaminant level (EPA, 1996)

(7) Secondary maximum contaminant level (Montana DEQ, 1998)

(8) Health Advisory for a 70-kg adult (Montana DEQ, 1998).

Table 14

LANDERS FORK SAMPLES--Organized by date

Statistic analysis of differences in water chemistry on a site by site basis within individual sampling events

Sample name	Sample date	Discharge	pH	Spec. Cond.	Inorganic C	Sulfate	As	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
			pH scale	mS/cm	mg/l	mg/l	µg/l	µg/l	mg/l	µg/l	µg/l	µg/l	mg/l	µg/l	mg/l	µg/l	mg/l	mg/l	mg/l	µg/l	µg/l
C-1	7/3/97	161	8.4	0.18	19.9	1.85	0.6	164	21.70	*(<1)*	*(<0.3)*	5	0.23	0.8	7.89	0.5	0.52	0.60	2.62	34	*(<0.2)*
C-2	7/3/97	163	8.4	0.18	19.9	1.81	0.6	171	22.55	*(<1)*	*(<0.3)*	5	0.24	0.8	8.10	0.6	0.50	0.63	2.73	35	*(<0.2)*
C-3	7/3/97		8.4	0.18	20.0	1.85	0.6	164	21.80	*(<1)*	*(<0.3)*	5	0.23	0.8	7.89	0.6	0.57	0.61	2.61	34	0.9
LA-1	7/3/97	114	8.5	0.22	24.2	2.47	0.6	131	27.33	*(<1)*	*(<0.3)*	6	0.40	2.1	9.95	0.3	0.57	0.87	2.69	36	0.5
LA-2	7/3/97	116	8.5	0.22	24.3	2.49	0.6	132	27.69	*(<1)*	*(<0.3)*	6	0.40	2.1	10.07	0.3	0.55	0.86	2.71	36	*(<0.2)*
LA-3	7/3/97		8.5	0.22	24.3	2.46	0.6	127	26.68	*(<1)*	*(<0.3)*	5	0.39	2.1	9.78	0.3	0.50	0.83	2.63	35	0.4
LB-1	7/3/97	316	8.4	0.21	23.4	2.26	0.6	160	25.67	*(<1)*	*(<0.3)*	6	0.34	1.5	9.31	0.4	0.56	0.75	2.75	37	*(<0.2)*
LB-2	7/3/97	334	8.4	0.21	23.7	2.28	0.5	161	25.81	*(<1)*	*(<0.3)*	5	0.34	1.5	9.30	0.4	0.69	0.77	2.76	37	0.8
LB-3	7/3/97		8.4	0.21	24.2	2.37	0.6	171	27.13	*(<1)*	*(<0.3)*	6	0.37	1.6	9.75	0.4	0.50	0.79	2.91	38	0.5
LC-1	7/3/97	398	8.3	0.21	23.9	2.28	0.6	174	27.01	*(<1)*	*(<0.3)*	6	0.37	1.7	9.61	0.4	0.60	0.82	3.00	39	0.8
LC-2	7/3/97	373	8.3	0.21	23.9	2.31	0.6	173	27.05	*(<1)*	*(<0.3)*	6	0.36	1.6	9.68	0.4	0.58	0.81	2.99	39	0.5
LC-3	7/3/97		8.3	0.21	24.0	2.30	0.6	168	26.76	*(<1)*	*(<0.3)*	6	0.34	1.6	9.28	0.4	0.48	0.74	2.84	38	*(<0.2)*
p-values (from 2-tailed t-tests)																					
Prob. that LA is not diff. from	LB		*(<0.01)*	*(<0.01)*	0.101	0.007	0.374	0.001	0.135	*(NA)*	*(NA)*	1.000	0.011	0.000	0.048	0.000	0.509	0.007	0.085	0.024	*(NA)*
Prob. that LB is not diff. from	LC		*(<0.01)*	1.000	0.519	0.843	0.374	0.126	0.195	*(NA)*	*(NA)*	0.374	0.643	0.101	0.737	1.000	0.679	0.510	0.135	0.047	*(NA)*
C-1	7/20/97	117	8.3	0.19	23.9	2.05	0.6	193	23.07	*(<1)*	0.4	6	0.25	0.9	8.56	0.5	0.63	0.69	2.88	39	*<0.2*
C-2	7/20/97	108	8.3	0.19	24.2	2.34	0.7	191	23.15	*(<1)*	0.3	6	0.25	1.0	8.56	0.5	0.58	0.67	2.86	39	*<0.2*
C-3	7/20/97	113	8.3	0.19	24.0	2.01	0.7	191	23.10	*(<1)*	0.3	6	0.25	0.9	8.53	0.5	0.53	0.66	2.86	39	*<0.2*
LA-1	7/20/97	84	8.3	0.22	28.8	2.84	0.4	144	27.79	*(<1)*	*(<0.3)*	6	0.41	2.3	10.47	0.4	0.71	0.93	2.74	39	*(<0.2)*
LA-2	7/20/97	85	8.3	0.22	28.8	2.88	0.4	143	27.94	*(<1)*	*(<0.3)*	6	0.41	2.4	10.52	0.4	0.62	0.90	2.74	39	*(<0.2)*
LA-3	7/20/97		8.3	0.22	28.9	2.74	0.6	142	27.65	*(<1)*	*(<0.3)*	6	0.41	2.4	10.49	0.4	0.76	0.92	2.74	39	*(<0.2)*
LB-1	7/20/97	190	7.9	0.22	28.4	2.59	0.6	181	26.92	*(<1)*	*(<0.3)*	6	0.36	1.7	10.03	0.4	0.73	0.83	2.96	41	*(<0.2)*
LB-2	7/20/97	198	7.9	0.22	28.4	2.50	0.6	184	26.92	*(<1)*	0.3	6	0.36	1.7	9.99	0.4	0.65	0.85	2.97	41	*(<0.2)*
LB-3	7/20/97		7.9	0.22	28.4	2.77	0.6	183	26.90	*(<1)*	0.3	6	0.36	1.7	9.98	0.4	0.79	0.85	2.97	41	*(<0.2)*
LC-1	7/21/97	227	8.1	0.23	30.0	2.83	0.6	198	28.52	*(<1)*	*(<0.3)*	7	0.39	1.9	10.48	0.3	0.84	0.90	3.20	44	1.0
LC-2	7/21/97	225	8.1	0.23	30.1	2.73	0.7	200	28.96	*(<1)*	*(<0.3)*	7	0.39	1.9	10.57	0.3	0.71	0.89	3.22	44	*(<0.2)*
LC-3	7/21/97	227	8.1	0.23	30.0	2.76	0.6	200	28.76	*(<1)*	0.3	6	0.39	1.9	10.56	0.3	0.78	0.90	3.22	44	*(<0.2)*
LD-1	7/20/97	226	8.4	0.22	29.2	2.92	0.6	195	28.01	*(<1)*	*(<0.3)*	6	0.39	1.8	10.26	0.6	0.75	0.88	3.17	43	*(<0.2)*
LD-2	7/20/97	230	8.4	0.22	30.1	2.55	0.6	196	27.82	*(<1)*	*(<0.3)*	6	0.39	1.8	10.29	0.6	0.61	0.87	3.16	43	*(<0.2)*
LD-3	7/20/97	228	8.4	0.22	30.0	2.64	0.6	197	27.96	*(<1)*	*(<0.3)*	6	0.39	1.8	10.23	0.6	0.69	0.89	3.17	43	*(<0.2)*
p-values (from 2-tailed t-tests)																					
Prob. that LA is not diff. from	LB		0.000	1.000	0.000	0.089	0.116	0.000	0.000	*(NA)*	*(NA)*	1.000	0.000	0.000	0.000	1.000	0.668	0.003	0.000	*(<0.01)*	*(NA)*
Prob. that LB is not diff. from	LC		0.000	*(<0.01)*	0.000	0.137	0.374	0.000	0.000	*(NA)*	*(NA)*	0.116	0.000	0.000	0.000	0.000	0.389	0.002	0.000	*(<0.01)*	*(NA)*
Prob. that LC is not diff. from	LD		*(<0.01)*	*(<0.01)*	0.405	0.569	0.374	0.019	0.004	*(NA)*	*(NA)*	0.116	1.000	0.000	0.001	*(<0.01)*	0.167	0.067	0.003	*(<0.01)*	*(NA)*
C-1	8/7/97	52	8.3	0.22	27.0	2.38	0.5	245	29.65	*(<1)*	*(<0.3)*	7	0.31	1.3	11.19	0.4	0.64	0.70	3.22	49	1.2
C-2	8/7/97	51	8.3	0.22	27.0	2.43	0.5	256	30.93	*(<1)*	*(<0.3)*	7	0.32	1.3	11.64	0.4	0.79	0.67	3.20	51	*(<0.2)*
C-3	8/7/97		8.3	0.22	27.8	2.46	0.4	266	31.28	*(<1)*	*(<0.3)*	7	0.34	1.3	11.80	0.5	0.72	0.67	3.21	52	*(<0.2)*
LA-1	8/7/97	38	8.6	0.26	31.8	3.11	0.4	161	31.75	*(<1)*	*(<0.3)*	6	0.43	2.7	11.91	*(<0.3)*	0.86	1.11	3.04	45	*(<0.2)*
LA-2	8/7/97	40	8.6	0.26	31.8	3.10	0.4	162	32.42	*(<1)*	*(<0.3)*	6	0.44	2.7	12.12	*(<0.3)*	0.90	1.11	3.10	46	*(<0.2)*
LA-3	8/7/97		8.6	0.26	31.7	3.23	0.4	166	32.54	*(<1)*	0.7	7	0.43	2.7	12.16	*(<0.3)*	0.80	1.08	3.03	46	0.2
LB-1	8/7/97	96	8.2	0.24	30.9	2.83	0.4	216	31.19	*(<1)*	*(<0.3)*	7	0.41	2.1	11.51	0.4	0.84	0.97	3.33	48	*(<0.2)*

Sample name	Sample date	Discharge	pH	Spec. Cond.	Inorganic C	Sulfate	As	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
LB-2	8/7/97	100	8.2	0.24	31.2	2.86	0.4	216	31.91	(<1)	(<0.3)	7	0.42	2.1	11.68	0.4	0.83	0.96	3.36	47	0 3
LB-3	8/7/97		8.2	0.24	31.3	2.82	0.4	219	31.44	(<1)	(<0.3)	7	0.42	2.1	11.57	0.4	0.89	1.00	3.37	48	1.6
LC-1	8/7/97	133	8.2	0.25	32.0	3.06	0.4	236	32.29	(<1)	(<0.3)	7	0.45	2.2	11.85	0.5	0.80	1.00	3.58	50	(<0.2)
LC-2	8/7/97	128	8.2	0.25	31.9	2.93	0.4	235	32.14	(<1)	(<0.3)	7	0.45	2.3	11.84	0.5	0.80	1.01	3.58	50	1.1
LC-3	8/7/97		8.2	0.25	31.7	2.98	0.5	240	32.67	(<1)	(<0.3)	8	0.46	2.3	11.82	0.5	0.86	1.03	3.60	51	4.6
LD-1	8/7/97	116	8.5	0.26	32.3	3.0	0.5	236	33.01	(<1)	(<0.3)	7	0.45	2.2	11.86	0.5	0.79	0.96	3.55	50	0 4
LD-2	8/7/97	112	8.5	0.26	32.2	3.0	0.5	234	32.81	(<1)	(<0.3)	7	0.45	2.2	11.81	0.5	0.88	0.96	3.52	49	0.5
LD-3	8/7/97		8 5	0.26	31.5	2.9	0.5	234	32.75	(<1)	(<0.3)	7	0.45	2.2	11.82	0.5	0.81	0.95	3.53	50	1.3
p-values (from 2-tailed t-tests)																					
Prob. that LA is not diff. from	LB		(<0.01)	(<0.01)	0.007	0.002	1.000	0.000	0.089	(NA)	(NA)	0.116	0.024	0.000	0.007	(NA)	1.000	0.001	0.000	0.013	(NA)
Prob. that LB is not diff. from	LC		1.000	(<0.01)	0.008	0.019	0.374	0.000	0.032	(NA)	(NA)	0.374	0.001	0.007	0.008	0.000	0.289	0.070	0.000	0.005	(NA)
Prob. that LC is not diff. from	LD		(<0.01)	(<0.01)	0.643	0.688	0.116	0.234	0.050	(NA)	(NA)	0.374	0.374	0.116	0.725	1.000	0.853	0.004	0.008	0.230	(NA)
C-1	9/13/97	25	8.3	(NA)	29.9	2.77	0 5	270	32.4	(<1)	(<0.3)	7	0.36	1.4	11.9	0.3	1.4	1.01	3.81	49	(<0.2)
C-2	9/13/97	23	8.3	(NA)	29.7	2.88	0.5	269	32.97	(<1)	(<0.3)	7	0.36	1.5	12.22	0.3	1.23	0.98	3.80	51	(<0.2)
C-3	9/13/97		8.3	(NA)	29.5	2.57	0.5	267	32.80	(<1)	(<0.3)	7	0.36	1.4	12.18	0.3	1.45	1.00	3.73	51	(<0.2)
LA-1	9/13/97	16	8.2	(NA)	35.1	3.43	0.3	194	39.77	(<1)	(<0.3)	7	0.51	3.3	14.41	(<0.3)	1.21	1.32	3.29	55	(<0.2)
LA-2	9/13/97	16	8.2	(NA)	34.6	3.50	0.4	192	39.54	(<1)	(<0.3)	7	0.49	3.3	14.35	(<0.3)	1.58	1.35	3.29	54	(<0.2)
LA-3	9/13/97		8.2	(NA)	35.2	3.40	0.3	192	39.75	(<1)	(<0.3)	7	0.49	3.3	14.37	(<0.3)	1.41	1.31	3.28	55	(<0.2)
LB-1	9/13/97	38	8.3	(NA)	34.2	2.85	0.4	256	37.44	(<1)	(<0.3)	7	0.50	2.5	13.14	0.3	1.57	1.14	3.80	53	(<0.2)
LB-2	9/13/97	37	8.3	(NA)	34.1	2.96	0.3	266	36.94	(<1)	(<0.3)	6	0.52	2.5	13.14	0.3	1.57	1.14	3.80	55	(<0.2)
LB-3	9/13/97		8.3	(NA)	34.3	2.93	0.4	259	38.22	(<1)	(<0.3)	7	0.52	2.5	13.34	0.3	1.27	1.09	3.83	54	(<0.2)
LC-1	9/13/97	64	8.3	(NA)	34.2	3.09	0.5	295	36.30	(<1)	(<0.3)	5	0.57	2.6	12.84	0.3	1.28	1.55	4.15	58	0.2
LC-2	9/13/97	68	8.3	(NA)	34.9	3.15	0.5	299	36.05	(<1)	(<0.3)	5	0.57	2.6	12.80	0.3	1.04	1.55	4.13	58	(<0.2)
LC-3	9/13/97		8.3	(NA)	34.6	3.14	0.5	291	36.99	(<1)	(<0.3)	6	0.55	2.6	12.73	0.3	1.35	1.38	4.20	56	(<0.2)
LD-1	9/14/97	54	8.3	(NA)	34.4	3.01	0.5	300	36.33	(<1)	(<0.3)	5	0.57	2.6	12.87	0.3	1.00	1.55	4.16	58	(<0.2)
LD-2	9/14/97	49	8.3	(NA)	34.0	3.01	0.5	290	37.08	(<1)	(<0.3)	6	0.55	2.5	12.77	0.3	1.29	0.137	4.19	56	(<0.2)
LD-3	9/14/97		8.3	(NA)	33.7	3.09	0.5	297	36.46	(<1)	(<0.3)	5	0.56	2.7	12.91	0.3	1.00	1.53	4.15	58	(<0.2)
p-values (from 2-tailed t-tests)																					
Prob. that LA is not diff. from	LB		(<0.01)	(NA)	0.017	0.000	0.519	0.000	0.005	(NA)	(NA)	0.374	0.152	0.000	0.000	(NA)	0.658	0.001	0.000	0.374	(NA)
Prob. that LB is not diff. from	LC		1.000	(NA)	0.157	0.005	0.016	0.001	0.080	(NA)	(NA)	0.047	0.006	(<0.01)	0.005	1.000	0.146	0.003	0.000	0.019	(NA)
Prob. that LC is not diff. from	LD		1.000	(NA)	0.136	0.041	1.000	0.868	0.653	(NA)	(NA)	1.000	0.725	1.000	0.318	1.000	0.399	0.422	0.795	1.000	(NA)
LB-1	11/16/97	11	7 6	0.27	35.9	3.06	0.2	249	35.00	1.0	(<0.3)	6	0.52	2.2	13.09	(<0.3)	1.11	1.14	3.62	53	0.5
LB-2	11/16/97	12	7 7	0.27	36.9	2.99	0.3	248	34.80	1.1	0.3	6	0.52	2.2	13.02	(<0.3)	1.09	1.14	3.61	53	1.0
LB-3	11/16/97		7 6	0.27	35.6	2.96	0.3	247	34.72	1.0	(<0.3)	6	0.52	2.2	13.00	(<0.3)	0.93	1.11	3.59	53	(<0.2)
LC-1	11/16/97	36	7 9	0.27	34.6	3.03	0.6	269	34.51	1.2	(<0.3)	6	0.53	2.3	12.87	(<0.3)	1.03	1.12	4.15	57	(<0.2)
LC-2	11/16/97	33	8.0	0.27	34.4	3.00	0.6	265	34.43	1.1	(<0.3)	6	0.53	2.3	12.87	(<0.3)	0.97	1.09	4.11	56	(<0.2)
LC-3	11/16/97		7 9	0.27	34.7	3.04	0.6	269	34.165	1.1	(<0.3)	6	0.53	2.3	12.77	(<0.3)	1.12	1 13	4.16	56	(<0.2)
LD-1	11/16/97	30	8.0	0.27	34.8	3.01	0.7	266	34.25	1.1	(<0.3)	6	0.54	2.3	12.84	(<0.3)	0.94	1 09	4.10	56	(<0.2)
LD-2	11/16/97		8 0	0.28	34.5	3.01	0.7	263	34.33	1.0	(<0.3)	6	0.53	2.3	12.79	(<0.3)	1.20	1 09	4.08	56	(<0.2)
LD-3	11/16/97		8.0	0.27	34.7	2.98	0.6	267	33.75	1.1	(<0.3)	6	0.54	2.3	12.71	(<0.3)	0.95	1.10	4.07	56	(<0.2)
p-values (from 2-tailed t-tests)																					
Prob. that LB is not diff. from	LC		0.003	1.000	0.018	0.642	0.001	0.000	0.024	0.192	(NA)	1.000	(<0.01)	(<0.01)	0.0097	(NA)	0.965	0.346	0.000	0.001	(NA)
Prob. that LC is not diff. from	LD		0.116	0.374	0.468	0.203	0.116	0.263	0.285	0.486	(NA)	1.000	0.116	1.000	0.322	(NA)	0.922	0.184	0 033	0.374	(NA)
C-1	1/6/98	14	8.1	0.24	27.3	3.0	0.5	260	30.45	1.2	(<0.3)	6	0.38	1.4	12.15	(<0.3)	1.02	0.96	3.94	49	0.2
C-2	1/6/98	16	8.1	0.24	26.7	3.1	0.5	258	30.48	1.1	(<0.3)	6	0.38	1.4	12.17	(<0.3)	0.99	0.94	3.93	49	0.7
C-3	1/6/98		8.1	0.24	26.7	3.0	0.5	255	29.65	1.2	(<0.3)	6	0.38	1.4	11.98	(<0.3)	1.04	0.96	3 86	48	1.7
LB-1	1/6/98	6	7.6	0.27	34.2	3.1	0.3	245	35.30	1.1	(<0.3)	6	0.58	2.3	13.06	(<0.3)	0.95	1.01	3.57	53	1.0

Sample name	Sample date	Discharge	pH	Spec. Cond.	Inorganic C	Sulfate	As	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
LB-2	1/6/98	S	7.6	0.27	35.0	3.2	0.3	239	35.65	1.0	*(<0.3)*	6	0.56	2.3	13.08	*(<0.3)*	1.02	1.02	3.59	52	1.7
LB-3	1/6/98		7.6	0.28	33.8	3.2	0.3	240	35.14	1.1	*(<0.3)*	6	0.57	2.3	12.96	*(<0.3)*	0.97	1.04	3.58	52	2.4
LC-1	1/6/98	26	8.0	0.27	33.0	3.4	0.8	243	31.16	1.2	*(<0.3)*	6	0.50	2.2	11.74	*(<0.3)*	0.99	1.11	4.03	52	0.3
LC-2	1/6/98	26	8.0	0.26	33.3	3.3	0.7	250	31.97	1.2	*(<0.3)*	6	0.51	2.2	12.01	*(<0.3)*	0.95	1.14	4.10	53	*<0.2*
LC-3	1/6/98		8.0	0.27	32.5	3.4	0.8	260	33.08	1.3	*(<0.3)*	6	0.52	2.2	12.33	*(<0.3)*	1.00	1.10	4.16	55	*<0.2*
LD-1	1/6/98	25	8.1	0.27	33.6	3.4	0.7	262	32.10	1.4	*(<0.3)*	6	0.53	2.2	12.03	*(<0.3)*	0.97	1.13	4.06	55	0.2
LD-1	1/6/98		8.1	0.27	34.0	3.4	0.8	260	32.11	1.3	*(<0.3)*	6	0.53	2.2	12.00	*(<0.3)*	0.95	1.12	4.07	55	0.3
LD-1	1/6/98		8.1	0.27	33.0	3.3	0.7	261	32.83	1.3	*(<0.3)*	6	0.53	2.3	12.32	*(<0.3)*	1.19	1.10	4.06	56	*(<0.2)*
p-values (from 2-tailed t-tests)																					
Prob. that C is not diff. from	LB		0.000	0.001	0.000	0.047	*(<0.01)*	0.002	0.000	0.066	*(NA)*	1.000	0.000	0.000	0.000	*(NA)*	0.222	0.003	0.000	0.001	0.233
Prob. that LB is not diff. from	LC		0.000	0.230	0.030	0.013	0.000	0.141	0.005	0.009	*(NA)*	1.000	0.002	*(<0.01)*	0.004	*(NA)*	1.000	0.003	0.000	0.349	*(NA)*
Prob. that LC is not diff. from	LD		*(<0.01)*	0.374	0.183	1.000	0.519	0.114	0.672	0.061	*(NA)*	1.000	0.026	0.374	0.674	*(NA)*	0.510	1.000	0.427	0.101	*(NA)*
LB-1	3/8/98	1	7.7	*(NA)*	34.5	*(NA)*	0.3	234	33.56	*(<1)*	*(<0.3)*	*(<5)*	0.62	2.4	12.87	*(<0.3)*	1.78	1.05	3.67	51	*(<0.2)*
LB-2	3/8/98		7.6	*(NA)*	33.7	*(NA)*	0.3	232	33.37	*(<1)*	*(<0.3)*	*(<5)*	0.63	2.3	12.77	*(<0.3)*	1.72	1.07	3.67	51	*(<0.2)*
LB-3	3/8/98		7.7	*(NA)*	34.7	*(NA)*	0.3	234	33.34	*(<1)*	*(<0.3)*	*(<5)*	0.64	2.4	12.82	*(<0.3)*	1.57	1.07	3.68	51	*(<0.2)*
LC-1	3/8/98	22	7.8	*(NA)*	33.5	*(NA)*	1.0	268	32.55	*(<1)*	*(<0.3)*	*(<5)*	0.60	2.2	12.85	*(<0.3)*	2.01	1.19	4.16	57	*(<0.2)*
LC-2	3/8/98		7.8	*(NA)*	33.8	*(NA)*	1.0	268	33.22	*(<1)*	*(<0.3)*	*(<5)*	0.58	2.2	12.98	*(<0.3)*	1.55	1.15	4.09	58	*(<0.2)*
LC-3	3/8/98		7.8	*(NA)*	34.5	*(NA)*	1.0	269	33.17	*(<1)*	*(<0.3)*	*(<5)*	0.58	2.2	12.91	*(<0.3)*	1.85	1.17	4.12	58	*(<0.2)*
LD-1	3/8/98	13	8.0	*(NA)*	33.6	*(NA)*	1.0	265	33.10	*(<1)*	*(<0.3)*	*(<5)*	0.58	2.3	12.87	*(<0.3)*	1.53	1.17	4.05	58	*(<0.2)*
LD-1	3/8/98		8.0	*(NA)*	34.0	*(NA)*	0.9	268	32.87	*(<1)*	*(<0.3)*	*(<5)*	0.06	2.2	12.99	*(<0.3)*	1.63	1.15	4.08	58	*(<0.2)*
LD-1	3/8/98		8.0	*(NA)*	33.4	*(NA)*	0.9	262	33.36	*(<1)*	*(<0.3)*	*(<5)*	0.58	2.2	12.85	*(<0.3)*	1.97	1.10	4.01	57	*(<0.2)*
p-values (from 2-tailed t-tests)																					
Prob. that LB is not diff. from	LC		0.016	*(NA)*	0.438	*(NA)*	*(<0.01)*	0.000	0.122	*(NA)*	*(NA)*	*(NA)*	0.008	0.007	0.120	*(NA)*	0.488	0.001	0.000	0.000	*(NA)*
Prob. that LC is not diff. from	LD		*(<0.01)*	*(NA)*	0.482	*(NA)*	0.116	0.132	0.641	*(NA)*	*(NA)*	*(NA)*	0.358	0.374	0.871	*(NA)*	0.648	0.276	0.056	1.000	*(NA)*

Table 15

Calculations of concentrations in groundwater between sites LB and LC

(These calculations backcalculate the concentrations in groundwater based on changes in chemistry and discharge between LB and LC)

(See the first set of calculations below for a description of formulas used)

Sample name	Sample date	Q [cfs]	Inorg. C	Sulfate	As	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
LB-1	7/3/97,	303	23.4	2.26	0.6	160	25.67	(<1)	(<0.3)	6	0.34	1.5	9.31	0.4	0.56	0.75	2.75	37	(<0.2)
LB-2	7.3/97.	332	23.7	2.28	0.5	161	25.81	(<1)	(<0.3)	5	0.34	1.5	9.30	0.4	0.69	0.77	2.76	37	0.8
LB-3	7/3/97,		24.2	2.37	0.6	171	27.13	(<1)	(<0.3)	6	0.37	1.6	9.75	0.4	0.50	0.79	2.91	38	0.5
Mean		*318*	*23.8*	*2.30*	*0.6*	*164*	*26.20*	*(<1)*	*(<0.3)*	*6*	*0.35*	*1.5*	*9.45*	*0.4*	*0.58*	*0.77*	*2.81*	*37*	*0.5*
Std. Dev.			*0.4*	*0.06*	*0.1*	*6*	*0.81*	*(<1)*	*(<0.3)*	*1*	*0.02*	*0.1*	*0.26*	*0.0*	*0.10*	*0.02*	*0.09*	*1*	*0.4*
LC-1	7/3/97,	398	23.9	2.28	0.6	174	27.01	(<1)	(<0.3)	6	0.37	1.7	9.61	0.4	0.60	0.82	3.00	39	0.8
LC-2	7/3/97,	373	23.9	2.31	0.6	173	27.05	(<1)	(<0.3)	6	0.36	1.6	9.68	0.4	0.58	0.81	2.99	39	0.5
LC-3	7 3/97,		24.0	2.30	0.6	168	26.76	(<1)	(<0.3)	6	0.34	1.6	9.28	0.4	0.48	0.74	2.84	38	(<0.2)
Mean		*386*	*23.9*	*2.30*	*0.6*	*172*	*26.94*	*(<1)*	*(<0.3)*	*6*	*0.36*	*1.6*	*9.52*	*0.4*	*0.55*	*0.79*	*2.94*	*39*	*0.5*
Std. Dev.			*0.1*	*0.02*	*0.0*	*3*	*0.16*	*(<1)*	*(<0.3)*	*0*	*0.02*	*0.1*	*0.21*	*0.0*	*0.06*	*0.04*	*0.09*	*1*	*0.4*
Mean change (mean LC-mean LB)		68	0.17	-0.01	0.03	7.7	0.74	*(N.Q.)*	*(N.Q.)*	0.3	0.01	0.10	0.07	0.00	-0.03	0.02	0.14	1.33	*(N.Q.)*
(Conc.inGW)=((Conc.atLC)-(proportion of SW from LB)(Conc.at LB)/(proportion of GW at LC)																			
proportion of GW at LC=		(Mean change btw. LC & LB /Mean Q at LC)					0.176												
proportion of SWfromLB=		(1-Mean Q at LB)					0.824												
Backcalcuated conc.in GW			24.7	2.27	0.8	207	30.38	*(N.Q.)*	*(N.Q.)*	8	0.4	2.1	9.85	0.4	0.41	0.88	3.58	45	*(N.Q.)*
LB-1	7/20/97,	191	28.4	2.59	0.6	181	26.92	(<1)	(<0.3)	6	0.36	1.7	10.03	0.4	0.73	0.83	2.96	41	(<0.2)
LB-2	7/20/97,	198	28.4	2.50	0.6	184	26.92	(<1)	0.3	6	0.36	1.7	9.99	0.4	0.65	0.85	2.97	41	(<0.2)
LB-3	7/20/97,		28.4	2.77	0.6	183	26.90	(<1)	0.3	6	0.36	1.7	9.98	0.4	0.79	0.85	2.97	41	(<0.2)
Mean		*195*	*28.4*	*2.62*	*0.6*	*183*	*26.91*	*(<1)*	*(<0.3)*	*6*	*0.36*	*1.7*	*10.00*	*0.4*	*0.72*	*0.84*	*2.97*	*41*	*(<0.2)*
Std. Dev.			*0.0*	*0.14*	*0.0*	*2*	*0.01*	*(<1)*	*(<0.3)*	*0*	*0.00*	*0.0*	*0.03*	*0.0*	*0.07*	*0.01*	*0.01*	*0*	*(<0.2)*
LC-1	7/21/97,	227	30.0	2.83	0.6	198	28.52	(<1)	(<0.3)	7	0.39	1.9	10.48	0.3	0.84	0.90	3.20	44	1.0
LC-2	7 21/97,	225	30.1	2.73	0.7	200	28.96	(<1)	(<0.3)	7	0.39	1.9	10.57	0.3	0.71	0.89	3.22	44	(<0.2)
LC-3	7 21/97,	227	30.0	2.76	0.6	200	28.76	(<1)	0.3	6	0.39	1.9	10.56	0.3	0.78	0.90	3.22	44	(<0.2)
Mean		*226*	*30.0*	*2.77*	*0.6*	*199*	*28.75*	*(<1)*	*(<0.3)*	*7*	*0.39*	*1.9*	*10.54*	*0.3*	*0.78*	*0.90*	*3.21*	*44*	*(<0.2)*
Std. Dev.			*0.1*	*0.05*	*0.1*	*1*	*0.22*	*(<1)*	*(<0.3)*	*1*	*0.00*	*0.0*	*0.05*	*0.0*	*0.07*	*0.01*	*0.01*	*0*	*(<0.2)*
proportion of GW at LC=		0.1406																	
proportiou of SWfromLB=		0.8594																	
Backcalcuated conc.in GW			40.0	3.71	0.8	301	39.95	*(N.Q.)*	*(N.Q.)*	11	0.57	3.1	13.81	-0.3	1.10	1.22	4.72	62	*(N.Q.)*
LB-1	8/7/97,	95	30.9	2.83	0.4	216	31.19	(<1)	(<0.3)	7	0.41	2.1	11.51	0.4	0.84	0.97	3.33	48	(<0.2)
LB-2	8/7/97,	102	31.2	2.86	0.4	216	31.91	(<1)	(<0.3)	7	0.42	2.1	11.68	0.4	0.83	0.96	3.36	47	0.3
LB-3	8/7/97,		21.3	2.82	0.4	219	31.44	(<1)	(<0.3)	7	0.42	2.1	11.57	0.4	0.89	1.00	3.37	48	1.6
Mean		*99*	*27.8*	*2.84*	*0.4*	*217*	*31.51*	*(<1)*	*(<0.3)*	*7*	*0.42*	*2.1*	*11.59*	*0.4*	*0.85*	*0.98*	*3.35*	*48*	*0.7*
Std. Dev.			*5.6*	*0.02*	*0.0*	*2*	*0.37*	*(<1)*	*(<0.3)*	*0*	*0.01*	*0.0*	*0.09*	*0.0*	*0.03*	*0.02*	*0.02*	*1*	*0.8*
LC-1	8/7/97,	133	32.0	3.06	0.4	236	32.29	(<1)	(<0.3)	7	0.45	2.2	11.85	0.5	0.80	1.00	3.58	50	(<0.2)
LC-2	8/7/97,	128	31.9	2.93	0.4	235	32.14	(<1)	(<0.3)	7	0.45	2.3	11.84	0.5	0.80	1.01	3.58	50	1.1
LC-3	8/7/97,		31.7	2.98	0.5	240	32.67	(<1)	(<0.3)	8	0.46	2.3	11.82	0.5	0.86	1.03	3.60	51	4.6
Mean		*131*	*31.9*	*2.99*	*0.4*	*237*	*32.37*	*(<1)*	*(<0.3)*	*7*	*0.45*	*2.3*	*11.84*	*0.5*	*0.82*	*1.01*	*3.59*	*50*	*1.9*
Std. Dev.			*0.2*	*0.07*	*0.1*	*3*	*0.27*	*(<1)*	*(<0.3)*	*1*	*0.01*	*0.1*	*0.02*	*0.0*	*0.03*	*0.02*	*0.01*	*1*	*2.4*
proportion of GW at LC=		0.245																	
proportion of SWfromLB=		0.755																	
Backcalcuated conc.in GW			44.4	3.46	0.5	299	34.99	*(N.Q.)*	*(N.Q.)*	8	0.57	2.8	12.61	0.8	0.72	1.13	4.30	58.5	*(N.Q.)*
LB-1	9/13/97,	38	34.3	2.85	0.4	256	37.44	(<1)	(<0.3)	7	0.50	2.5	13.14	0.3	1.57	1.14	3.80	53	(<0.2)
LB-2	9/13/97,	39	34.1	2.96	0.3	266	36.94	(<1)	(<0.3)	6	0.52	2.5	13.14	0.3	1.57	1.14	3.80	55	(<0.2)
LB-3	9/13/97,		34.3	2.93	0.4	259	38.22	(<1)	(<0.3)	7	0.52	2.5	13.34	0.3	1.27	1.09	3.83	54	(<0.2)
Mean		*39*	*34.2*	*2.91*	*0.4*	*260*	*37.53*	*(<1)*	*(<0.3)*	*7*	*0.51*	*2.50*	*13.21*	*0.3*	*1.47*	*1.12*	*3.81*	*54*	*(<0.2)*
Std. Dev.			*0.1*	*0.06*	*0.1*	*5*	*0.65*	*(<1)*	*(<0.3)*	*1*	*0.01*	*0.0*	*0.12*	*0.0*	*0.17*	*0.03*	*0.02*	*1*	*(<0.2)*
LC-1	9/13/97,	64	34.2	3.09	0.5	295	36.30	(<1)	(<0.3)	5	0.57	2.6	12.84	0.3	1.28	1.55	4.15	58	0.2
LC-2	9/13/97,	68	34.9	3.15	0.5	299	36.05	(<1)	(<0.3)	5	0.57	2.6	12.80	0.3	1.04	1.55	4.13	58	(<0.2)
LC-3	9/13/97,		34.6	3.14	0.5	291	36.99	(<1)	(<0.3)	6	0.55	2.6	12.73	0.3	1.35	1.38	4.20	56	(<0.2)
Mean		*66*	*34.6*	*3.13*	*0.5*	*295*	*36.45*	*(<1)*	*(<0.3)*	*5*	*0.56*	*2.62*	*12.79*	*0.3*	*1.22*	*1.49*	*4.16*	*57*	*(<0.2)*
Std. Dev.			*0.4*	*0.03*	*0.0*	*4*	*0.49*	*(<1)*	*(<0.3)*	*1*	*0.01*	*0.0*	*0.06*	*0.0*	*0.16*	*0.10*	*0.04*	*1*	*(<0.2)*
proportion of GW at LC=		0.417																	
proportion of SWfromLB=		0.583																	
Backcalcuated conc.in GW			35.0	3.43	0.7	344	34.93	*(N.Q.)*	*(N.Q.)*	3	0.63	2.8	12.21	0.3	0.88	2.01	4.65	62	*(N.Q.)*
LB-1	11/16/97,	11	35.9	3.06	0.2	249	35.00	1.0	(<0.3)	6	0.52	2.2	13.09	(<0.3)	1.11	1.14	3.62	53	0.5
LB-2	11/16/97,	12	36.9	2.99	0.3	248	34.80	1.1	0.3	6	0.52	2.2	13.02	(<0.3)	1.09	1.14	3.61	53	1.0
LB-3	11/16/97,		35.6	2.96	0.3	247	34.72	1.0	(<0.3)	6	0.52	2.2	13.00	(<0.3)	0.93	1.11	3.59	53	(<0.2)
Mean		*12*	*36.1*	*3.00*	*0.3*	*248*	*34.84*	*1.0*	*(<0.3)*	*6*	*0.52*	*2.2*	*13.04*	*(<0.3)*	*1.04*	*1.13*	*3.61*	*53*	*0.8*
Std. Dev.			*0.7*	*0.05*	*0.1*	*1*	*0.14*	*0.1*	*(<0.3)*	*0*	*0.00*	*0.0*	*0.05*	*(<0.3)*	*0.10*	*0.02*	*0.02*	*0*	*0.4*

Sample name	Sample date	Q [cfs]	Inorg. C	Sulfate	As	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
LC-1	11/16/97,	36	34.6	3.03	0.6	269	34.51	1.2	(<0.3)	6	0.53	2.3	12.87	(<0.3)	1.03	1.12	4.15	57	(<0.2)
LC-2	11/16/97,	33	34.4	3.00	0.6	265	34.43	1.1	(<0.3)	6	0.53	2.3	12.87	(<0.3)	0.97	1.09	4.11	56	(<0.2)
LC-3	11/16/97,		34.7	3.04	0.6	269	34.165	1.1	(<0.3)	6	0.53	2.3	12.77	(<0.3)	1.12	1.13	4.16	56	(<0.2)
Mean		*35*	*34.6*	*3.02*	*0.6*	*268*	*34.37*	*1.1*	(<0.3)	*6*	*0.53*	*2.3*	*12.84*	(<0.3)	*1.04*	*1.11*	*4.14*	*56*	(<0.2)
Std. Dev.			*0.2*	*0.02*	*0.0*	*2*	*0.18*	*0.1*	(<0.3)	*0*	*0.00*	*0.0*	*0.06*	(<0.3)	*0.08*	*0.02*	*0.03*	*1*	(<0.2)
proportion of GW at LC=		0.667																	
proportion of SWfromLB=		0.333																	
Backcalcuated conc.in GW			33.8	3.03	0.8	278	34.13	1.2	(N.Q.)	6	0.54	2.4	12.74	(N.Q.)	1.04	1.11	4.41	58	(N.Q.)
LB-1	1/6/98	6	34.2	3.1	0.3	245	35.30	1.1	(<0.3)	6	0.58	2.3	13.06	(<0.3)	0.95	1.01	3.57	53	1.0
LB-2	1/6/98	5	35.0	3.2	0.3	239	35.65	1.0	(<0.3)	6	0.56	2.3	13.08	(<0.3)	1.02	1.02	3.59	52	1.7
LB-3	1/6/98		33.8	3.2	0.3	240	35.14	1.1	(<0.3)	6	0.57	2.3	12.96	(<0.3)	0.97	1.04	3.58	52	2.4
Mean	1 6 98	*6*	*34.3*	*3.2*	*0.3*	*241*	*35.36*	*1.1*	(<0.3)	*6*	*0.57*	*2.3*	*13.03*	(<0.3)	*0.98*	*1.02*	*3.58*	*52*	*1.7*
Std. Dev.			*0.6*	*0.1*	*0.0*	*3*	*0.26*	*0.1*	(<0.3)	*0*	*0.01*	*0.0*	*0.06*	(<0.3)	*0.04*	*0.02*	*0.01*	*1*	*0.7*
LC-1	1 6 98	26	33.0	3.4	0.8	243	31.16	1.2	(<0.3)	6	0.50	2.2	11.74	(<0.3)	0.99	1.11	4.03	52	0.3
LC-2	1 6 98	26	33.3	3.3	0.7	250	31.97	1.2	(<0.3)	6	0.51	2.2	12.01	(<0.3)	0.95	1.14	4.10	53	<0.2
LC-3	1 6/98		32.5	3.4	0.8	260	33.08	1.3	(<0.3)	6	0.52	2.2	12.33	(<0.3)	1.00	1.10	4.16	55	<0.2
Mean		*26*	*32.9*	*3.4*	*0.8*	*251*	*32.07*	*1.2*	(<0.3)	*6*	*0.51*	*2.2*	*12.03*	(<0.3)	*0.98*	*1.12*	*4.10*	*53*	<0.2
Std. Dev.			*0.4*	*0.1*	*0.1*	*8.5*	*0.96*	*0.1*	(<0.3)	*0*	*0.01*	*0.0*	*0.30*	(<0.3)	*0.03*	*0.02*	*0.07*	*2*	<0.2
proportion of GW at LC=		0.788																	
proportion of SWfromLB=		0.212																	
Backcalcuated conc.in GW			32.6	3.4	0.9	254	31.19	1.3	(N.Q.)	6	0.49	2.2	11.76	(N.Q.)	0.98	1.14	4.24	54	(N.Q.)
LB-1	3/8/98	1	34.47		0.3	234	33.56	(<1)	<0.8	<5	0.62	2.4	12.87	<0.3	1.78	1.08	3.67	51	<0.2
LB-2	3/8/98		33.68		0.3	232	33.37	(<1)	<0.8	<5	0.63	2.3	12.77	<0.3	1.72	1.07	3.67	51	<0.2
LB-3	3/8/98		34.67		0.3	234	33.34	(<1)	<0.8	<5	0.64	2.4	12.82	<0.3	1.57	1.07	3.68	51	<0.2
Mean		1	34.27		0.3	233	33.42	(<1)	<0.8	<5	0.63	2.4	12.82	<0.3	1.69	1.07	3.67	51	<0.2
Std. Dev.			0.523482		0.0	1	0.1193	(<1)	<0.8	<5	0.01	0.1	0.0501	<0.3	0.108	0.006	0.01	0	<0.2
LC-1	3/8/98	22	33.54		1.0	268	32.55	(<1)	<0.8	<5	0.60	2.2	12.85	<0.3	1.25	2.201	4.16	57	<0.2
LC-2	3/8/98		33.78		1.0	268	33.22	(<1)	<0.8	<5	0.58	2.2	12.98	<0.3	0.93	2.136	4.09	58	<0.2
LC-3	3/8/98		34.53		1.0	269	33.17	(<1)	<0.8	<5	0.58	2.2	12.91	<0.3	1.10	2.169	4.12	58	<0.2
Mean		22	33.95		1.0	268	32.98	(<1)	<0.8	<5	0.59	2.2	12.91	<0.3	1.10	2.17	4.12	58	<0.2
Std. Dev.			0.51643		0.0	.1	0.37	(<1)	<0.8	<5	0.01	0.0	0.0651	<0.3	0.157	0.033	0.04	1	<0.2
proportion of GW at LC=		0.955																	
proportion of SWfromLB=		0.045																	
Backcalcuated conc.in GW			33.9		1.0	270	32.96	(N.Q.)	(N.Q.)	(N.Q.	0.58	2.2	12.92	(N.Q.)	1.07	2.22	4.14	58	(N.Q.)

Compilation: all backcalculated GW concentrations

	Inorg. C	Sulfate	As	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
Backcalcuated conc.in GW	24.7	2.27	0.8	207	30.38	(N.Q.)	(N.Q.)	8	0.39	2.1	9.85	0.4	0.41	0.88	3.58	45	(N.Q.)
Backcalcuated conc.in GW	40.0	3.71	0.8	301	39.95	(N.Q.)	(N.Q.)	11	0.57	3.1	13.81	-0.3	1.10	1.22	4.72	62	(N.Q.)
Backcalcuated conc.in GW	44.4	3.46	0.5	299	34.99	(N.Q.)	(N.Q.)	8	0.57	2.8	12.61	0.8	0.72	1.13	4.30	59	(N.Q.)
Backcalcuated conc.in GW	35.0	3.43	0.7	344	34.93	(N.Q.)	(N.Q.)	3	0.63	2.8	12.21	0.3	0.88	2.01	4.65	62	(N.Q.)
Backcalcuated conc.in GW	33.8	3.03	0.8	278	34.13	1.2	(N.Q.)	6	0.54	2.4	12.74	(N.Q.)	1.04	1.11	4.41	58	(N.Q.)
Backcalcuated conc.in GW	32.6	3.4	0.9	254	31.19	1.3	(N.Q.)	6	0.49	2.2	11.76	(N.Q.)	0.98	1.14	4.24	54	(N.Q.)
Backcalcuated conc.in GW	33.9		1.0	270	32.96	(N.Q.)	(N.Q.)	(N.Q.	0.58	2.2	12.92	(N.Q.)	1.07	2.22	4.14	58	(N.Q.)
Mean	*34.9*	*3.22*	*0.8*	*279*	*34.07*	*1.2*	(N.Q.)	*7*	*0.54*	*2.5*	*12.27*	*0.3*	*0.89*	*1.39*	*4.29*	*57*	(N.Q.)
Stdev	*6.2*	*0.52*	*0.2*	*43*	*3.14*	*0.1*		*2*	*0.08*	*0.4*	*1.24*	*0.5*	*0.25*	*0.51*	*0.38*	*6.0*	

Compilation: Groundwater seep samples measured at LC

LC Seep 1 11 16/97	37.9	3.27	0.9	311	37.19	1.2	(<0.3)	7	0.64	2.8	13.60	(<0.3)	1.39	1.25	5.13	65	0.3
LC Seep 2 11/16/97	38.4	3.25	0.9	310	37.16	1.1	(<0.3)	7	0.64	2.8	13.58	(<0.3)	1.39	1.24	5.12	65	6.0
LC Seep 1 1/6/98	35.6	3.60	0.9	282	35.44	1.3	(<0.3)	6	0.60	2.7	12.87	(<0.3)	1.10	1.15	4.81	62	1.7
LC Seep 2 1/6 98	38.1	3.60	0.9	281	35.44	1.1	(<0.3)	6	0.59	2.7	12.92	(<0.3)	1.06	1.14	4.83	61	1.6
LC Seep1 3/8/98	37.0		0.9	283	35.01	(<1)	(<0.8)	(<5)	0.64	2.6	13.42	(<0.3)	1.01	2.18	4.67	63	(<0.2)
LC Seep2 3/8/98	37.0		0.9	281	35.40	(<1)	(<0.8)	(<5)	0.62	2.6	13.40	(<0.3)	0.97	2.13	4.61	62	(<0.2)
LC Seep3 3/8/98	36.7		1.0	281	35.13	(<1)	(<0.8)	(<5)	0.63	2.6	13.42	(<0.3)	1.04	2.15	4.63	63	(<0.2)
Mean	*37.2*	*3.43*	*0.9*	*290*	*35.82*	(N.Q.)	(N.Q.)	(N.Q.	*0.62*	*2.7*	*13.32*	(N.Q.)	*1.14*	*1.61*	*4.83*	*63*	(N.Q.)
Stdev	*1.0*	*0.20*	*0.0*	*14*	*0.94*				*0.02*	*0.1*	*0.30*		*0.18*	*0.51*	*0.22*	2	

p-values of t-test analyses of difference between calculated and measured GW concentrations

Are the backcalc. GW conc. different from seep conc.?	no	no	no	no	no				no	no	no		no	no	yes	no	
p-value	0.343	0.465	0.065	0.528	0.184				0.019	0.244	0.051		0.048	0.441	0.007	0.021	

*N.Q.= NOT QUANTIFIABLE (Typically because some or all values are BPQL)

Table 16

BLACKFOOT RIVER SAMPLES--Organized by date

Statistic analysis of differences in water chemistry on a site by site basis within individual sampling events

Sample name	Sample date	Discharge	pH	Spec. Cond.	Inorganic C	Sulfate	As	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
			pH scale	mS/cm	mg/L	mg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	mg/L	mg/L	µg/L	µg/L
BA-1	7/4/97	99	8.2	0.20	20.35	10.82	0.4	201	22.31	*(<1)*	0.8	40	0.62	1.8	9.62	7.4	1.66	3.95	5.62	76	25.3
BA-2	7/4/97	94	8.2	0.20	20.29	10.85	0.4	200	22.62	*(<1)*	0.9	43	0.61	1.8	9.72	7.5	1.78	3.97	5.66	77	27.7
BA-3	7/4/97		8.2	0.20	20.52	10.82	0.4	195	22.19	*(<1)*	0.8	44	0.60	1.8	9.64	7.3	1.73	3.87	5.58	75	29.0
BH-1	7/4/97	103	8.2	0.20	20.2	10.83	0.4	207	23.66	*(<1)*	0.8	44	0.63	1.9	10.04	7.1	1.74	4.06	5.87	80	28.4
BH-2	7/4/97	111	8.2	0.20	20.2	10.79	0.4	201	22.66	*(<1)*	0.9	43	0.61	1.8	9.70	6.8	1.80	3.98	5.66	78	20.4
BH-3	7/4/97		8.2	0.20	20.2	10.80	0.3	208	23.66	*(<1)*	0.8	42	0.61	1.9	9.95	7.0	1.61	4.06	5.84	80	28.2
BB-1	7/4/97	102	8.3	0.20	20.1	10.45	0.6	190	21.80	*(<1)*	0.7	40	0.62	2.0	9.36	5.8	1.83	3.68	5.87	94	13.5
BB-2	7/4/97	100	8.3	0.20	20.0	10.50	0.6	190	21.71	*(<1)*	0.7	43	0.63	2.1	9.31	5.9	1.78	3.64	5.82	94	22.0
BB-3	7/4/97		8.3	0.20	20.1	10.48	0.5	178	20.86	*(<1)*	0.7	38	0.62	2.1	9.34	5.7	1.89	3.60	5.67	88	11.2
p-values (from 2-tailed t-test)																					
Prob. that BA is diff. from BH			1.000	1.000	0.056	0.210	0.374	0.081	0.056	(NA)	1.000	0.643	0.492	0.116	0.090	0.015	0.924	0.063	0.071	0.019	0.590
Prob. that BH is diff. from BB			*(<0.01)*	1.000	0.004	0.000	0.013	0.013	0.014	(NA)	0.016	0.163	0.422	0.013	0.006	0.000	0.145	0.000	0.972	0.004	0.074
BA-1	7/20/97	77	7.6	0.20	22.78	10.78	0.3	202	21.11	*(<1)*	1.0	58	0.77	1.9	9.74	9.7	2.03	4.28	5.85	84	29.4
BA-2	7/20/97	74	7.6	0.20	22.75	10.73	0.3	203	21.38	*(<1)*	0.9	56	0.76	1.9	9.81	9.8	1.77	4.27	5.89	85	29.7
BA-3	7/20/97	76	7.6	0.20	22.76	10.76	0.3	201	20.97	*(<1)*	0.9	57	0.76	1.8	9.66	9.6	1.79	4.20	5.80	84	30.4
BH-1	7/20/97	74	7.9	0.20	22.8	10.77	0.5	204	21.45	*(<1)*	1.0	67	0.77	1.9	9.88	9.5	1.93	4.42	5.95	86	19.7
BH-2	7/20/97	80	7.9	0.20	22.8	10.82	0.5	202	21.38	*(<1)*	1.0	69	0.77	1.9	9.85	9.5	1.73	4.31	5.88	85	27.5
BH-3	7/20/97		7.9	0.20	22.8	10.87	0.5	201	21.42	*(<1)*	1.0	64	0.75	1.8	9.85	9.5	1.78	4.32	5.88	85	15.6
BB-1	7/20/97	79	8.0	0.20	22.6	10.68	0.5	194	20.85	*(<1)*	0.9	66	0.76	2.1	9.43	8.1	1.97	4.08	6.09	104	18.9
BB-2	7/20/97	79	8.0	0.20	22.6	10.62	0.5	190	20.60	*(<1)*	0.9	60	0.74	2.1	9.35	7.5	2.07	4.01	6.01	102	15.1
BB-3	7/20/97		8.0	0.20	23.6	10.57	0.5	191	20.61	*(<1)*	0.8	52	0.75	2.1	9.38	7.5	1.95	4.04	6.03	103	16.3
BC-1	7/20/97	100	7.9	0.21	23.8	10.52	0.5	192	21.46	*(<1)*	0.8	48	0.77	2.3	9.65	5.2	2.17	3.92	6.05	106	5.7
BC-2	7/20/97	107	7.9	0.21	23.7	10.62	0.5	194	21.08	*(<1)*	0.8	46	0.76	2.2	9.55	5.2	1.98	3.99	6.01	106	11.2
BC-3	7/20/97		7.9	0.21	23.6	10.74	0.5	193	21.29	*(<1)*	0.8	49	0.76	2.2	9.62	5.2	2.15	4.00	6.05	106	6.7
p-values (from 2-tailed t-test)																					
Prob. that BA is diff. from BH			0.000	1.000	0.205	0.122	*(<0.01)*	0.768	0.097	(NA)	0.116	0.003	1.000	1.000	0.050	0.026	0.652	0.082	0.180	0.101	0.064
Prob. that BH is diff. from BB			0.000	1.000	0.676	0.010	1.000	0.002	0.001	(NA)	0.016	0.164	0.205	0.002	0.000	0.001	0.060	0.002	0.014	0.000	0.319
Prob. that BB is diff. from BC			0.000	0.000	0.081	0.965	1.000	0.374	0.013	(NA)	0.116	0.048	0.116	0.016	0.004	0.000	0.218	0.086	0.820	0.007	0.012
BA-1	8/8/97	41	8.2	0.24	26.29	10.61	0.3	231	25.83	*(<1)*	0.7	42	0.75	2.3	11.60	5.0	2.21	3.95	6.33	97	11.1
BA-2	8/8/97	41	8.2	0.24	26.16	10.54	0.3	231	25.53	*(<1)*	0.7	42	0.74	2.3	11.50	4.9	2.21	4.03	6.36	98	8.2
BA-3	8/8/97		8.2	0.24	26.49	10.66	0.3	229	25.46	*(<1)*	0.6	40	0.73	2.2	11.51	4.8	2.18	3.93	6.29	96	8.8
BH-1	8/8/97	38	8.3	0.24	26.2	10.51	0.4	237	25.82	1.1	0.6	40	0.74	2.3	11.54	3.6	2.17	4.09	6.39	99	4.4
BH-2	8/8/97	38	8.3	0.24	26.0	10.48	0.4	234	25.71	1.0	0.6	40	0.74	2.3	11.58	3.6	2.15	4.00	6.35	98	13.3
BH-3	8/8/97		8.3	0.24	26.1	10.48	0.4	233	26.02	*(<1)*	0.6	42	0.74	2.3	11.64	3.6	2.20	3.98	6.36	99	3.9
BB-1	8/8/97	36	8.3	0.23	25.33	10.13	0.4	226	24.94	*(<1)*	0.5	42	0.79	2.8	10.78	13.6	2.38	3.74	6.60	132	4.7
BB-2	8/8/97	33	8.3	0.23	25.28	10.06	0.4	229	25.04	*(<1)*	0.6	44	0.79	2.6	10.85	2.6	2.30	3.82	6.58	126	4.1
BB-3	8/8/97		8.3	0.23	25.39	10.21	0.4	220	24.1'	*(<1)*	0.6	41	0.79	2.6	10.79	2.8	2.24	3.68	6.45	122	5.4
BC-1	8/8/97	52	8.1	0.23	26.2	10.11	0.4	233	26.23	*(<1)*	0.4	28	0.82	2.8	11.24	1.8	2.46	3.93	6.67	133	2.4

Sample name	Sample date	Discharge	pH	Spec. Cond.	Inorganic C	Sulfate	As	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
BC-2	8/8/97	50	8.1	0.23	26.1	10.03	0.4	230	25.58	*(<1)*	0.4	28	0.82	2.8	11.06	1.8	2.41	3.93	6.61	131	4.1
BC-3	8/8/97		8.1	0.23	25.6	10.04	0.4	248	27.77	*(<1)*	0.6	29	0.86	2.9	11.88	2.0	2.43	3.65	6.61	141	3.1
p-values (from 2-tailed t-test)																					
Prob. that BA is diff. from BH			*(<0.01)*	1.000	0.136	0.035	*(<0.01)*	0.034	0.169	(NA)	0.116	0.519	1.000	0.374	0.310	0.000	0.205	0.307	0.165	0.067	0.533
Prob. that BH is diff. from BB			1.000	*(<0.01)*	0.000	0.001	1.000	0.029	0.021	(NA)	0.374	0.206	0.000	0.005	0.000	0.494	0.036	0.006	0.022	0.001	0.468
Prob. that BB is diff. from BC			*(<0.01)*	1.000	0.020	0.217	1.000	0.123	0.062	(NA)	0.251	0.000	0.031	0.089	0.079	0.286	0.042	0.426	0.165	0.119	0.069
BA-1	9/13/97	28	8.3	*(NA)*	29.10	14.60	0.4	279	28.50	*(<1)*	0.6	32	0.93	2.6	12.57	4.2	2.83	6.08	7.00	116	1.3
BA-2	9/13/97	27	8.3	*(NA)*	28.00	14.70	0.3	274	29.35	*(<1)*	0.3	34	0.91	2.7	12.86	4.3	2.67	5.79	7.02	116	2.5
BA-3	9/13/97		8.3	*(NA)*	28.70	14.70	0.3	275	29.03	*(<1)*	0.4	33	0.92	2.6	12.76	4.2	2.72	5.91	7.02	116	1.2
BH-1	9/13/97	33	8.3	*(NA)*	28.5	14.54	0.3	275	29.38	*(<1)*	0.5	30	0.91	2.7	12.89	3.0	2.88	5.90	7.04	116	1.0
BH-2	9/13/97	31	8.2	*(NA)*	26.7	14.50	0.3	271	29.13	*(<1)*	0.4	31	0.91	2.6	12.77	3.0	2.81	5.81	6.96	115	1.1
BH-3	9/13/97		8.3	*(NA)*	26.9	14.57	0.3	263	28.38	*(<1)*	0.5	31	0.89	2.6	12.65	2.8	3.00	5.60	6.93	107	1.1
BB-1	9/13/97	23	8.1	*(NA)*	27.9	14.04	0.4	254	29.72	*(<1)*	0.4	33	0.87	2.7	12.01	1.6	3.01	4.97	7.14	127	1.1
BB-2	9/13/97	22	8.1	*(NA)*	27.4	14.11	0.4	258	29.64	*(<1)*	0.3	35	0.88	2.7	12.11	1.7	2.72	5.07	7.19	128	1.8
BB-3	9/13/97		8.1	*(NA)*	27.5	14.03	0.4	253	29.35	*(<1)*	0.5	34	0.87	2.8	12.09	1.7	2.99	4.98	7.17	127	1.0
BC-1	9/14/97	29	7.9	*(NA)*	27.6	13.57	0.4	253	29.65	*(<1)*	0.3	19	0.86	2.9	12.07	0.9	2.83	4.90	7.17	129	3.1
BC-2	9/14/97	33	7.9	*(NA)*	28.9	13.50	0.3	245	29.87	*(<1)*	*(<0.3)*	18	0.84	2.9	12.04	0.9	2.69	4.66	7.02	127	3.6
BC-3	9/14/97	29	7.9	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
p-values (from 2-tailed t-test)																					
Prob. that BA is diff. from BH			0.374	*(NA)*	0.132	0.029	0.374	0.175	0.994	*(NA)*	0.742	0.025	0.132	1.000	0.734	0.000	0.098	0.270	0.335	0.307	0.225
Prob. that BH is diff. from BB			0.007	*(NA)*	0.713	0.000	0.000	0.019	0.132	*(NA)*	0.374	0.007	0.016	0.101	0.001	0.000	0.931	0.001	0.006	0.007	0.410
Prob. that BB is diff. from BC			0.000	*(NA)*	0.302	0.001	0.272	0.192	0.337	*(NA)*	*(NA)*	0.000	0.073	0.030	0.739	0.000	0.346	0.105	0.311	0.495	0.012
BB-1	10/25/97		8.3	0.24	27.5	13.40	0.3	226	27.7	*(<1)*	*(<0.3)*	26	0.74	2.4	11.16	2.2	2.56	5.25	7.00	112	4.8
BB-2	10/25/97		8.3	0.24	28.3	13.40	0.3	206	25.12	*(<1)*	*(<0.3)*	23	0.67	2.3	10.22	2.0	2.43	5.46	6.85	102	4.3
BB-3			8.3	0.24																	
BC-1	10/25/97		7.8	0.24	27.7	13.39	0.3	263	32.43	*(<1)*	*(<0.3)*	20	0.84	2.8	12.68	0.9	2.97	4.54	7.04	135	2.2
BC-2	10/25/97		7.9	0.24	27.9	13.41	0.3	205	24.84	*(<1)*	*(<0.3)*	17	0.65	2.4	9.95	0.7	2.46	5.81	6.98	106	1.0
BC-3	10/25/97		7.9	0.24	27.9	13.36	0.3	221	27.62	*(<1)*	*(<0.3)*	18	0.71	2.5	10.96	0.8	2.65	5.33	6.98	115	1.0
p-values (from 2-tailed t-test)																					
Prob. that BB is diff. from BC			0.000	1.000	0.844	0.528	1.000	0.602	0.576	*(NA)*	*(NA)*	0.031	0.737	0.268	0.673	0.001	0.391	0.808	0.310	0.391	0.011
BH-1	11/18/97	26	8.0	0.25	27.6	15.19	0.3	229	26.82	1.2	0.3	16	0.84	2.1	12.55	3.4	2.32	5.43	6.55	106	9.5
BH-2	11/18/97		8.0	0.25	27.3	15.23	0.3	230	27.00	1.3	0.3	16	0.83	2.2	12.57	3.4	2.43	5.46	6.57	106	5.7
BH-3	11/18/97		8.0	0.25	27.3	15.34	0.3	230	26.91	1.3	0.3	16	0.83	2.1	12.60	3.5	2.41	5.49	6.59	106	2.4
BB-1	11/16/97	21	8.1	0.26	29.0	15.65	0.4	233	28.07	1.2	0.4	15	0.91	2.4	13.14	3.6	2.69	5.67	7.01	126	6.0
BB-2	11/16/97		8.1	0.26	29.5	15.72	0.3	232	28.05	1.2	0.3	15	0.91	2.4	13.11	3.5	2.57	5.59	7.00	126	3.8
BB-3	11/16/97		8.1	0.26	28.5	15.84	0.3	228	28.52	1.1	0.3	14	0.90	2.4	13.20	3.5	2.82	5.48	6.98	126	2.0
BC-1	11/16/97	15	7.8	0.25	28.8	14.28	0.3	226	27.24	1.3	0.6	10	0.84	2.5	12.37	0.7	2..7	5.20	6.75	134	1.8
BC-2	11/16/97	15	7.8	0.25	28.2	14.32	0.3	227	27.09	1.3	*(<0.3)*	10	0.84	2.5	12.28	0.7	2.83	5.27	6.74	134	3.0
BC-3	11/16/97		7.8	0.25	27.9	14.24	0.3	228	27.30	1.3	*(<0.3)*	10	0.84	2.5	12.35	0.7	2.46	5.21	6.76	134	4.7
p-values (from 2-tailed t-test)																					
Prob. that BH is diff. from BB			*(<0.01)*	*(<0.01)*	0.007	0.002	0.374	0.442	0.001	0.240	0.374	0.016	0.000	0.001	0.000	0.101	0.018	0.106	0.000	*(<0.01)*	0.458
Prob. that BB is diff. from BC			*(<0.01)*	*(<0.01)*	0.147	0.000	0.374	0.070	0.004	0.042	*(NA)*	0.000	0.000	*(<0.01)*	0.000	0.000	0.790	0.004	0.000	*(<0.01)*	0.620

Sample name	Sample date	Discharge	pH	Spec. Cond.	Inorganic C	Sulfate	As	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	S	Si	Sr	Zn
BH-1	1/6/98	20	8.1	0.24	27.3	14.10	0.3	210	25.40	1.3	*(<0.3)*	12	0.75	2.1	11.86	2.5	2.24	4.24	6.12	107	3.5
BH-2	1/6/98		8.1	0.24	26.7	14.00	0.3	217	26.12	1.5	*(<0.3)*	11	0.78	2.1	12.13	2.6	2.22	4.31	6.23	110	4.1
BH-3	1/6/98		8.1	0.25	26.7	14.10	0.4	222	26.66	1.4	*(<0.3)*	12	0.80	2.1	12.38	2.7	2.34	4.21	6.21	113	2.7
BC-1	1/6/98	14	7.8	0.25	27.5	15.00	0.4	222	27.23	1.4	*(<0.3)*	9	82.00	2.5	12.12	0.4	2.46	4.46	6.39	137	3.4
BC-2	1/6/98	14	7.8	0.25	27.6	15.10	0.4	219	27.16	1.5	*(<0.3)*	9	0.81	2.5	12.07	0.4	2.78	4.45	6.36	137	2.0
BC-3	1/6/98		7.8	0.25	27.3	15.20	0.3	220	27.46	1.3	*(<0.3)*	9	0.81	2.5	12.11	0.4	2.57	4.40	6.35	137	4.2
p-values (from 2-tailed t-test)																					
Prob. that BH is diff. from BC			*(<0.01)*	0.116	0.064	0.000	0.519	0.328	0.031	0.745	*(NA)*	0.001	0.373	*(<0.01)*	0.885	0.000	0.029	0.006	0.007	0.000	0.774
BH-1	3/8/98	23	8.1		27.8		0.4	215	26.36	*(<1)*	*(<0.3)*	8	0.86	2.0	12.89	3.9	3.06	4.37	6.08	114	(<0.2)
BH-2	3/8/98	23	8.1		28.2		0.3	211	26.12	*(<1)*	*(<0.3)*	8	0.85	2.0	12.81	3.8	2.78	4.32	6.02	114	0.5
BH-3	3/8/98	23	8.1		27.2		0.3	211	26.34	*(<1)*	*(<0.3)*	8	0.83	2.0	12.77	3.8	2.86	4.27	5.99	114	0.6
BC-1	3/8/98	15	7.9		27.9		0.3	208	26.33		*(<0.3)*	*(<5)*	0.80	2.3	12.34	0.6	3.10	4.38	6.00	140	0.2
BC-2	3/8/98		7.8		27.5		0.3	215	26.49		*(<0.3)*	*(<5)*	0.84	2.3	12.59	0.6	3.31	4.52	6.15	141	*(<0.2)*
BC-3	3/8/98		7.9		27.6		0.3	209	26.15		*(<0.3)*	*(<5)*	0.81	2.0	12.28	0.6	3.33	4.45	5.99	138	*(<0.2)*
p-values (from 2-tailed t-test)																					
Prob. that BH is diff. from BC			0.002		0.842		0.374	0.551	0.709	*(NA)*	*(NA)*	*(NA)*	0.114	0.116	0.014	0.000	0.036	0.059	0.789	0.000	*(NA)*

Piezemeter Measurements

(NM=not measured, NMF=not measurable because frozen, NA=not applicable because frozen, SW=surface water, WW=well water, all values are +/- 1.0 centimeters.)

Table 17.1

	Date of Measurement	Mean Discharge (cfs)	Diff. betw. WW head and SW level (cm)	Diff. betw. WW head and streambed elevation (cm)	Depth of piezometer below streambed	Comments
Copper Creek Site						
Piezometer W	9/13/97	24	-1.9	2.5	33.0	
	1/6/98	15	NA	NA	33.0	WW frozen
	3/8/98	NA	NA	NA	33.0	frozen
Piezometer E	8/7/97	52	-4.4	32.9	44.6	
	9/13/97	24	-1.3	25.2	44.6	
	1/6/98	15	NA	NA	44.6	WW frozen
	3/8/98	NA	NA	NA	44.6	frozen
Landers Fork A						
Piezometer 1 (under bridge)	8/7/97	39	-27.0	1.6	54.3	
	9/13/97	16	-30.5	-8.6	54.3	
	1/6/98	NA	NA	NA	54.3	frozen
	3/8/98	NA	NA	NA	54.3	frozen
						1 day after installation
Piezometer 2 (upstream of bridge)	8/8/97	39	-8.3	12.7	48.3	
	9/13/97	16	-6.0	9.5	48.3	
	1/6/98	NA	NA	NA	48.3	frozen
	3/8/98	NA	NA	NA	48.3	frozen
Landers Fork B						
Piezometer NW	8/7/97	99	-3.5	32.7	48.1	
	9/6/97	49	-2.9	26.3	48.1	
	9/13/97	38	-1.4	26.5	48.1	
	11/16/97	12	-2.2	18.4	48.1	
	1/6/98	6	-2.5	13.3	48.1	
	3/8/98	1	NA	NA	48.1	WW frozen
Piezometer SE	9/6/97	49	-5.4	24.8	55.8	
	9/13/97	38	-5.1	23.2	55.8	
	11/16/97	12	-5.7	14.9	55.8	
	1/6/98	6	-5.1	9.9	55.8	
	3/8/98	1	NA	NA	55.8	WW frozen
Landers Fork C						
Piezometer W	8/7/97	131	-3.3	59.5	60.6	
	9/6/97	77	-5.7	50.2	60.6	
	9/13/97	66	-6.0	48.6	60.6	
	10/19/97	NM	-7.0	43.8	60.6	
	11/16/97	35	-7.8	38.6	60.6	
	1/6/98	26	-7.6	34.9	60.6	
	3/8/98	22	-8.7	32.5	60.6	
Piezometer E	9/6/97	131	1.0	81.3	48.0	
	9/13/97	66	1.8	79.4	48.0	
	10/19/97	NM	0.3	76.2	48.0	
	11/16/97	35	1.3	73.0	48.0	
	1/6/98	26	-2.5	66.7	48.0	
	3/8/98	22	0.0	66.0	48.0	
Landers Fork D						
Piezometer NW	8/7/97	114	-75.7	-41.4	49.1	
	9/14/97	52	-54.9	-33.3	49.1	
	3/8/98	13	-28.0	-26.0	49.1	
Piezometer SE	9/14/97	52	NA	<-61.0	61.0	Dry well
	11/16/97	30	NA	<-61.0	61.0	Dry well
	3/8/98	13	NA	<-61.0	61.0	Dry well

Table 17.2

	Date of Measurement	Mean Discharge (cfs)	Diff. betw. WW head and SW level (cm)	Diff. betw. WW head and streambed elevation (cm)	Depth of piezometer below streambed	Comments
Blackfoot A						
Piezometer N	7/20/97	77	NA	45.5	45.5	Dry well
	7/21/97	67	NA	45.5	45.5	Dry well
	8/8/97	41	NA	45.5	45.5	Dry well
	9/13/97	28	NA	45.5	45.5	Dry well
Piezometer S	8/8/97	41	NA	61.0	61.0	Dry well
	9/13/97	28	NA	61.0	61.0	Dry well
Blackfoot BH						
PiezometerW	8/8/97	38	-93.3	-50.2	52.6	
	9/13/97	32	-89.9	-50.5	52.6	stream mostly frozen
	1/6/98	20	-105.0	-48.9	52.6	stream mostly frozen
	3/8/98	22	-90.2	-50.5	52.6	
						1 day after installation
Blackfoot B						
Piezometer N	7/21/97	65	0.8	49.3	55.4	
	8/7/97	38	0.0	40.8	55.4	
	9/13/97	32	-1.9	33.5	55.4	
	11/16/97	26	-15.5	39.6	55.4	WW frozen
	1/6/98	20	NA	NA	55.4	
Piezometer S	9/13/97	32	1.2	21.2	61	WW frozen
	11/16/97	26	NA	NA	61	WW frozen
	1/6/98	20	NA	NA	61	
Blackfoot C						
Piezometer N	9/14/97	30	-15.4	11.3	58.0	
	10/19/97	NM	-33.4	-7.4	58.0	
	10/25/98	NM	-38.4	-13.3	58.0	
	11/16/97	15	-47.7	-25.6	58.0	
	1/6/98	14	-44.5	-24.1	58.0	
	3/8/98	15	-63.5	42.2	58	
Piezometer S	9/14/97	30	0.0	20.3	43.8	
	10/25/97	NM	-13.3	4.5	43.8	
	11/16/97	15	-26.0	-8.3	43.8	
	1/6/98	14	-29.2	-12.7	43.8	
Blackfoot D						
Piezometer N	8/7/97	151	-57.5	-3.9	54.5	
	9/14/97	80	-78.4	-36.3	54.5	
Piezometer S	9/14/97	80	-4.1	44.2	48.3	

Table 18: Snow samples collected near confluence.
1/6/98

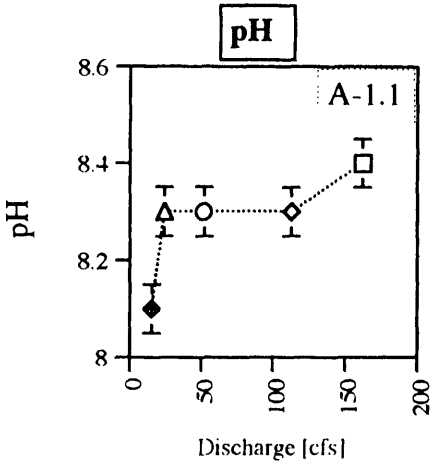
Sample name Sample date, approx. time		SNOW 1 1/6/98, 17:00	SNOW 2 1/6/98, 17:00
	Units		
pH	pH scale	*(NA)*	*(NA)*
Diss. oxygen	mg/L	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	*(NA)*	*(NA)*
Water temp.	deg. C	*(NA)*	*(NA)*
Air temp	deg. C	*(NA)*	*(NA)*
Inorganic carbon	mg/L	*(NA)*	*(NA)*
Organic carbon	mg/L	*(NA)*	*(NA)*
Fluoride	mg/L	*(NA)*	*(NA)*
Sulfate	mg/L	*(NA)*	*(NA)*
As	µg/L	*(NA)*	*(<0.2)*
Ag	µg/L	*(<0.8)*	*(<0.8)*
Al	µg/L	*(<3)*	*(<3)*
Ba	µg/L	*(<1)*	*(<1)*
Ca	mg/L	0.11	0.07
Cr	µg/L	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*
Fe	µg/L	*(<5)*	*(<5)*
K	mg/L	*(<0.10)*	*(<0.10)*
Li	µg/L	*(<0.5)*	*(<0.5)*
Mg	mg/L	0.02	0.02
Mn	µg/L	*(<0.3)*	*(<0.3)*
Na	mg/L	0.23	0.40
S	mg/L	0.02	0.03
Si	mg/L	*(<0.02)*	*(<0.02)*
Sr	µg/L	*(<2)*	*(<2)*
Zn	µg/L	*(<0.2)*	*(<0.2)*

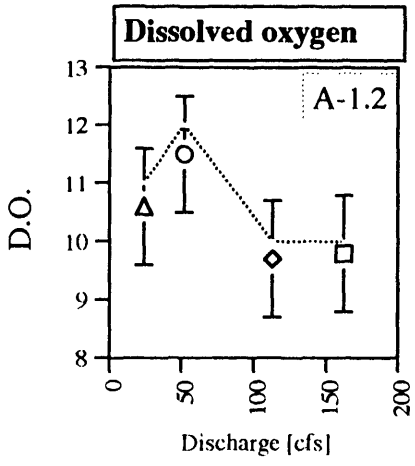
Appendix A.

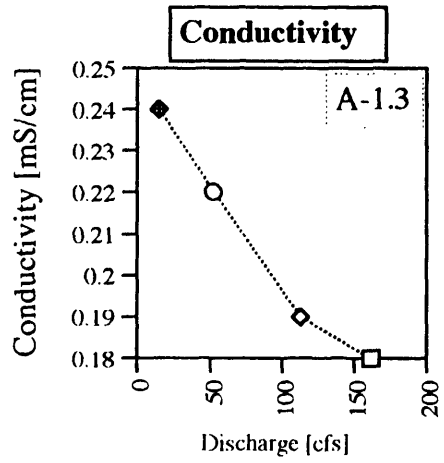
Graphs of discharge versus constituent concentration for Copper Creek and Landers Fork sites.

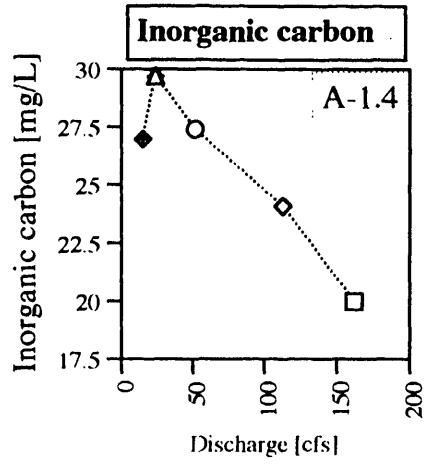
Appendix A-1

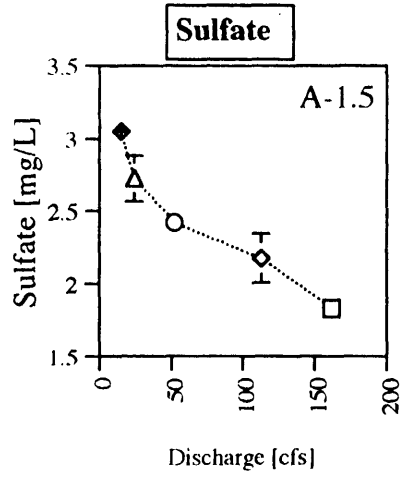
COPPER CREEK, SITE "C"

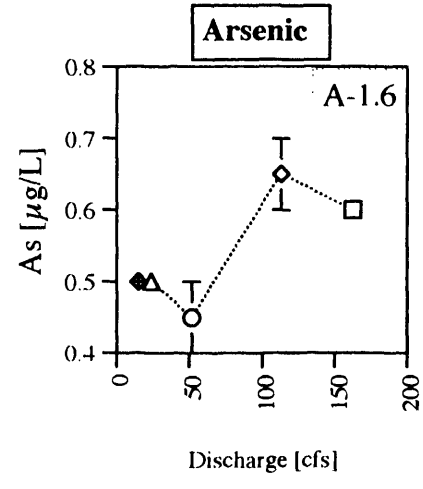


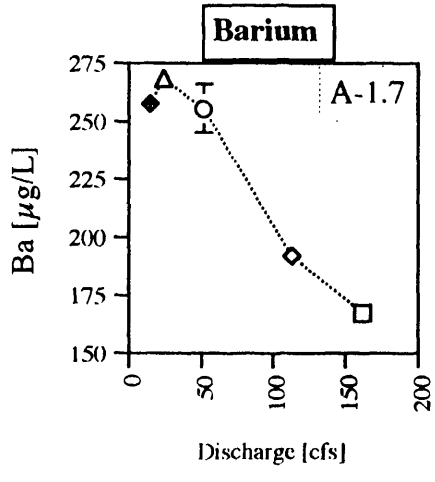


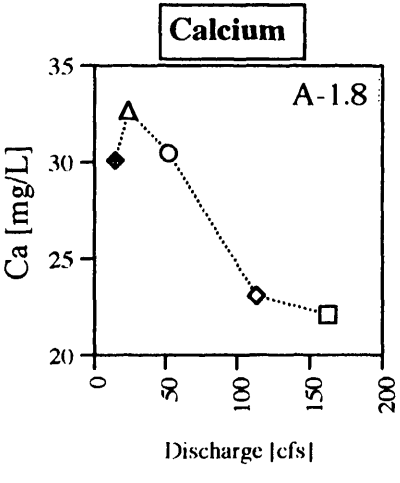












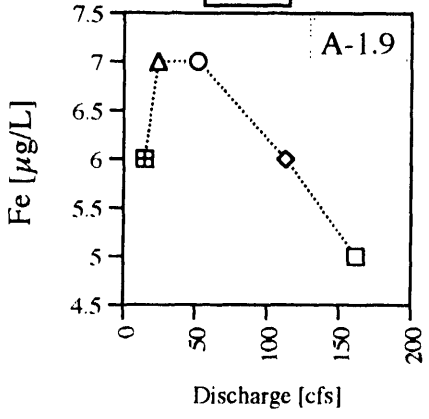
Legend: sample dates

□	7/3/97	△	9/13/97
◇	7/20/97	◆	1/6/98
○	8/7/97		

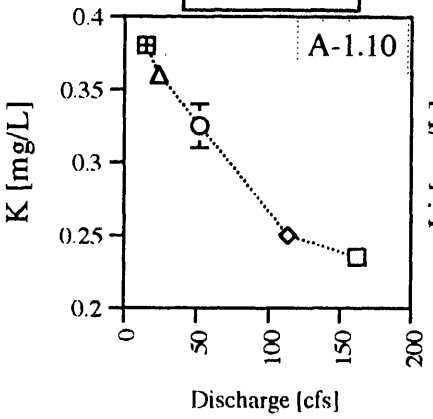
COPPER CREEK, SITE "C"

Appendix A-1

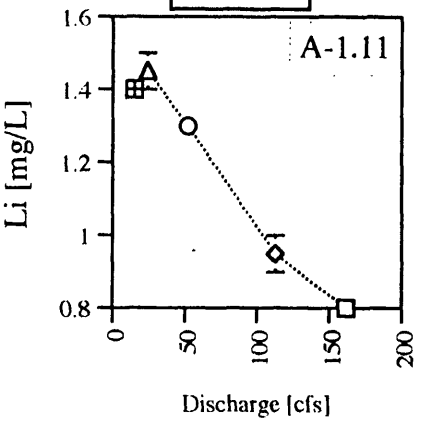
Iron



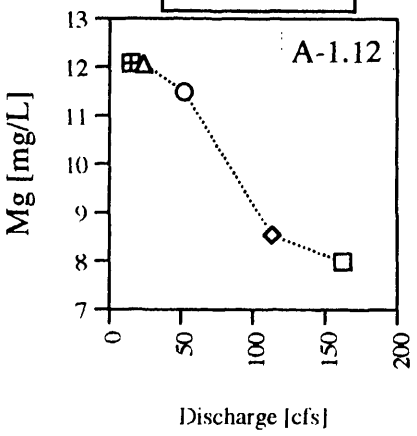
Potassium



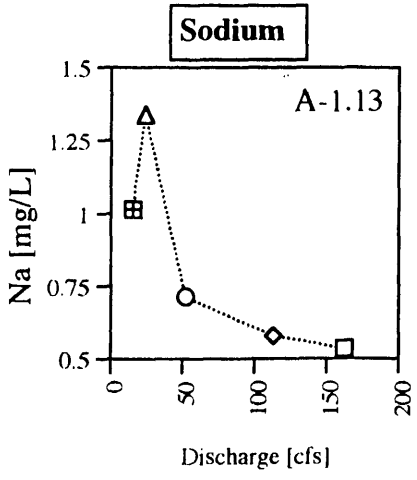
Lithium



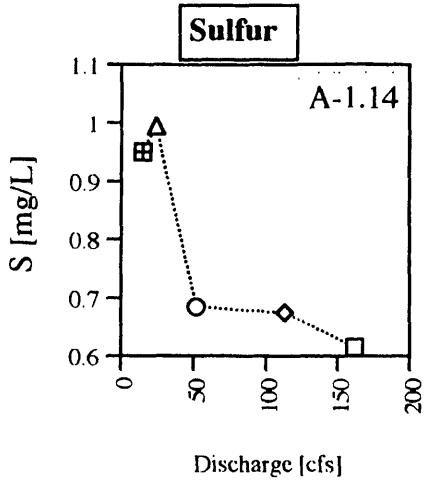
Magnesium



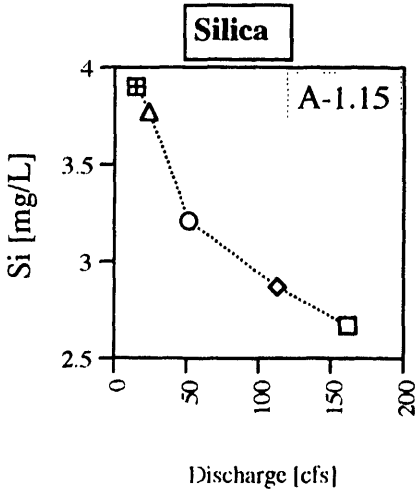
Sodium



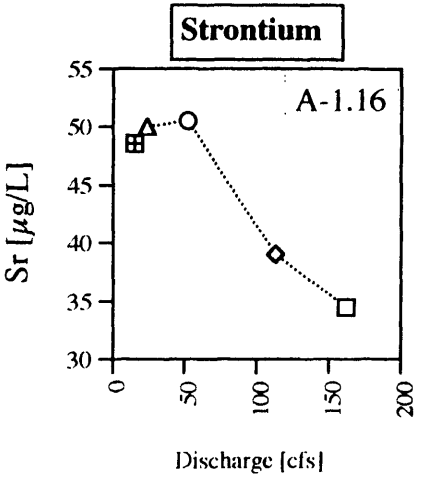
Sulfur



Silica



Strontium

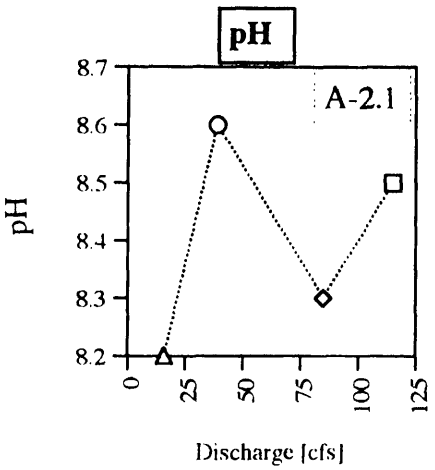


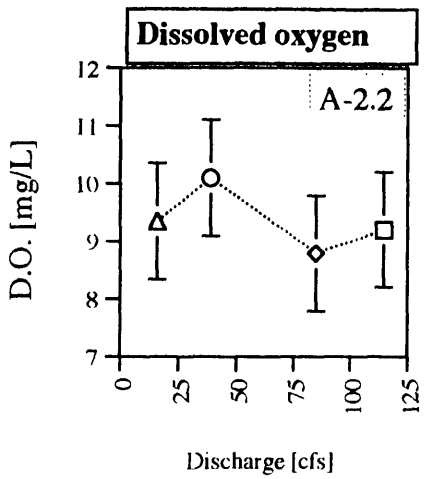
Legend: Sample dates

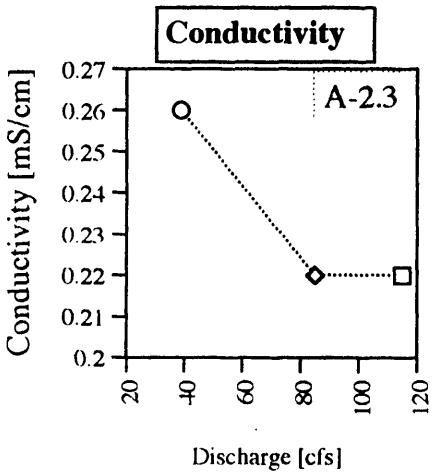
□	7/3/97	△	9/13/97
◇	7/20/97	⊞	1/6/97
○	8/7/97		

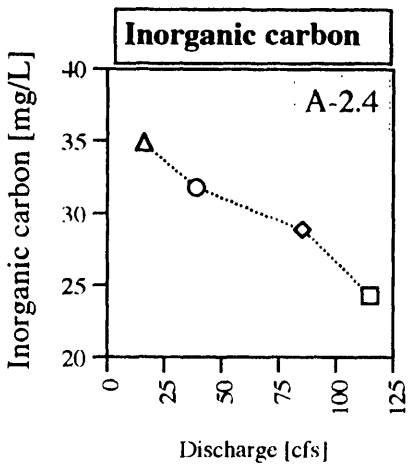
Appendix A-2

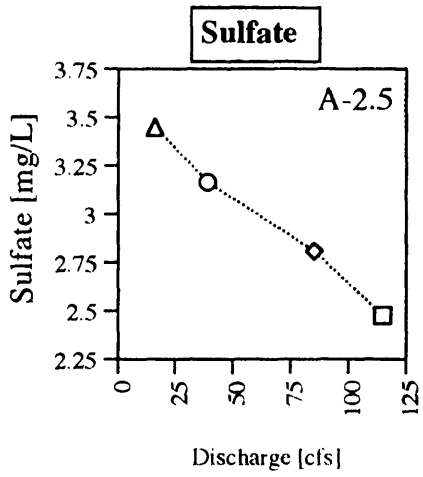
LANDERS FORK, SITE "LA"

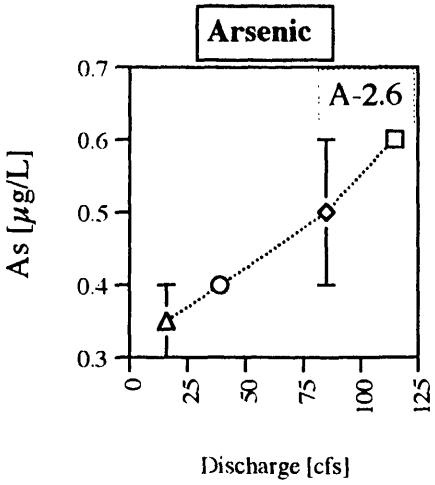


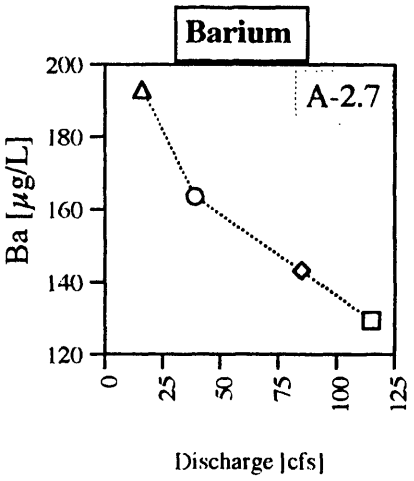


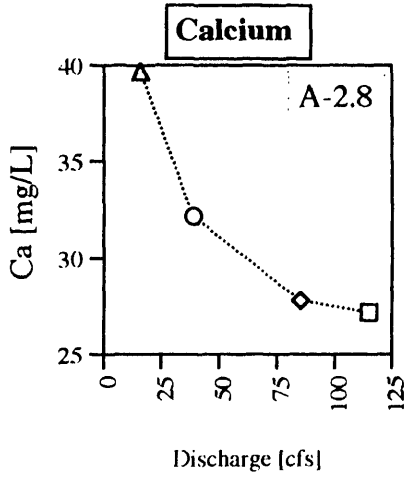










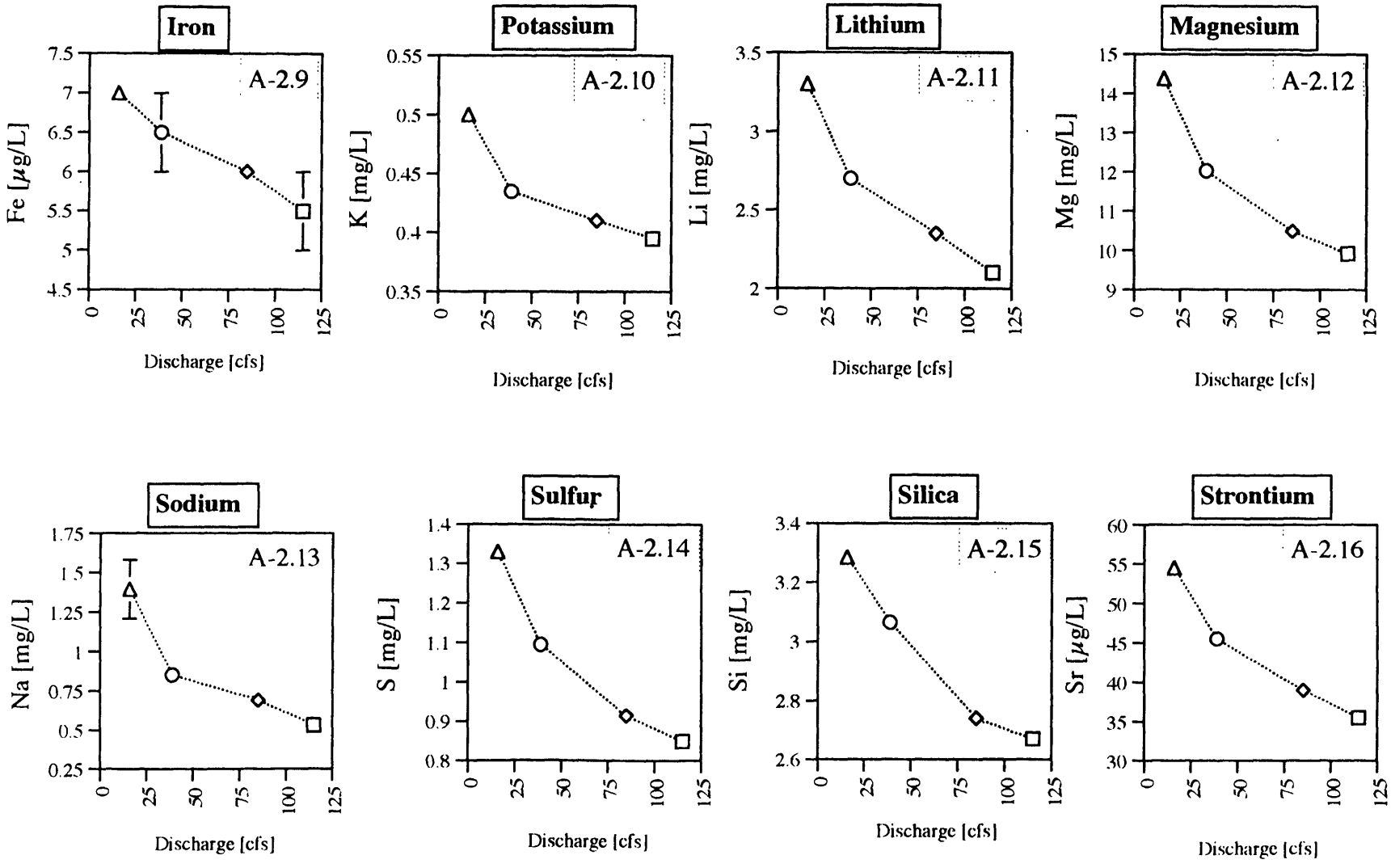


Legend: sample dates

□	7/3/97	○	8/7/97
◇	7/20/97	△	9/13/97

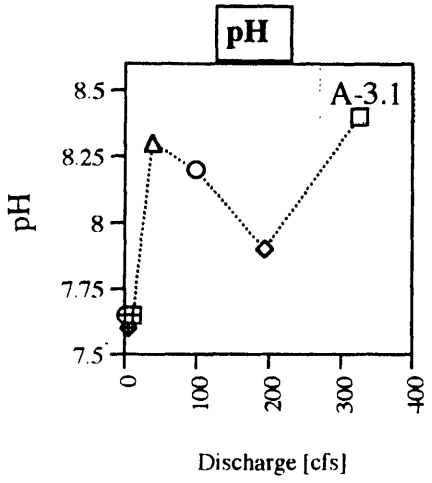
LANDERS FORK, SITE "LA"

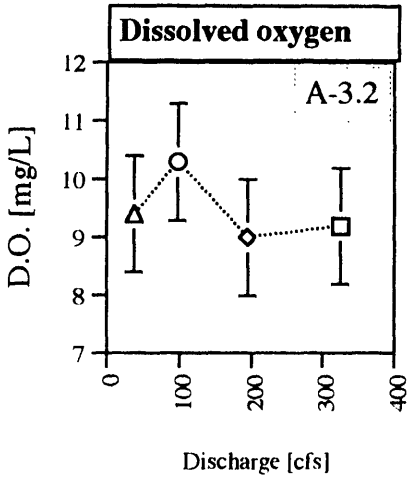
Appendix A-2

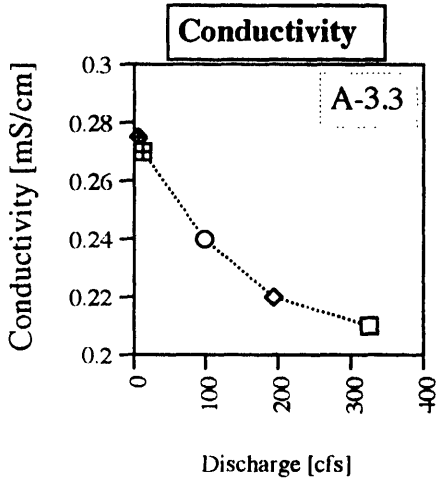


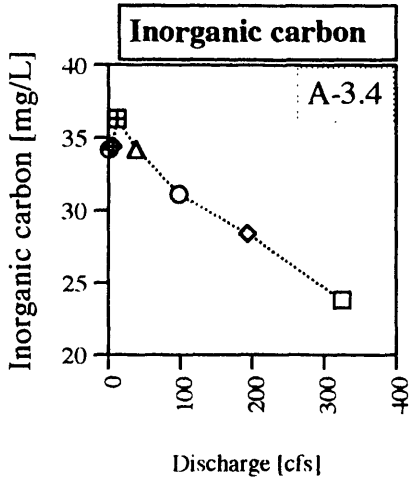
Appendix A-3

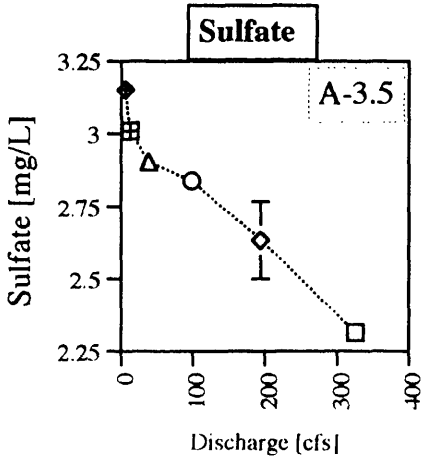
LANDERS FORK, SITE "LB"

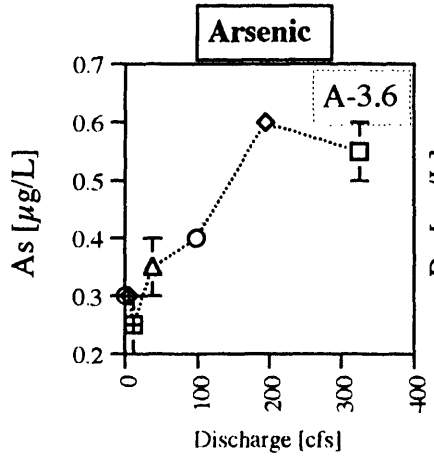


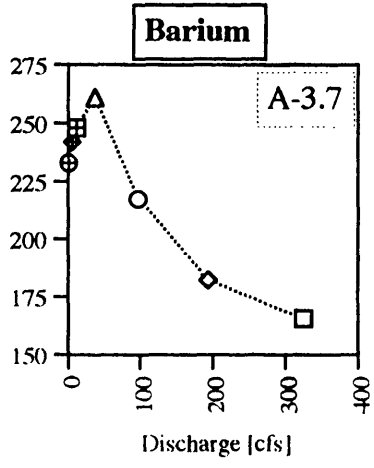


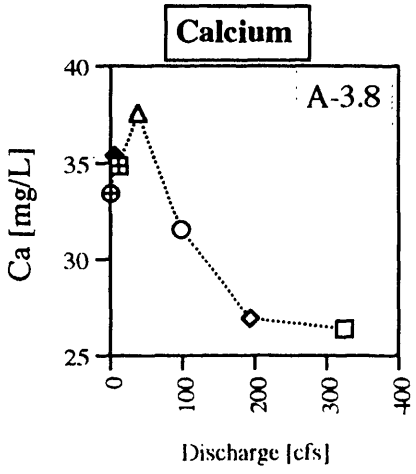










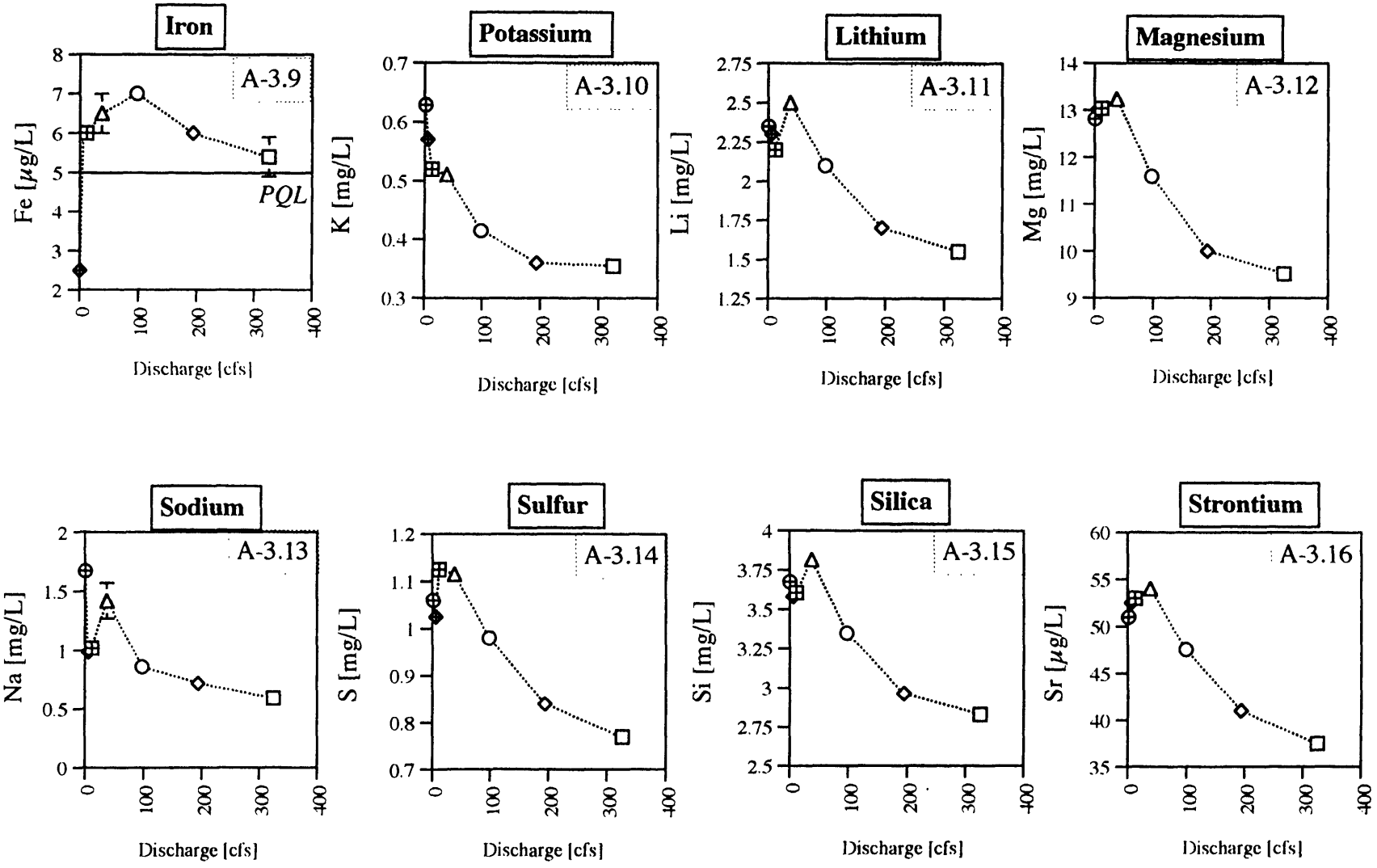


Legend: sample dates

□	7/3/97	△	9/13/97	⊕	3/8/97
◇	7/20/97	⊞	11/16/97		
○	8/7/97	◆	1/6/97		

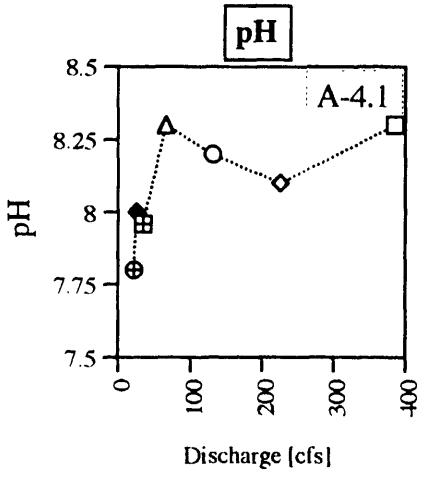
Appendix A-3

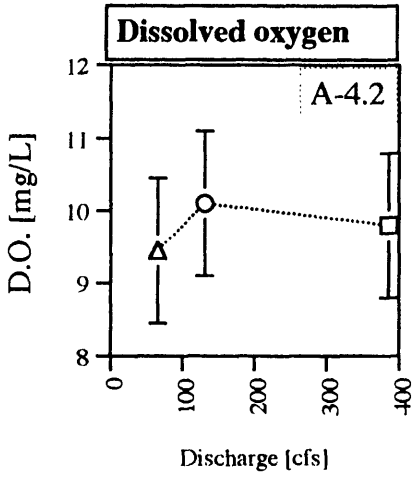
LANDERS FORK, SITE "LB"

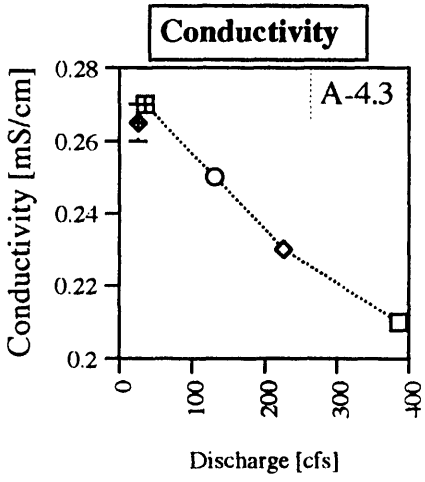


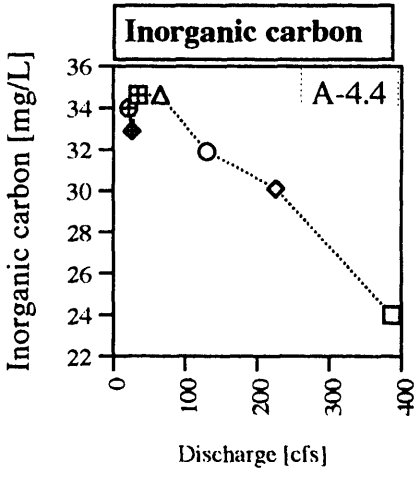
Appendix A-4

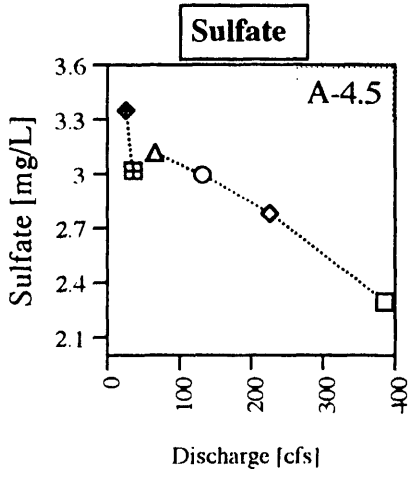
LANDERS FORK, SITE "LC"

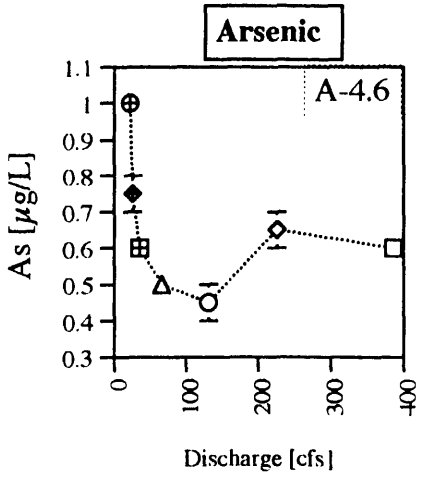


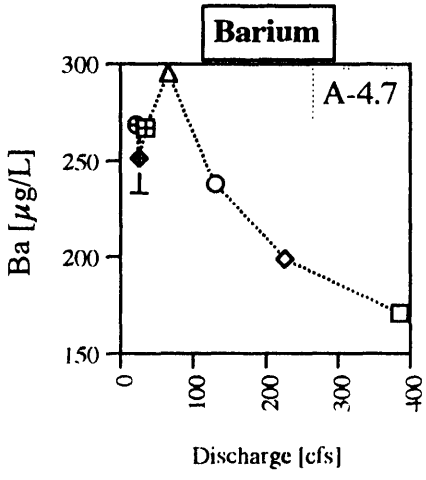


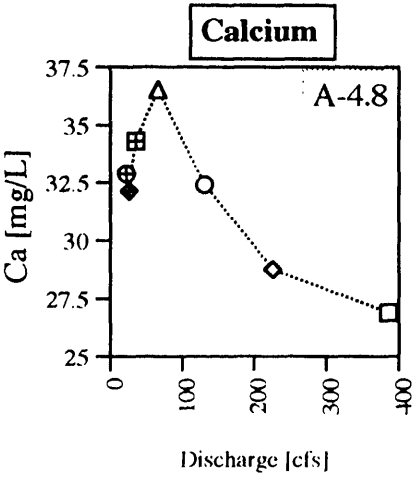


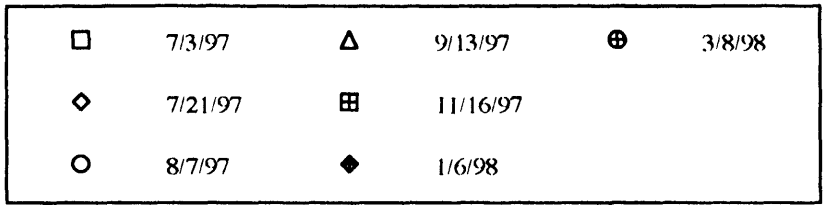






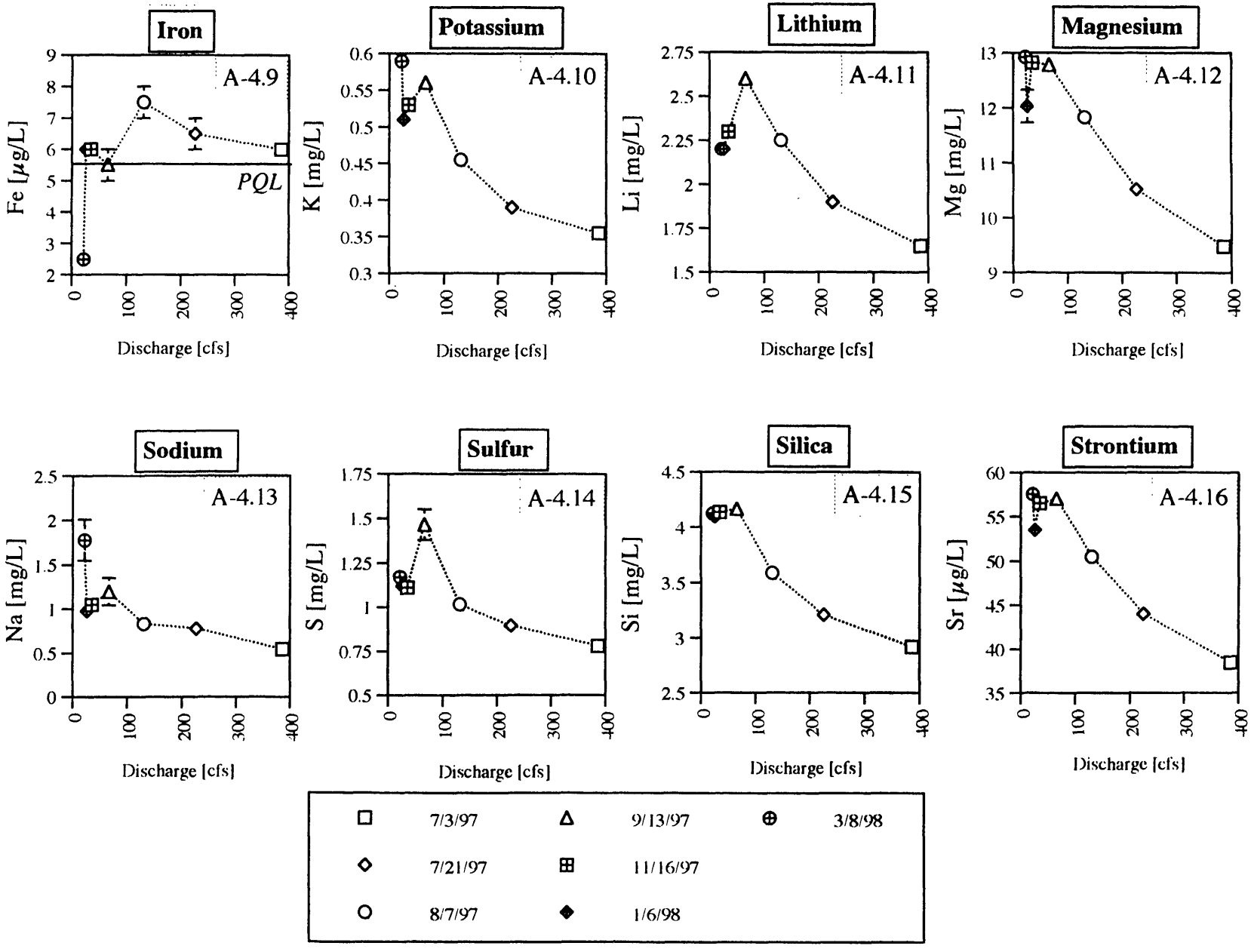






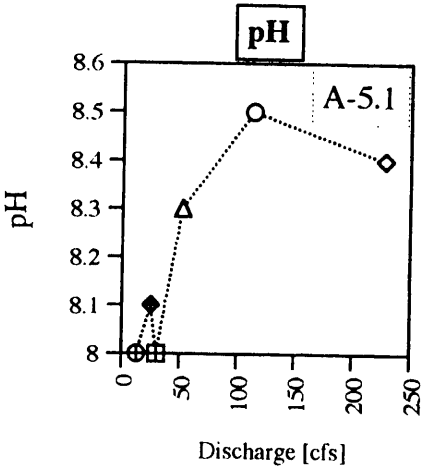
LANDERS FORK, SITE "LC"

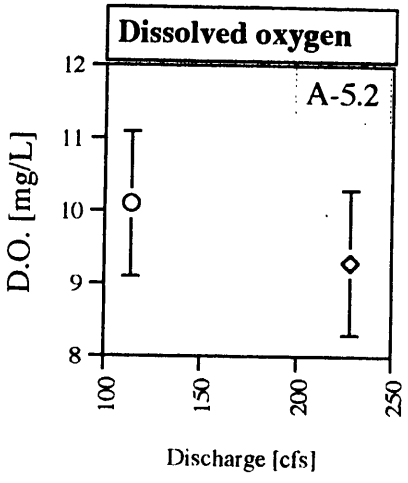
Appendix A-4

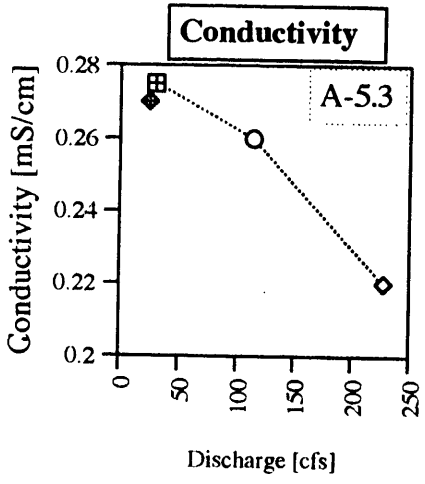


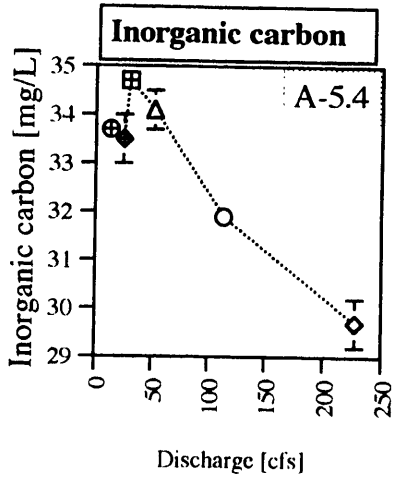
Appendix A-5

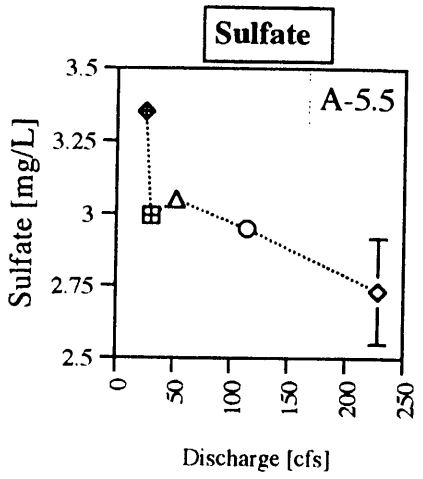
LANDERS FORK, SITE "LD"

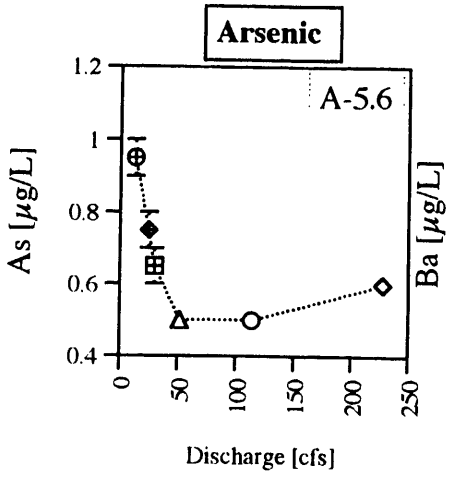


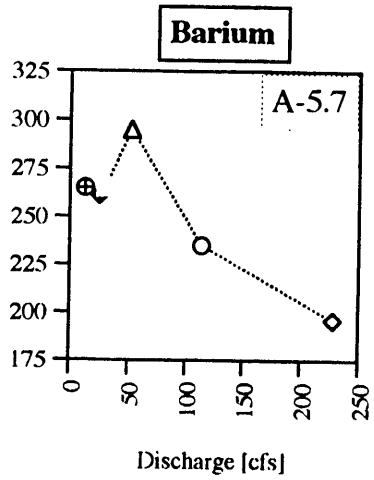


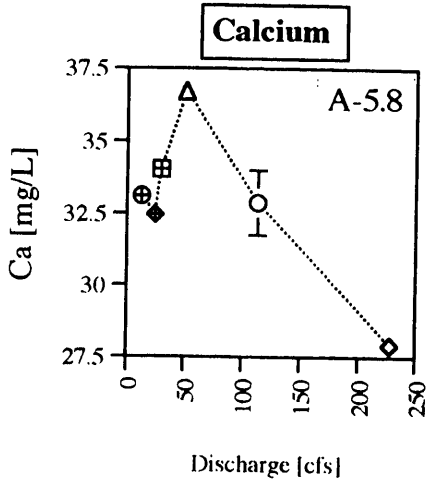










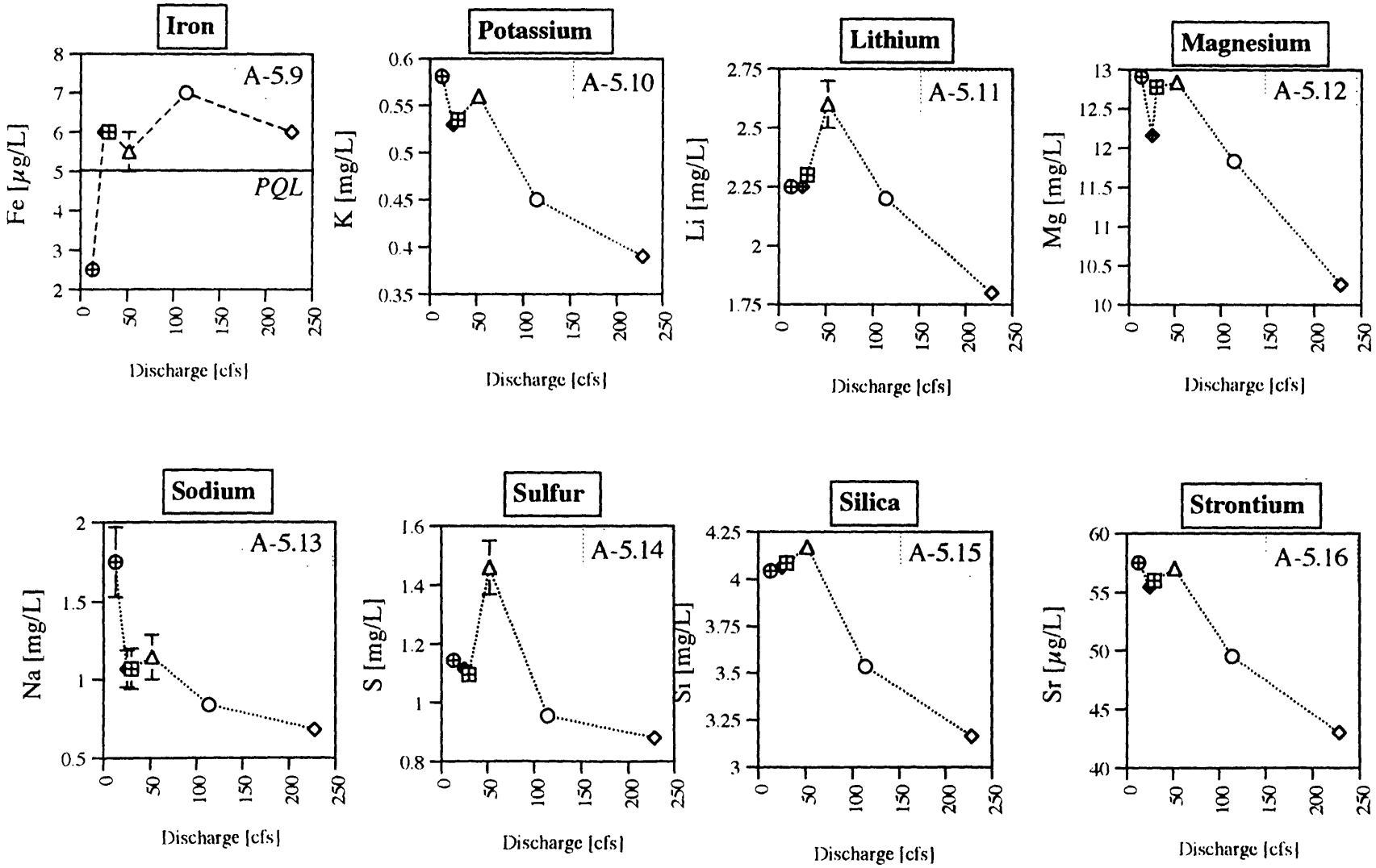


◇ 7/20/97 △ 9/13/97 ◆ 1/6/98

○ 8/7/97 ⊞ 11/16/97 ⊕ 3/8/98

LANDERS FORK, SITE "LD"

Appendix A-5

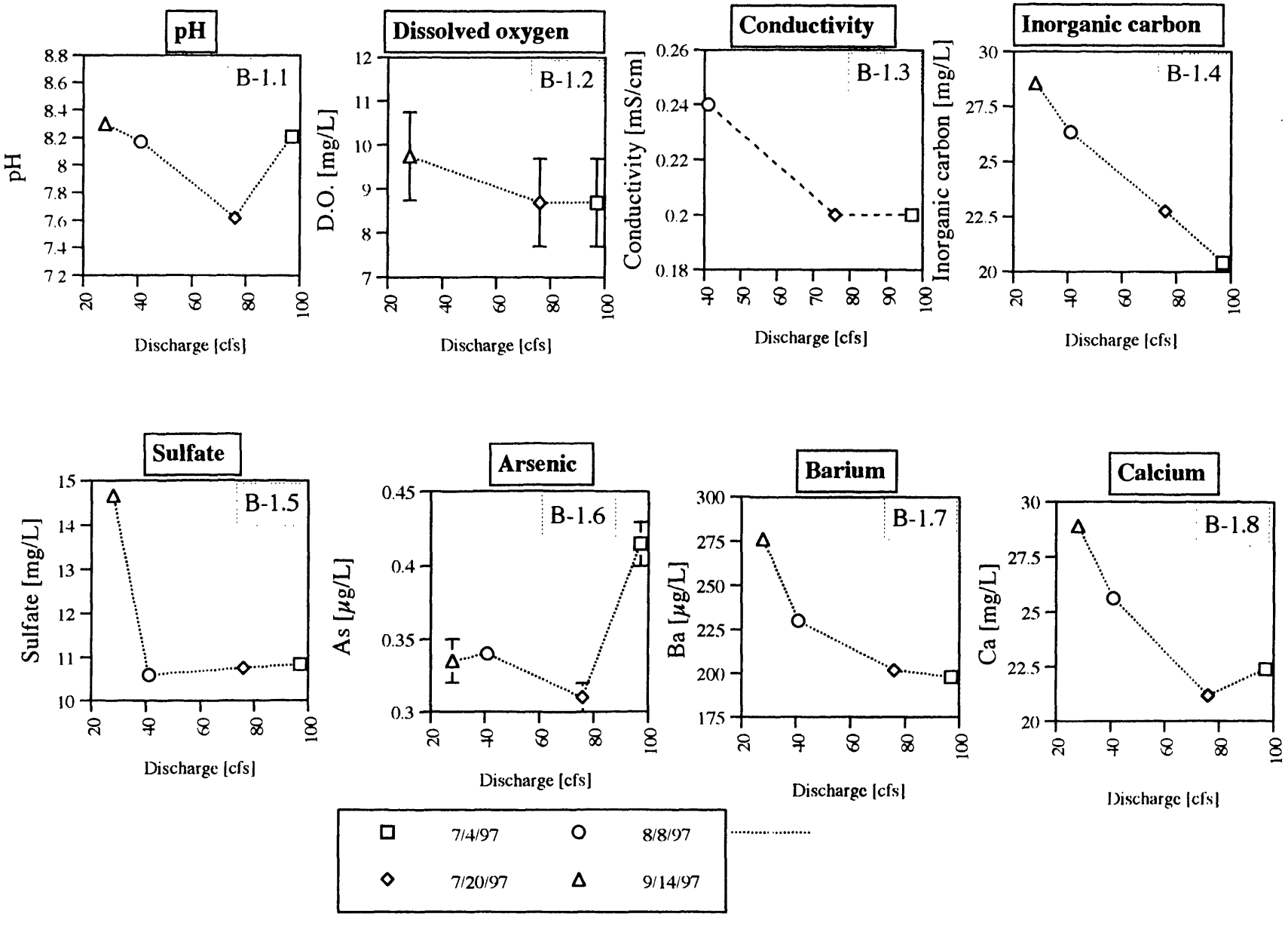


Appendix B.

Graphs of discharge versus constituent concentration for Hogum Creek and Blackfoot River sites.

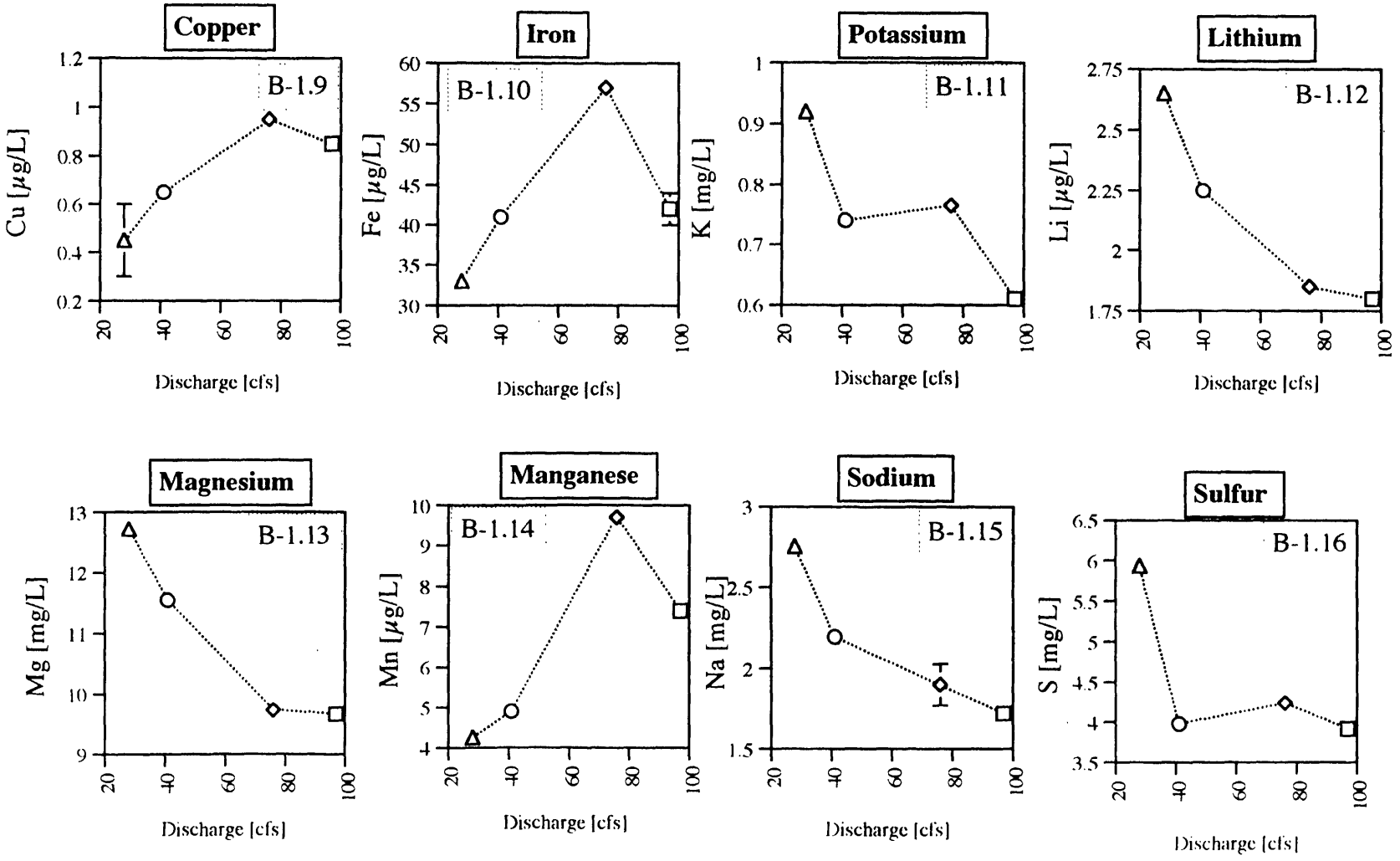
Appendix B-1

BLACKFOOT RIVER, SITE "BA"



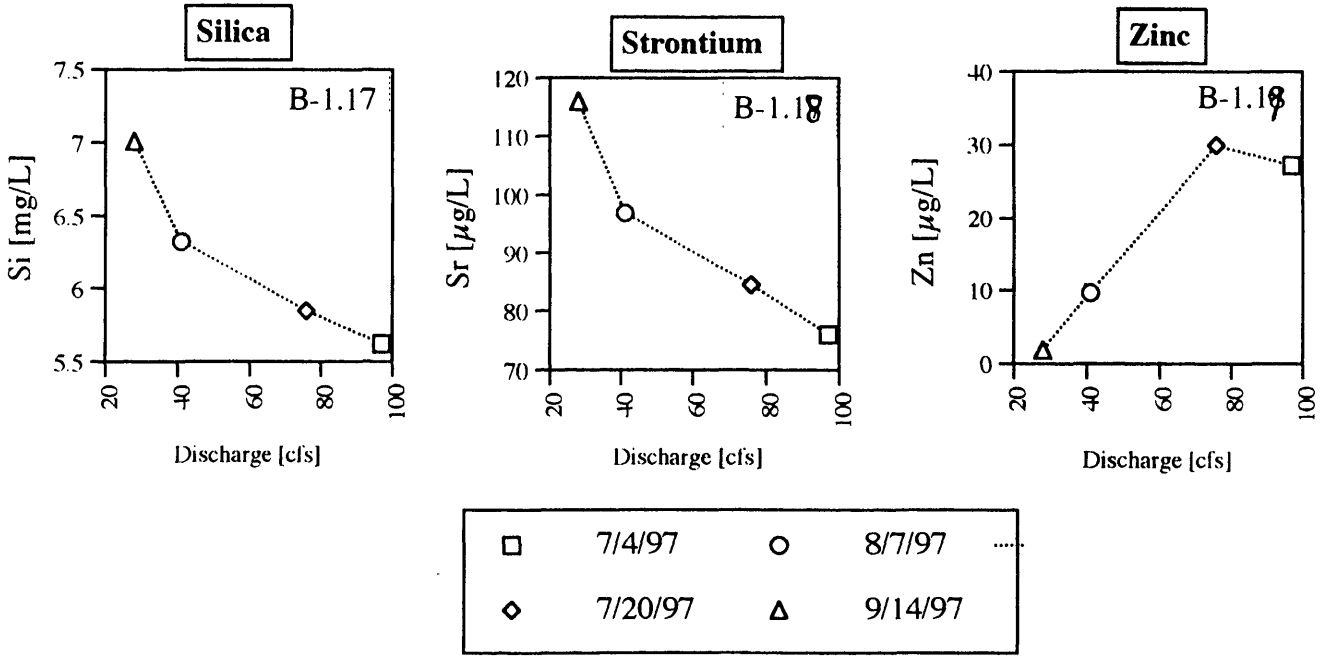
Appendix B-1

BLACKFOOT RIVER, SITE "BA"



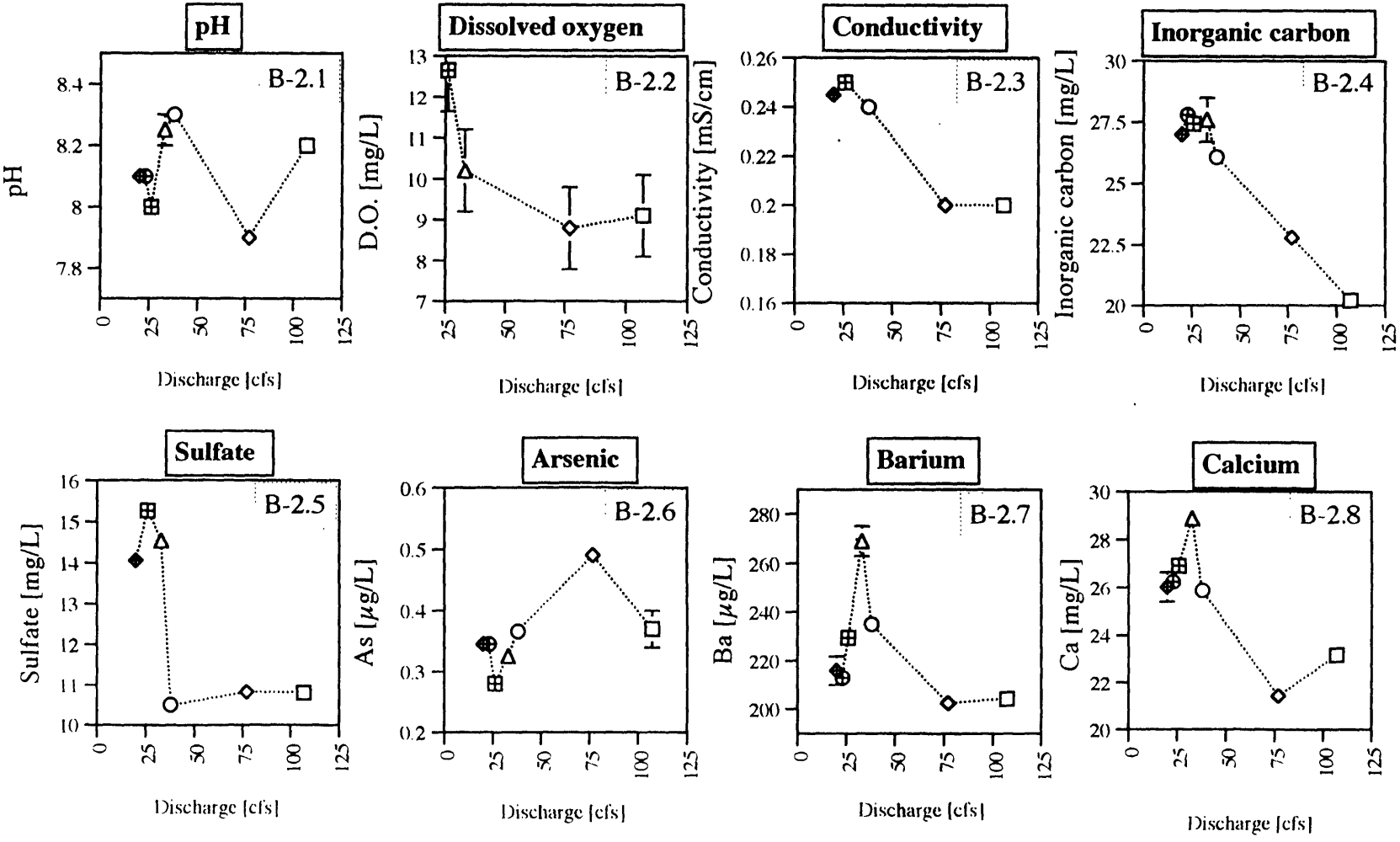
Appendix B-1

BLACKFOOT RIVER, SITE "BA"



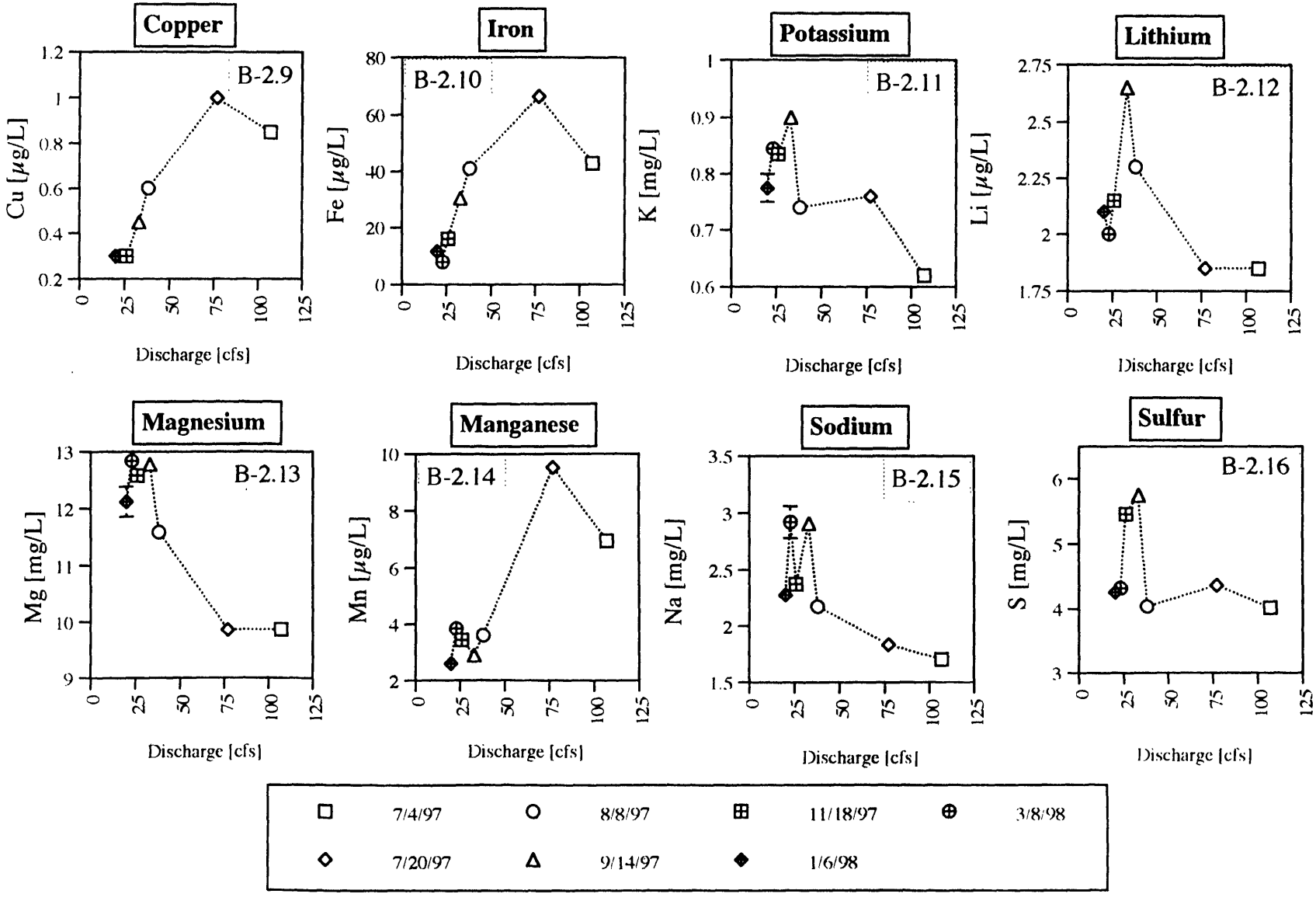
Appendix B-2

BLACKFOOT RIVER, SITE "BH"



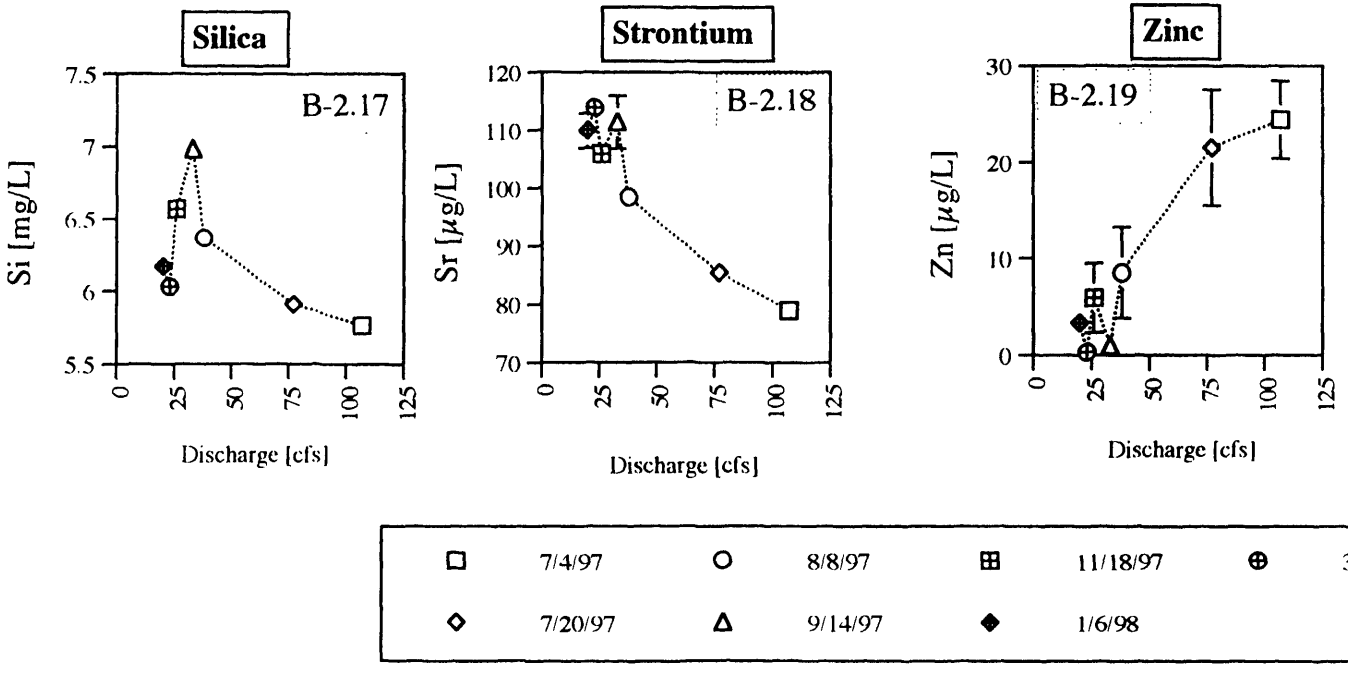
Appendix B-2

BLACKFOOT RIVER, SITE "BH"



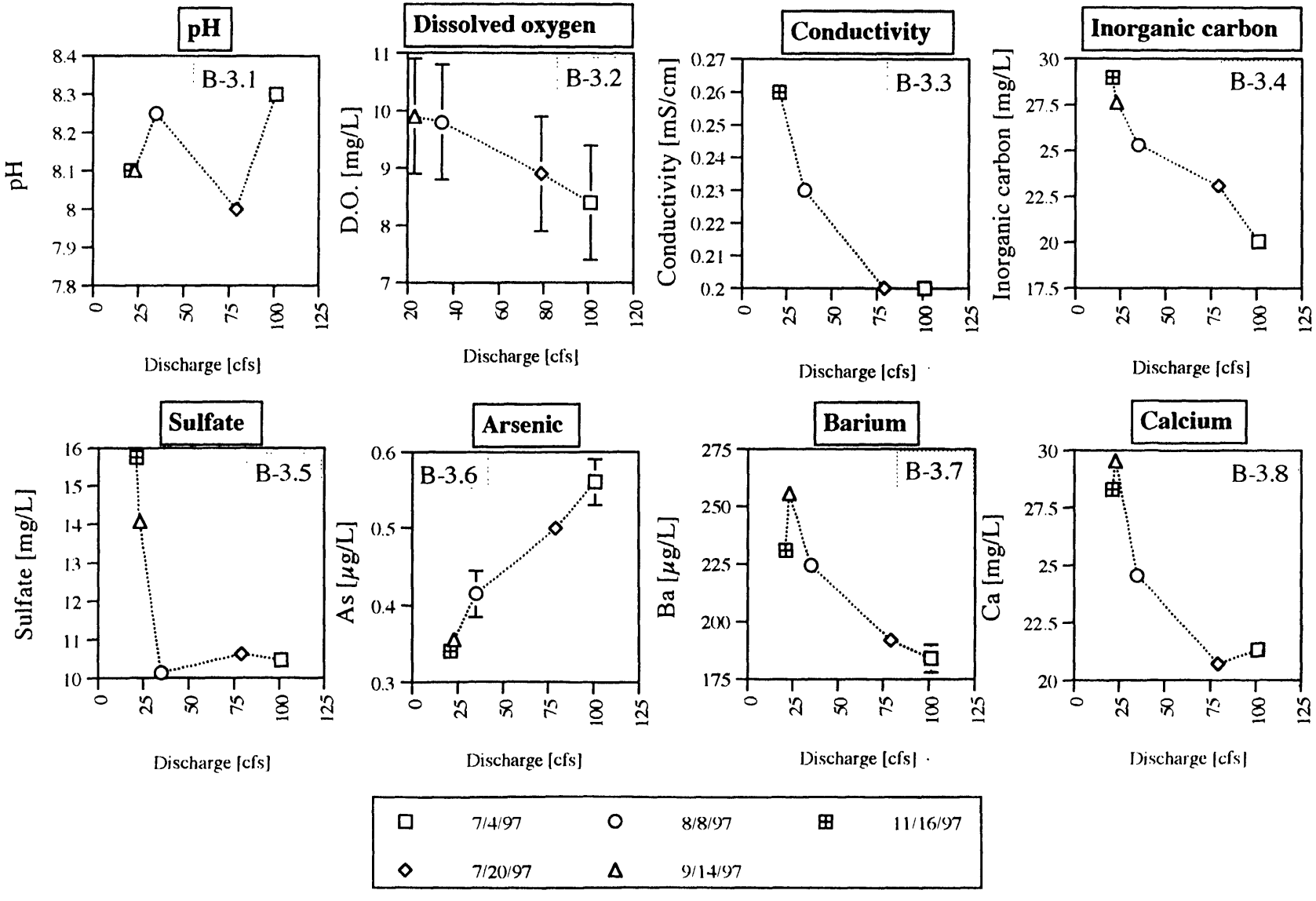
Appendix B-2

BLACKFOOT RIVER, SITE "BH"



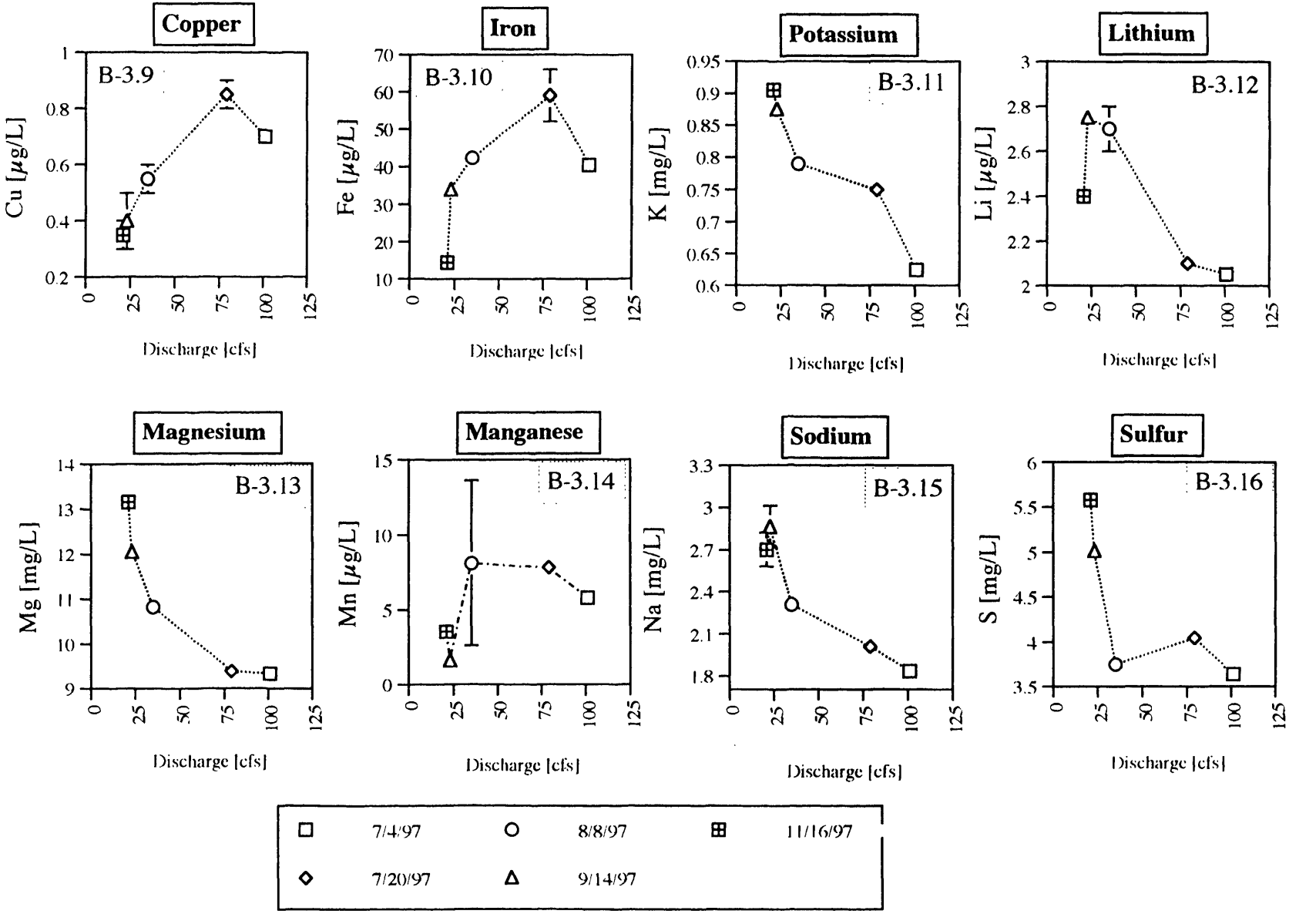
Appendix B-3

BLACKFOOT RIVER, SITE "BB"



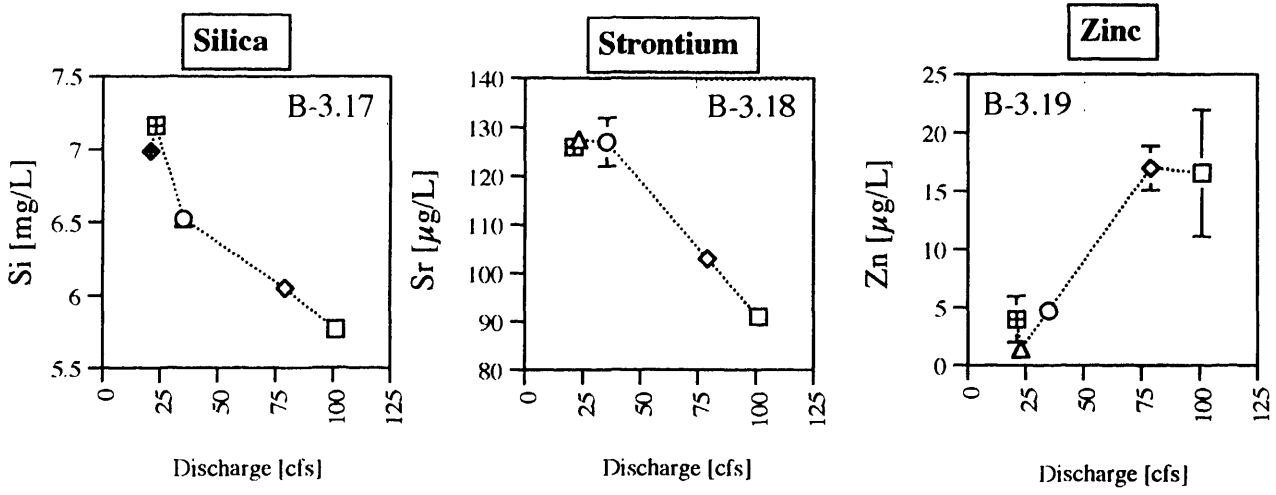
Appendix B-3

BLACKFOOT RIVER, SITE "BB"



Appendix B-3

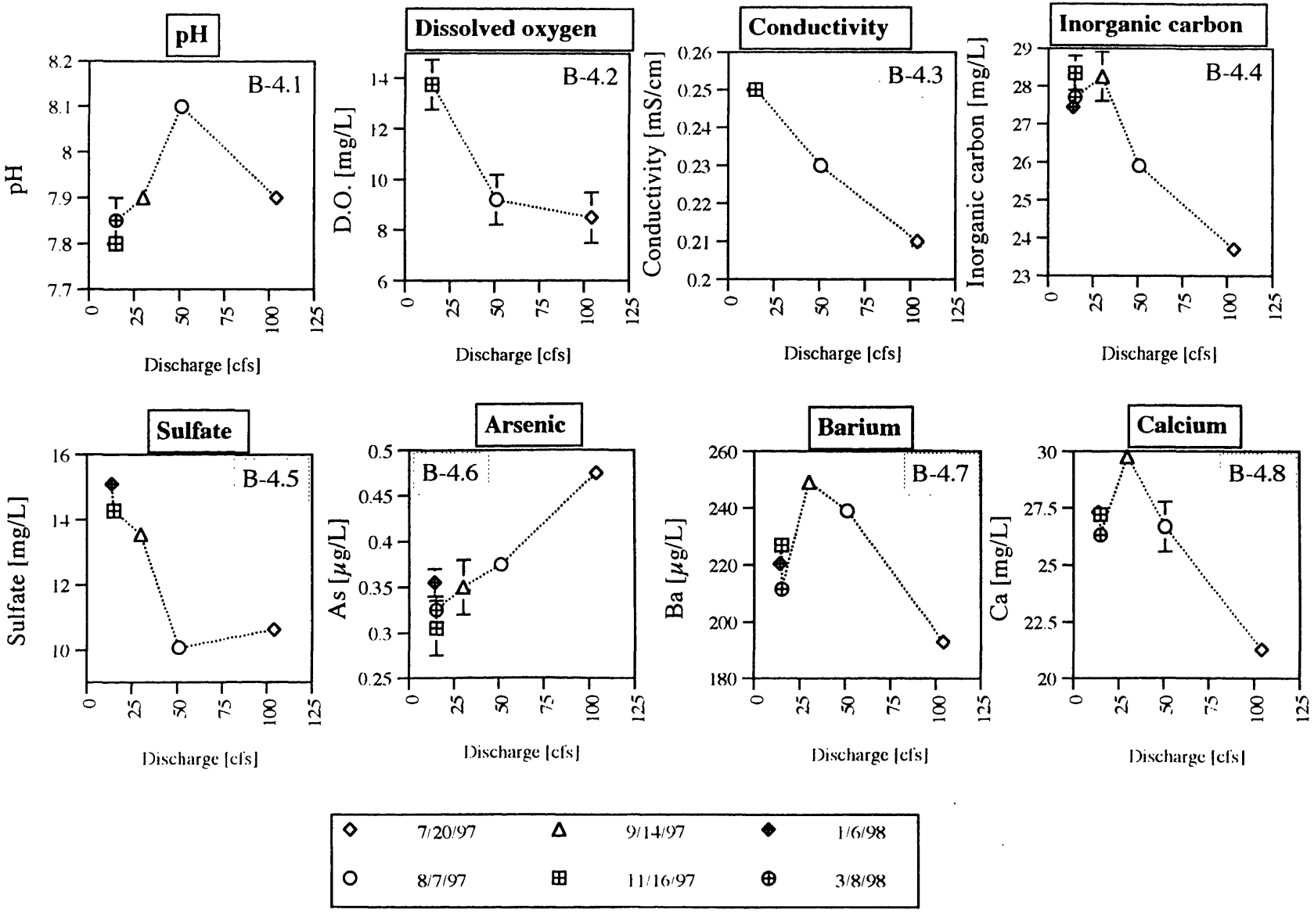
BLACKFOOT RIVER, SITE "BB"



□	7/4/97	○	8/8/97	⊞	11/16/97
◇	7/20/97	△	9/14/97		

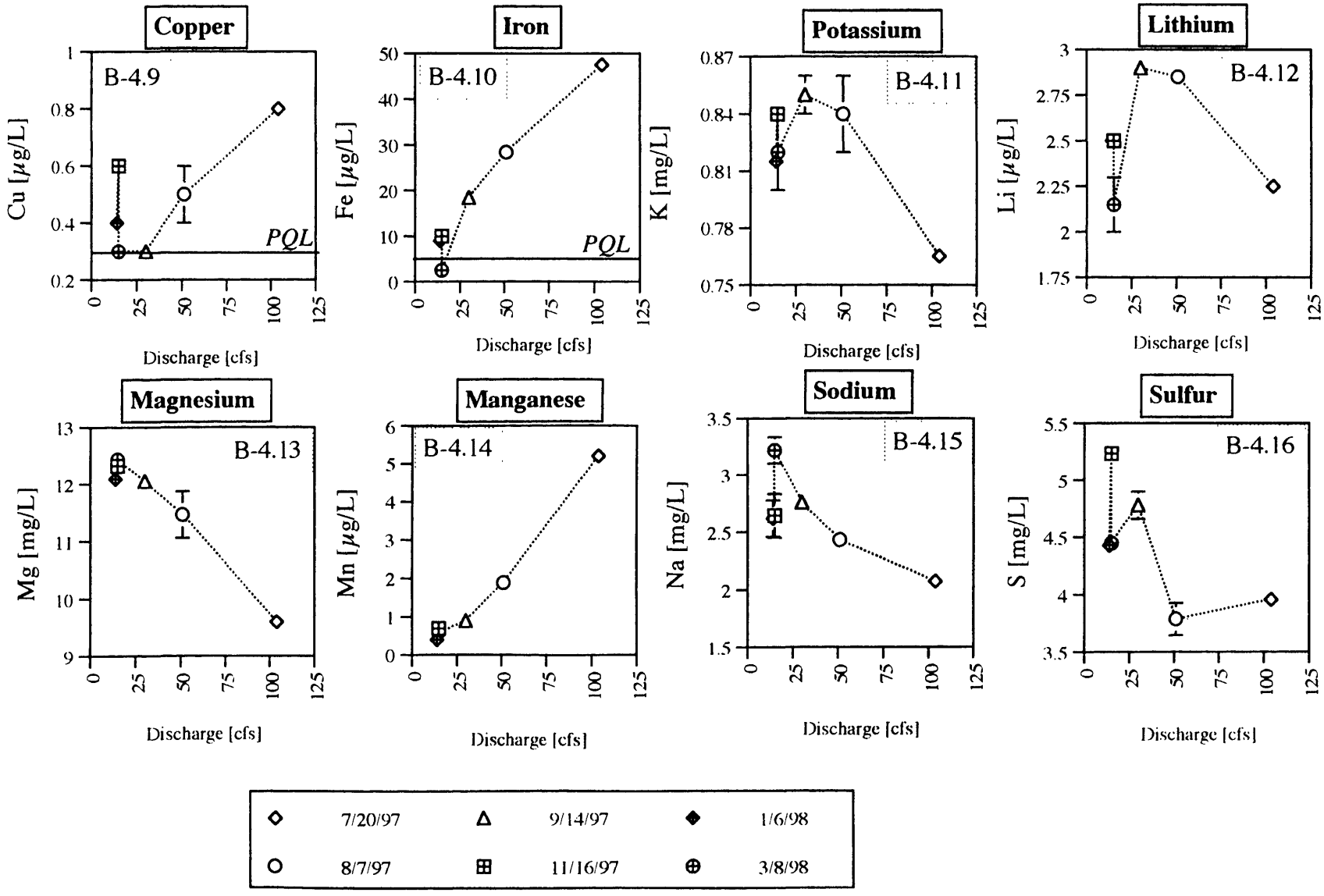
Appendix B-4

BLACKFOOT RIVER, SITE "BC"



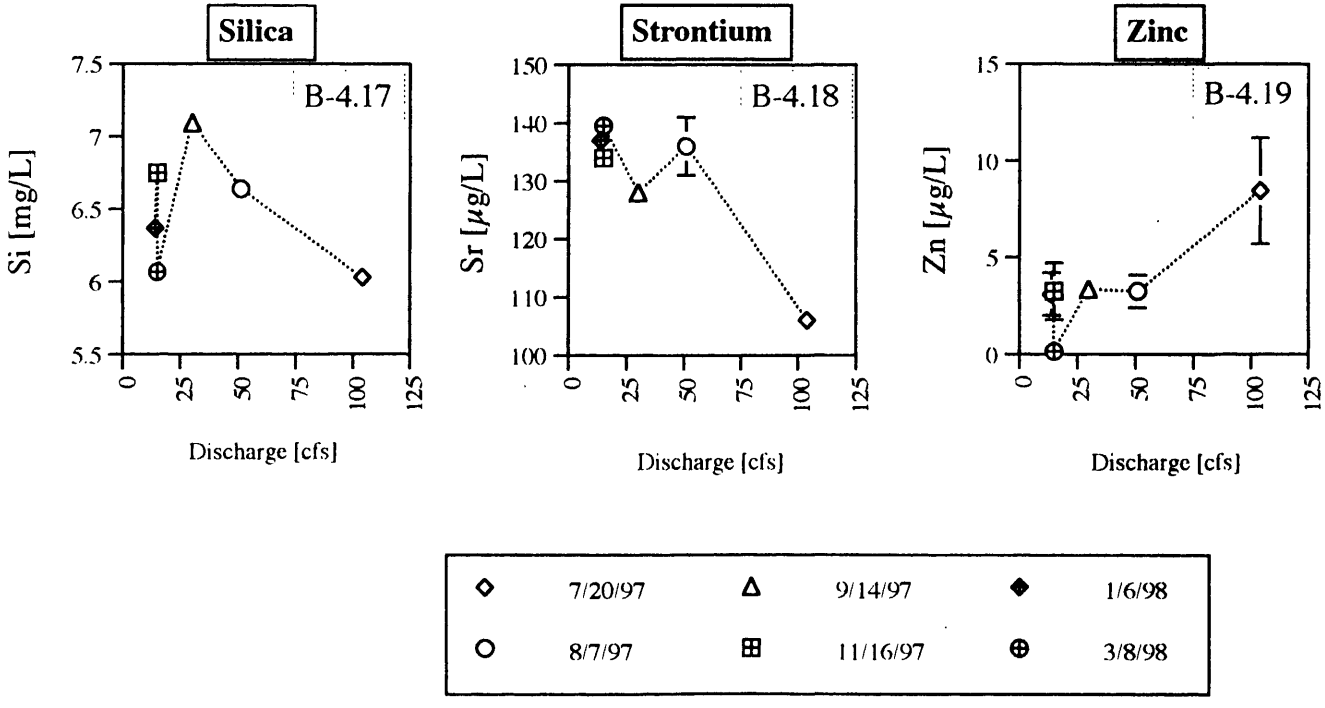
Appendix B-4

BLACKFOOT RIVER, SITE "BC"



Appendix B-4

BLACKFOOT RIVER, SITE "BC"



Appendix C.

Field measurements and chemical analysis of all surface water samples. Each page contains a list measurement results for a set of triplicate surface water samples taken at a specified site and specified date.

COPPER CREEK-AT FISHING ACCESS
SITE "C", ON 7/3/97

C-1.1

Sample name Sample date, approx. time		C-1 7/3/97, 13:50	C-2 7/3/97, 13:50	C-3 7/3/97, 13:50	Mean	Std. Dev.
	Units					
pH	pH scale	8.4	8.4	8.4	8.4	0.0
Diss. oxygen	mg/L	9.8	9.8	9.8	9.8	0.0
Spec. Cond.	mS/cm	0.18	0.18	0.18	0.18	0.00
Water temp.	deg. C	10.1	10.1	10.1	10.1	0.0
Air temp	deg. C	20.9	20.9	20.9	20.9	0.0
Inorganic carbon	mg/L	19.9	19.9	20.0	19.9	0.0
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	1.85	1.81	1.85	1.84	0.02
As	µg/L	0.6	0.6	0.6	0.6	0.0
Ba	µg/L	164	171	164	166	4
Ca	mg/L	21.70	22.55	21.80	22.02	0.46
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	5	5	5	5	0
K	mg/L	0.2	0.2	0.2	0.2	0.0
Li	µg/L	0.8	0.8	0.8	0.8	0.0
Mg	mg/L	7.89	8.10	7.89	7.96	0.12
Mn	µg/L	0.5	0.6	0.6	0.6	0.0
Na	mg/L	0.52	0.50	0.57	0.53	0.03
S	mg/L	0.60	0.63	0.61	0.61	0.01
Si	mg/L	2.62	2.73	2.61	2.65	0.07
Sr	µg/L	34	35	34	34	1
Zn	µg/L	*(<0.2)*	*(<0.2)*	0.9	0.4	0.5

COPPER CREEK-AT FISHING ACCESS
SITE "C", ON 7/20/97

C-1.2

Sample name Sample date, approx. time		C-1 7/20/97, 19:00	C-2 7/20/97, 19:00	C-3 7/20/97, 19:00	Mean	Std. Dev.
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	9.7	9.7	9.7	9.7	0.0
Spec. Cond.	mS/cm	0.19	0.19	0.19	0.2	0.0
Water temp.	deg. C	9.0	9.0	9.0	9.0	0.0
Air temp	deg. C	14.3	14.3	14.3	14.3	0.0
Inorganic carbon	mg/L	23.9	24.2	24.0	24.0	0.2
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Fluoride	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.05	2.34	2.01	2.13	0.18
As	µg/L	0.6	0.7	0.7	0.7	0.0
Ba	µg/L	193	191	191	192	1
Ca	mg/L	23.07	23.15	23.10	23.11	0.04
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.4	0.3	0.3	0.3	0.0
Fe	µg/L	6	6	6	6	0
K	mg/L	0.25	0.25	0.25	0.25	0.00
Li	µg/L	0.9	1.0	0.9	0.9	0.0
Mg	mg/L	8.56	8.56	8.53	8.55	0.02
Mn	µg/L	0.5	0.5	0.5	0.5	0.0
Na	mg/L	0.63	0.58	0.53	0.58	0.05
S	mg/L	0.69	0.67	0.66	0.67	0.01
Si	mg/L	2.88	2.86	2.86	2.87	0.01
Sr	µg/L	39	39	39	39	0
Zn	µg/L	*<0.2*	*<0.2*	*<0.2*	*<0.2*	*<0.2*

COPPER CREEK-AT FISHING ACCESS
SITE "C", ON 8/7/97

C-1.3

Sample name		C-1	C-2	C-3	Mean	Std. Dev.
Sample date, approx. time		8/7/97, 09:30	8/7/97, 09:30	8/7/97, 09:30		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	11.5	11.5	11.5	11.5	0.0
Spec. Cond.	mS/cm	0.22	0.22	0.22	0.22	0.00
Water temp.	deg. C	8.1	8.1	8.1	8.1	0.0
Air temp	deg. C	19.1	19.1	19.1	19.1	0.0
Inorganic carbon	mg/L	27.0	27.0	27.8	27.2	0.5
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.38	2.43	2.46	2.42	0.04
As	µg/L	0.5	0.5	0.4	0.5	0.0
Ba	µg/L	245	256	266	256	11
Ca	mg/L	29.65	30.93	31.28	30.62	0.86
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	7	7	7	7	0
K	mg/L	0.31	0.32	0.34	0.32	0.02
Li	µg/L	1.3	1.3	1.3	1.3	0.0
Mg	mg/L	11.19	11.64	11.80	11.54	0.32
Mn	µg/L	0.4	0.4	0.5	0.4	0.0
Na	mg/L	0.64	0.79	0.72	0.71	0.08
S	mg/L	0.70	0.67	0.67	0.68	0.02
Si	mg/L	3.22	3.20	3.21	3.21	0.01
Sr	µg/L	49	51	52	51	2
Zn	µg/L	1.2	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

COPPER CREEK-AT FISHING ACCESS
SITE "C", ON 9/13/97

C-1.4

Sample name		C-1	C-2	C-3	Mean	Std. Dev.
Sample date, approx. time		9/13/97, 11:00	9/13/97, 11:00	9/13/97, 11:00		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	10.5	10.6	10.5	10.5	0.1
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	6.6	6.6	6.6	6.6	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	29.9	29.7	29.5	29.7	0.2
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.77	2.88	2.57	2.74	0.16
As	µg/L	0.5	0.5	0.5	0.5	0.0
Ba	µg/L	270	269	267	269	2
Ca	mg/L	32.4	32.97	32.80	32.72	0.29
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	7.2	7	7	7	0
K	mg/L	0.36	0.36	0.36	0.36	0.00
Li	µg/L	1.4	1.5	1.4	1.4	0.0
Mg	mg/L	11.9	12.22	12.18	12.09	0.19
Mn	µg/L	0.3	0.3	0.3	0.3	0.0
Na	mg/L	1.4	1.23	1.45	1.34	0.11
S	mg/L	1.01	0.98	1.00	1.00	0.02
Si	mg/L	3.81	3.80	3.73	3.78	0.05
Sr	µg/L	49	51	51	51	1
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

APPENDIX C-1

COPPER CREEK-AT FISHING ACCESS
SITE "C", ON 1/6/98

C-1.5

Sample name		C-1	C-2	C-3	Mean	Std. Dev.
Sample date, approx. time		1/6/98, 08:30	1/6/98, 08:30	1/6/98, 08:30		
	Units					
pH	pH scale	8.1	8.1	8.1	8.1	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	0.24	0.24	0.24	0.2	0.0
Water temp.	deg. C	0.1	0.1	0.1	0.1	0.0
Air temp	deg. C	-4.7	-4.7	-4.7	-4.7	0.0
Inorganic carbon	mg/L	27.3	26.7	26.7	26.9	0.3
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.0	3.1	3.0	3.0	0.1
As	µg/L	0.5	0.5	0.5	0.5	0.0
Ba	µg/L	260	258	255	258	2
Ca	mg/L	30.45	30.48	29.65	30.19	0.47
Cr	µg/L	1.2	1.1	1.2	1.2	0.0
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	6	0
K	mg/L	0.38	0.38	0.38	0.38	0.00
Li	µg/L	1.4	1.4	1.4	1.4	0.0
Mg	mg/L	12.15	12.17	11.98	12.10	0.10
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	1.02	0.99	1.04	1.01	0.02
S	mg/L	0.96	0.94	0.96	0.95	0.01
Si	mg/L	3.94	3.93	3.86	3.91	0.04
Sr	µg/L	49	49	48	49	1
Zn	µg/L	0.2	0.7	1.7	0.9	0.7

LANDER'S FORK
SITE "LA", ON 7/3/97

C-2.1

Sample name		LA-1	LA-2	LA-3	Mean	Std. Dev.
Sample date, approx. time		7/3/97, 20:00	7/3/97, 20:00	7/3/97, 20:00		
	Units					
pH	pH scale	8.5	8.5	8.5	8.5	0.0
Diss. oxygen	mg/L	9.2	9.2	9.2	9.2	0.0
Spec. Cond.	mS/cm	0.22	0.22	0.22	0.22	0.00
Water temp.	deg. C	11.1	11.1	11.1	11.1	0.0
Air temp	deg. C	11.0	11.0	11.0	11.0	0.0
Inorganic carbon	mg/L	24.2	24.3	24.3	24.3	0.1
Organic carbon	mg/L	*(<1)*	1.3	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.47	2.49	2.46	2.47	0.01
As	µg/L	0.6	0.6	0.6	0.6	0.0
Ba	µg/L	131	132	127	130	2
Ca	mg/L	27.33	27.69	26.68	27.23	0.51
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	5	6	0
K	mg/L	0.40	0.40	0.39	0.40	0.01
Li	µg/L	2.1	2.1	2.1	2.1	0.0
Mg	mg/L	9.95	10.07	9.78	9.93	0.15
Mn	µg/L	0.3	0.3	0.3	0.3	0.0
Na	mg/L	0.57	0.55	0.50	0.54	0.04
S	mg/L	0.87	0.86	0.83	0.85	0.02
Si	mg/L	2.69	2.71	2.63	2.67	0.04
Sr	µg/L	36	36	35	36	1
Zn	µg/L	0.5	*(<0.2)*	0.4	0.3	0.2

LANDER'S FORK
SITE "LA", ON 7/20/97

C-2.2

Sample name		LA-1	LA-2	LA-3	Mean	Std. Dev.
Sample date, approx. time		7/20/97, 16:30	7/20/97, 16:30	7/20/97, 16:30		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	8.8	8.8	8.8	8.8	0.0
Spec. Cond.	mS/cm	0.22	0.22	0.22	0.22	0.00
Water temp.	deg. C	12.8	12.8	12.8	12.8	0.0
Air temp	deg. C	16.7	16.7	16.7	16.7	0.0
Inorganic carbon	mg/L	28.8	28.8	28.9	28.8	0.0
Organic carbon	mg/L	*(<1)*	*(NA)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.84	2.88	2.74	2.82	0.08
As	µg/L	0.4	0.4	0.6	0.5	0.1
Ba	µg/L	144	143	142	143	1
Ca	mg/L	27.79	27.94	27.65	27.79	0.15
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	6	0
K	mg/L	0.41	0.41	0.41	0.41	0.00
Li	µg/L	2.3	2.4	2.4	2.3	0.1
Mg	mg/L	10.47	10.52	10.49	10.49	0.03
Mn	µg/L	0.4	0.4	0.4	0.4	0.0
Na	mg/L	0.71	0.62	0.76	0.70	0.07
S	mg/L	0.93	0.90	0.92	0.92	0.01
Si	mg/L	2.74	2.74	2.74	2.74	0.00
Sr	µg/L	39	39	39	39	0
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LA", ON 8/7/97

C-2.3

Sample name		LA-1	LA-2	LA-3	Mean	Std. Dev.
Sample date, approx. time		8/7/97, 10:30	8/7/97, 10:30	8/7/97, 10:30		
	Units					
pH	pH scale	8.6	8.6	8.6	8.6	0.0
Diss. oxygen	mg/L	10.1	10.1	10.1	10.1	0.0
Spec. Cond.	mS/cm	0.26	0.26	0.26	0.26	0.00
Water temp.	deg. C	13.5	13.5	13.5	13.5	0.0
Air temp	deg. C	23.8	23.8	23.8	23.8	0.0
Inorganic carbon	mg/L	31.8	31.8	31.7	31.7	0.0
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.11	3.10	3.23	3.15	0.07
As	µg/L	0.4	0.4	0.4	0.4	0.0
Ba	µg/L	161	162	166	163	3
Ca	mg/L	31.75	32.42	32.54	32.24	0.43
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	0.7	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	7	7	0
K	mg/L	0.43	0.44	0.43	0.43	0.00
Li	µg/L	2.7	2.7	2.7	2.7	0.0
Mg	mg/L	11.91	12.12	12.16	12.06	0.13
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	0.86	0.90	0.80	0.85	0.05
S	mg/L	1.11	1.11	1.08	1.10	0.02
Si	mg/L	3.04	3.10	3.03	3.05	0.04
Sr	µg/L	45	46	46	46	1
Zn	µg/L	*(<0.2)*	*(<0.2)*	0.2	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LA", ON 9/13/97

C-2.4

Sample name		LA-1	LA-2	LA-3	Mean	Std. Dev.
Sample date, approx. time		9/13/97, 13:00	9/13/97, 13:00	9/13/97, 13:00		
	Units					
pH	pH scale	8.2	8.2	8.2	8.2	0.0
Diss. oxygen	mg/L	9.3	9.4	9.4	9.4	0.1
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	11.5	11.5	11.5	11.5	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	35.1	34.6	35.2	35.0	0.3
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.43	3.50	3.40	3.44	0.05
As	µg/L	0.3	0.4	0.3	0.3	0.0
Ba	µg/L	194	192	192	192	1
Ca	mg/L	39.77	39.54	39.75	39.69	0.13
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	7	7	7	7	0
K	mg/L	0.51	0.49	0.49	0.50	0.01
Li	µg/L	3.3	3.3	3.3	3.3	0.0
Mg	mg/L	14.41	14.35	14.37	14.38	0.03
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	1.21	1.58	1.41	1.40	0.19
S	mg/L	1.32	1.35	1.31	1.33	0.02
Si	mg/L	3.29	3.29	3.28	3.29	0.01
Sr	µg/L	55	54	55	55	0
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LB", ON 7/3/97

C-3.1

Sample name		LB-1	LB-2	LB-3	Mean	Std. Dev.
Sample date, approx. time		7/3/97, 08:00	7/3/97, 08:00	7/3/97, 08:00		
	Units					
pH	pH scale	8.4	8.4	8.4	8.4	0.0
Diss. oxygen	mg/L	9.20	9.20	9.2	9.2	0.0
Spec. Cond.	mS/cm	0.21	0.21	0.21	0.21	0.00
Water temp.	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	23.4	23.7	24.2	23.8	0.4
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.26	2.28	2.37	2.30	0.05
As	µg/L	0.6	0.5	0.6	0.5	0.0
Ba	µg/L	160	161	171	164	6
Ca	mg/L	25.67	25.81	27.13	26.20	0.81
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	5	6	5	0.2
K	mg/L	0.34	0.34	0.37	0.35	0.02
Li	µg/L	1.5	1.5	1.6	1.6	0.0
Mg	mg/L	9.31	9.30	9.75	9.45	0.26
Mn	µg/L	0.4	0.4	0.4	0.4	0.0
Na	mg/L	0.56	0.69	0.50	0.59	0.10
S	mg/L	0.75	0.77	0.79	0.77	0.02
Si	mg/L	2.75	2.76	2.91	2.80	0.09
Sr	µg/L	37	37	38	37	1
Zn	µg/L	*(<0.2)*	0.8	0.5	0.5	0.3

LANDER'S FORK
SITE "LB", ON 7/20/97

C-3.2

Sample name		LB-1	LB-2	LB-3	Mean	Std. Dev.
Sample date, approx. time		7/20/97, 21:00	7/20/97, 21:00	7/20/97, 21:00		
	Units					
pH	pH scale	7.9	7.9	7.9	7.9	0.0
Diss. oxygen	mg/L	9.0	9.0	9.0	9.0	0.0
Spec. Cond.	mS/cm	0.22	0.22	0.22	0.22	0.00
Water temp.	deg. C	10.0	10.0	10.0	10.0	0.0
Air temp	deg. C	12.9	12.9	12.9	12.9	0.0
Inorganic carbon	mg/L	28.4	28.4	28.4	28.4	0.0
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.59	2.50	2.77	2.62	0.14
As	µg/L	0.6	0.6	0.6	0.6	0.0
Ba	µg/L	181	184	183	182	2
Ca	mg/L	26.92	26.92	26.90	26.91	0.01
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	0.3	0.3	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	6	0
K	mg/L	0.36	0.36	0.36	0.36	0.00
Li	µg/L	1.7	1.7	1.7	1.7	0.0
Mg	mg/L	10.03	9.99	9.98	10.00	0.03
Mn	µg/L	0.4	0.4	0.4	0.4	0.0
Na	mg/L	0.73	0.65	0.79	0.72	0.07
S	mg/L	0.83	0.85	0.85	0.85	0.01
Si	mg/L	2.96	2.97	2.97	2.96	0.01
Sr	µg/L	41	41	41	41	0
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LB", ON 8/7/97

C-3.3

Sample name Sample date, approx. time		LB-1 8/7/97, 12:00	LB-2 8/7/97, 12:00	LB-3 8/7/97, 12:00	Mean	Std. Dev.
	Units					
pH	pH scale	8.2	8.2	8.2	8.2	0.0
Diss. oxygen	mg/L	10.3	10.3	10.3	10.3	0.0
Spec. Cond.	mS/cm	0.24	0.24	0.24	0.24	0.00
Water temp.	deg. C	11.5	11.5	11.5	11.5	0.0
Air temp	deg. C	27.5	27.5	27.5	27.5	0.0
Inorganic carbon	mg/L	30.9	31.2	31.3	31.2	0.2
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.83	2.86	2.82	2.84	0.02
As	µg/L	0.4	0.4	0.4	0.4	0.0
Ba	µg/L	216	216	219	217	1
Ca	mg/L	31.19	31.91	31.44	31.51	0.37
Cr	µg/L	1.0	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	7	7	7	7	0
K	mg/L	0.41	0.42	0.42	0.42	0.01
Li	µg/L	2.1	2.1	2.1	2.1	0.0
Mg	mg/L	11.51	11.68	11.57	11.59	0.09
Mn	µg/L	0.4	0.4	0.4	0.4	0.0
Na	mg/L	0.84	0.83	0.89	0.85	0.03
S	mg/L	0.97	0.96	1.00	0.98	0.02
Si	mg/L	3.33	3.36	3.37	3.35	0.02
Sr	µg/L	48	47	48	48	0
Zn	µg/L	*(<0.2)*	0.3	1.6	0.6	0.8

LANDER'S FORK
SITE "LB", ON 9/13/97

C-3.4

Sample Name, Date Sample date, approx. time		LB-1 9/13/97, 14:00	LB-2 9/13/97, 14:00	LB-3 9/13/97, 14:00	Mean	Std. Dev.
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	9.4	9.4	9.4	9.4	0.0
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	10.3	10.3	10.3	10.3	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	34.3	34.1	34.3	34.2	0.1
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Fluoride	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.85	2.96	2.93	2.91	0.06
As	µg/L	0.4	0.3	0.4	0.3	0.0
Ba	µg/L	256	266	259	260	5
Ca	mg/L	37.44	36.94	38.22	37.53	0.65
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	7	6	7	7	0
K	mg/L	0.50	0.52	0.52	0.51	0.01
Li	µg/L	2.5	2.5	2.5	2.5	0.0
Mg	mg/L	13.14	13.14	13.34	13.21	0.12
Mn	µg/L	0.3	0.3	0.3	0.3	0.0
Na	mg/L	1.57	1.57	1.27	1.47	0.17
S	mg/L	1.14	1.14	1.09	1.12	0.03
Si	mg/L	3.80	3.80	3.83	3.81	0.02
Sr	µg/L	53	55	54	54	1
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LB", ON 11/16/97

C-3.5

Sample name		LB-1	LB-2	LB-3	Mean	Std. Dev.
Sample date, approx. time		11/16/97, 09:00	11/16/97, 09:00	11/16/97, 09:00		
	Units					
pH	pH scale	7.6	7.7	7.6	7.6	0.0
Diss. oxygen	mg/L	(Not calibrating-- too cold)				
Spec. Cond.	mS/cm	0.27	0.27	0.27	0.27	0.00
Water temp.	deg. C	2.1	2.1	2.1	2.1	0.0
Air temp	deg. C	-7.5	-7.5	-7.5	-7.5	0.0
Inorganic carbon	mg/L	35.9	36.9	35.6	36.2	0.7
Organic carbon	mg/L	*(<1)*	1	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.06	2.99	2.96	3.00	0.05
As	µg/L	0.2	0.3	0.3	0.3	0.0
Ba	µg/L	249	248	247	248	1
Ca	mg/L	35.00	34.80	34.72	34.84	0.14
Cr	µg/L	1.0	1.1	1.0	1.0	0.1
Cu	µg/L	*(<0.3)*	0.3	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	6	0
K	mg/L	0.52	0.52	0.52	0.52	0.00
Li	µg/L	2.2	2.2	2.2	2.2	0.0
Mg	mg/L	13.09	13.02	13.00	13.04	0.05
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	1.11	1.09	0.93	1.04	0.10
S	mg/L	1.14	1.14	1.11	1.13	0.02
Si	mg/L	3.62	3.61	3.59	3.60	0.02
Sr	µg/L	53	53	53	53	0
Zn	µg/L	0.5	1.0	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LB", ON 1/6/98

C-3.6

Sample name		LB-1	LB-2	LB-3	Mean	Std. Dev.
Sample date, approx. time		1/6/98, 10:00	1/6/98, 10:00	1/6/98, 10:00		
	Units					
pH	pH scale	7.6	7.6	7.6	7.6	0.0
Diss. oxygen	mg/L	15.0-17.0			15.0-17.0	
Spec. Cond.	mS/cm	0.27	0.27	0.28	0.27	0.01
Water temp.	deg. C	3.1	3.1	3.1	3.1	0.0
Air temp	deg. C	0.2	0.2	0.2	0.2	0.0
Inorganic carbon	mg/L	34.2	35.0	33.8	34.3	0.6
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	0.05	0.05	0.05	0.05	0.00
Sulfate	mg/L	3.1	3.2	3.2	3.2	0.1
As	µg/L	0.3	0.3	0.3	0.3	0.0
Ba	µg/L	245	239	240	242	3
Ca	mg/L	35.30	35.65	35.14	35.36	0.26
Cr	µg/L	1.1	1.0	1.1	1.1	0.1
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	6	0
K	mg/L	0.58	0.56	0.57	0.57	0.01
Li	µg/L	2.3	2.3	2.3	2.3	0.0
Mg	mg/L	13.06	13.08	12.96	13.03	0.06
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	0.95	1.02	0.97	0.98	0.03
S	mg/L	1.01	1.02	1.04	1.02	0.02
Si	mg/L	3.57	3.59	3.58	3.58	0.01
Sr	µg/L	53	52	52	52	1
Zn	µg/L	1.0	1.7	2.4	1.7	0.7

LANDER'S FORK
SITE "LB", ON 3/8/98

Sample name		LB-1	LB-2	LB-3	Mean	Std. Dev.
Sample date, approx. time		3/8/1998, 11:30	3/8/1998, 11:30	3/8/1998, 11:30		
	Units					
pH	pH scale	7.7	7.6	7.7	7.7	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	4.0	3.9	4.0	4.0	0.1
Air temp	deg. C	-1.3	-1.3	-1.2	-1.3	0.1
Inorganic carbon	mg/L	34.5	33.7	34.7	34.3	0.5
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Sulfate	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
As	µg/L	0.3	0.3	0.3	0.3	0.0
Ba	µg/L	234	232	234	233.2	1.1
Ca	mg/L	33.56	33.37	33.34	33.42	0.12
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.8)*	*(<0.8)*	*(<0.8)*	*(<0.8)*	*(<0.8)*
Fe	µg/L	*(<5)*	*(<5)*	*(<5)*	*(<5)*	*(<5)*
K	mg/L	0.62	0.62	0.64	0.63	0.01
Li	µg/L	2.4	2.3	2.4	2.4	0.0
Mg	mg/L	12.87	12.77	12.82	12.8	0.1
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	0.86	1.06	0.77	0.89	0.15
S	mg/L	1.05	1.07	1.07	1.06	0.01
Si	mg/L	3.7	3.67	3.68	3.7	0.0
Sr	µg/L	51	51	51	51	0
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

APPENDIX C-3

LANDER'S FORK Hyporheic zone samples: Sampler 1 (East bank)
SITE "LB-HZ1", ON 11/18/97

C-3.8

Sample name		LB-HZ1	LB-HZ1	LB-HZ1	LB-HZ1
Sample depth		10cm	20cm	40cm	85cm
Sample date, approx. time		11/18/97, 11:00	11/18/97, 11:00	11/18/97, 11:00	11/18/97, 11:00
	Units				
pH	pH scale	8.0	8.0	8.0	8.2
Diss. oxygen	mg/L	11.5	10.8	11.5	8.3
Spec. Cond.	mS/cm	0.28	0.28	0.28	0.29
Water temp.	deg. C	4.3	4.2	4.9	5.3
Air temp	deg. C	1.8	1.8	1.8	1.8
Inorganic carbon	mg/L	34.6	34.5	35.2	38.2
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	1.8
F	mg/L	*(<0.05)*	*(<0.05)*	0.05	0.06
Sulfate	mg/L	2.98	2.98	2.99	3.90
As	µg/L	0.2	0.2	0.3	0.2
Ba	µg/L	245	246	246	260
Ca	mg/L	34.86	34.74	34.61	36.08
Cr	µg/L	1.0	1.0	1.0	1.2
Cu	µg/L	0.4	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	9
K	mg/L	0.51	0.53	0.53	0.66
Li	µg/L	2.2	2.2	2.2	2.8
Mg	mg/L	12.95	12.89	12.94	14.20
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	35.5
Na	mg/L	2.18	1.10	1.22	1.28
S	mg/L	1.25	1.13	1.14	1.19
Si	mg/L	3.59	3.58	3.58	4.18
Sr	µg/L	53	53	52	62
Zn	µg/L	*(<0.2)*	*(<0.2)*	0.2	1.8

(Surface water: pH=8.0; Spec. Cond.=0.28; Temp.=4.3)

LB "SPRING"- where it emerges from beneath snow upstream from LB

C-3.9

Sample name		LB-SPRING
Sample date, approx. time		1/6/98, 11:00
	Units	
pH	pH scale	*(NA)*
Diss. oxygen	mg/L	*(NA)*
Spec. Cond.	mS/cm	*(NA)*
Water temp.	deg. C	*(NA)*
Air temp	deg. C	*(NA)*
Inorganic carbon	mg/L	34.8
Organic carbon	mg/L	*(<1)*
F	mg/L	0.05
Sulfate	mg/L	3.34
As	µg/L	0.4
Ba	µg/L	214
Ca	mg/L	34.61
Cr	µg/L	1.0
Cu	µg/L	*(<0.3)*
Fe	µg/L	6
K	mg/L	0.41
Li	µg/L	2.0
Mg	mg/L	12.96
Mn	µg/L	*(<0.3)*
Na	mg/L	0.88
S	mg/L	1.07
Si	mg/L	3.37
Sr	µg/L	50
Zn	µg/L	1.8

LANDER'S FORK
SITE "LC", ON 7/3/97

C-4.1

Sample name		LC-1	LC-2	LC-3	Mean	Std. Dev.
Sample date, approx. time		7/3/97, 09:00	7/3/97, 09:00	7/3/97, 09:00		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	9.8	9.8	9.8	9.8	0.0
Spec. Cond.	mS/cm	0.21	0.21	0.21	0.21	0.00
Water temp.	deg. C	6.9	6.9	6.9	6.9	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	23.9	23.9	24.0	23.9	0.1
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.28	2.31	2.30	2.30	0.02
As	µg/L	0.6	0.6	0.6	0.6	0.0
Ba	µg/L	174	173	168	172	3
Ca	mg/L	27.01	27.05	26.76	26.94	0.16
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	6	0
K	mg/L	0.37	0.36	0.34	0.36	0.01
Li	µg/L	1.7	1.6	1.6	1.6	0.1
Mg	mg/L	9.61	9.68	9.28	9.52	0.21
Mn	µg/L	0.4	0.4	0.4	0.4	0.0
Na	mg/L	0.60	0.58	0.48	0.55	0.07
S	mg/L	0.82	0.81	0.74	0.79	0.04
Si	mg/L	3.00	2.99	2.84	2.94	0.09
Sr	µg/L	39	39	38	39	1
Zn	µg/L	0.8	0.5	0.2	0.5	0.3

LANDER'S FORK
SITE "LC", ON 7/21/97

C-4.2

Sample name		LC-1	LC-2	LC-3	Mean	Std. Dev.
Sample date, approx. time		7/21/97, 08:00	7/21/97, 08:00	7/21/97, 08:00		
	Units					
pH	pH scale	8.1	8.1	8.1	8.1	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	0.23	0.23	0.23	0.23	0.00
Water temp.	deg. C	7.4	7.4	7.4	7.40	0.00
Air temp	deg. C	11.5	11.5	11.5	11.5	0.0
Inorganic carbon	mg/L	30.0	30.1	30.0	30.0	0.1
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.83	2.73	2.76	2.77	0.05
As	µg/L	0.6	0.7	0.6	0.6	0.0
Ba	µg/L	198	200	200	199	1
Ca	mg/L	28.52	28.96	28.76	28.75	0.22
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	0.3	*(<0.3)*	*(<0.3)*
Fe	µg/L	7	7	6	7	0
K	mg/L	0.39	0.39	0.39	0.39	0.00
Li	µg/L	1.9	1.9	1.9	1.9	0.0
Mg	mg/L	10.48	10.57	10.56	10.54	0.05
Mn	µg/L	0.3	0.3	0.3	0.3	0.0
Na	mg/L	0.84	0.71	0.78	0.78	0.06
S	mg/L	0.90	0.89	0.90	0.90	0.01
Si	mg/L	3.20	3.22	3.22	3.21	0.01
Sr	µg/L	44	44	44	44	0
Zn	µg/L	1.0	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LC", ON 8/7/97

C-4.3

Sample name		LC-1	LC-2	LC-3	Mean	Std. Dev.
Sample date, approx. time		8/7/97, 14:00	8/7/97, 14:00	8/7/97, 14:00		
	Units					
pH	pH scale	8.2	8.2	8.2	8.2	0.0
Diss. oxygen	mg/L	10.1	10.1	10.1	10.1	0.0
Spec. Cond.	mS/cm	0.25	0.25	0.25	0.3	0.0
Water temp.	deg. C	12.3	12.3	12.3	12.3	0.0
Air temp	deg. C	24.4	24.4	24.4	24.4	0.0
Inorganic carbon	mg/L	32.0	31.9	31.7	31.9	0.2
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.06	2.93	2.98	2.99	0.07
As	µg/L	0.4	0.4	0.5	0.4	0.0
Ba	µg/L	236	235	240	237	3
Ca	mg/L	32.29	32.14	32.67	32.37	0.27
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	7	7	8	7	1
K	mg/L	0.45	0.45	0.46	0.46	0.00
Li	µg/L	2.2	2.3	2.3	2.3	0.0
Mg	mg/L	11.85	11.84	11.82	11.84	0.02
Mn	µg/L	0.5	0.5	0.5	0.5	0.0
Na	mg/L	0.80	0.80	0.86	0.82	0.04
S	mg/L	1.00	1.01	1.03	1.01	0.01
Si	mg/L	3.58	3.58	3.60	3.59	0.01
Sr	µg/L	50	50	51	50	1
Zn	µg/L	*(<0.2)*	1.1	4.6	1.9	2.3

LANDER'S FORK
SITE "LC", ON 9/13/97

C-4.4

Sample name		LC-1	LC-2	LC-3	Mean	Std. Dev.
Sample date, approx. time		9/13/97, 15:00	9/13/97, 15:00	9/13/97, 15:00		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	9.4	9.5	9.4	9.4	0.1
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	9.8	9.8	9.8	9.8	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	34.2	34.9	34.6	34.6	0.4
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.09	3.15	3.14	3.13	0.03
As	µg/L	0.5	0.5	0.5	0.5	0.0
Ba	µg/L	295	299	291	295	4
Ca	mg/L	36.30	36.05	36.99	36.45	0.49
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	5	5	6	5	0
K	mg/L	0.57	0.57	0.55	0.56	0.01
Li	µg/L	2.6	2.6	2.6	2.6	0.0
Mg	mg/L	12.84	12.80	12.73	12.79	0.06
Mn	µg/L	0.3	0.3	0.3	0.3	0.0
Na	mg/L	1.28	1.04	1.35	1.22	0.17
S	mg/L	1.55	1.55	1.38	1.49	0.10
Si	mg/L	4.15	4.13	4.20	4.16	0.04
Sr	µg/L	58	58	56	57	1
Zn	µg/L	0.2	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LC", ON 10/19/97

C-4.5

Sample name		LC-1	LC-2	LC-3	Mean	Std. Dev.
Sample date, approx. time		10/19/97, 10:00	10/19/97, 10:00	10/19/97, 10:00		
	Units					
pH	pH scale	8.5	8.5	8.4	8.5	0.0
Diss. oxygen	mg/L	13.2-14.0			13.2-14.0	
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	7.2	7.2	7.2	7.2	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	34.6	34.7	35.1	34.8	0.3
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.99	3.00	3.03	3.00	0.02
As	µg/L	0.5	0.5	0.5	0.5	0.0
Ba	µg/L	232	220	235	229	8
Ca	mg/L	30.27	29.87	31.53	30.56	0.87
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	7	6	0
K	mg/L	0.43	0.39	0.42	0.41	0.02
Li	µg/L	2.2	2.2	2.2	2.2	0.0
Mg	mg/L	10.34	10.15	10.73	10.41	0.30
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	1.34	1.27	1.19	1.27	0.07
S	mg/L	1.42	1.38	1.31	1.37	0.05
Si	mg/L	4.13	4.11	4.12	4.12	0.01
Sr	µg/L	44	42	45	43	1
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LC", ON 11/16/97

C-4.6

Sample name		LC-1	LC-2	LC-3	Mean	Std. Dev.
Sample date, approx. time		11/16/97, 11:00	11/16/97, 11:00	11/16/97, 11:00		
	Units					
pH	pH scale	7.94	7.98	7.94	7.95	0.02
Diss. oxygen	mg/L	12.5-13.5			12.5-13.5	
Spec. Cond.	mS/cm	0.27	0.27	0.27	0.27	0.00
Water temp.	deg. C	6.0	6.0	6.0	6.0	0.0
Air temp	deg. C	0.4	0.4	0.4	0.4	0.0
Inorganic carbon	mg/L	34.6	34.4	34.7	34.6	0.2
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.03	3.00	3.04	3.02	0.02
As	µg/L	0.6	0.6	0.6	0.6	0.0
Ba	µg/L	269	265	269	268	2
Ca	mg/L	34.51	34.43	34.165	34.37	0.18
Cr	µg/L	1.2	1.1	1.1	1.1	0.1
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	6	0
K	mg/L	0.53	0.53	0.53	0.53	0.00
Li	µg/L	2.3	2.3	2.3	2.3	0.0
Mg	mg/L	12.87	12.87	12.77	12.84	0.06
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	1.03	0.97	1.12	1.04	0.08
S	mg/L	1.12	1.09	1.13	1.11	0.03
Si	mg/L	4.15	4.11	4.16	4.14	0.02
Sr	µg/L	57	56	56	56	0
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LC", ON 1/6/98

C-4.7

Sample name		LC-1	LC-2	LC-3	Mean	Std. Dev.
Sample date and approx. time		1/6/98, 13:00	1/6/98, 13:00	1/6/98, 13:00		
	Units					
pH	pH scale	8.0	8.0	8.0	8.0	0.0
Diss. oxygen	mg/L	15-19			15-19	
Spec. Cond.	mS/cm	0.27	0.26	0.27	0.27	0.01
Water temp.	deg. C	4.0	4.0	4.0	4.0	0.0
Air temp	deg. C	0.6	0.6	0.6	0.6	0.0
Inorganic carbon	mg/L	33.0	33.3	32.5	32.9	0.4
Organic carbon	mg/L	1.1	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	0.05	0.05	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.4	3.3	3.4	3.4	0.1
As	µg/L	0.8	0.7	0.8	0.8	0.0
Ba	µg/L	243	250	260	251.0	8.9
Ca	mg/L	31.16	31.97	33.08	32.07	0.96
Cr	µg/L	1.2	1.2	1.3	1.2	0.0
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	6	0
K	mg/L	0.50	0.51	0.52	0.51	0.01
Li	µg/L	2.2	2.2	2.2	2.2	0.0
Mg	mg/L	11.74	12.01	12.33	12.03	0.30
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	0.99	0.95	1.00	0.98	0.03
S	mg/L	1.11	1.14	1.10	1.12	0.02
Si	mg/L	4.03	4.10	4.16	4.10	0.06
Sr	µg/L	52	53	55	53	2
Zn	µg/L	0.3	*<0.2*	*<0.2*	*<0.2*	*<0.2*

LANDER'S FORK
SITE "LC", ON 3/8/98

C-4.8

Sample name		LC-1	LC-2	LC-3	Mean	Std. Dev.
Sample date and approx. time		3/8/98, 12:30	3/8/98, 12:30	3/8/98, 12:30		
	Units					
pH	pH scale	7.8	7.8	7.8	7.8	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	5.1	5.1	5.0	5.1	0.1
Air temp	deg. C	0	0.1	0.1	0.1	0.1
Inorganic carbon	mg/L	33.5	33.8	34.5	34.0	0.5
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Sulfate	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
As	µg/L	1.0	1.0	1.0	1.0	0.0
Ba	µg/L	268	268	269	268.5	0.2
Ca	mg/L	*32.55*	*33.22*	*33.17*	33.0	0.4
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.8)*	*(<0.8)*	*(<0.8)*	*(<0.8)*	*(<0.8)*
Fe	µg/L	*(<5)*	*(<5)*	*(<5)*	*(<5)*	*(<5)*
K	mg/L	0.60	0.58	0.58	0.59	0.01
Li	µg/L	2.2	2.2	2.2	2.2	0.0
Mg	mg/L	12.85	12.98	12.91	12.9	0.1
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	1.25	0.93	1.10	1.1	0.2
S	mg/L	1.19	1.15	1.17	1.2	0.0
Si	mg/L	4.16	4.09	4.12	4.1	0.0
Sr	µg/L	57	58	58	57.5	0.7
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

Ground water seep at LANDER'S FORK C Site
"LC Seep", ON 11/16/97

C-4.9

Sample Name		LC Seep	LC Seep Field Dup.
Sample date, approx. time		11/16/97, 12:00	11/16/97, 12:00
	Units		
pH	pH scale	7.4	7.4
Diss. oxygen	mg/L	8	9
Spec. Cond.	mS/cm	0.29	0.29
Water temp.	deg. C	6.6	6.6
Air temp	deg. C	0.4	0.4
Inorganic carbon	mg/L	37.9	38.4
Organic carbon	mg/L	*(<1)*	*(<1)*
F	mg/L	0.05	0.05
Sulfate	mg/L	3.27	3.25
As	µg/L	0.9	0.9
Ba	µg/L	311	310
Ca	mg/L	37.19	37.16
Cr	µg/L	1.2	1.1
Cu	µg/L	*(<0.3)*	*(<0.3)*
Fe	µg/L	7	7
K	mg/L	0.64	0.64
Li	µg/L	2.8	2.8
Mg	mg/L	13.60	13.58
Mn	µg/L	*(<0.3)*	*(<0.3)*
Na	mg/L	1.39	1.39
S	mg/L	1.25	1.24
Si	mg/L	5.13	5.12
Sr	µg/L	65	65
Zn	µg/L	0.3	0.3

Ground water seep at LANDER'S FORK C Site
"LC Seep", ON 1/6/98

C-4.10

Sample name		LC Seep	LC Seep F.Dup
Sample date, approx. time		1/6/98, 13:00	1/6/98, 13:00
	Units		
pH	pH scale	7.4	7.4
Diss. oxygen	mg/L	13	14
Spec. Cond.	mS/cm	0.29	0.29
Water temp.	deg. C	5.3	5.3
Air temp	deg. C	0.6	0.6
Inorganic carbon	mg/L	35.6	38.1
Organic carbon	mg/L	*(<1)*	*(<1)*
F	mg/L	0.05	0.05
Sulfate	mg/L	3.6	3.6
As	µg/L	0.9	0.9
Ba	µg/L	282	281
Ca	mg/L	35.44	35.78
Cr	µg/L	1.3	1.1
Cu	µg/L	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6
K	mg/L	0.60	0.59
Li	µg/L	2.7	2.7
Mg	mg/L	12.87	12.92
Mn	µg/L	*(<0.3)*	*(<0.3)*
Na	mg/L	1.10	1.06
S	mg/L	1.15	1.14
Si	mg/L	4.81	4.83
Sr	µg/L	62	61
Zn	µg/L	1.6	1.0

APPENDIX C-4

Ground water seep at LANDER'S FORK C Site
"LC Seep", ON 3/8/98

C-4.11

Sample Name		LC Seep	LC Seep Field Dup.
Sample date, approx. time		3/8/98	3/8/98
	Units		
pH	pH scale	7.4	7.47
Diss. oxygen	mg/L	6.7	6.9
Spec. Cond.	mS/cm	0.26	0.27
Water temp.	deg. C	4.4	4.4
Air temp	deg. C	8	8.1
Inorganic carbon	mg/L	35.8	35.8
Organic carbon	mg/L	*(<1)*	*(<1)*
F	mg/L	*(NA)*	*(NA)*
Sulfate	mg/L	*(NA)*	*(NA)*
As	µg/L	0.9	1.0
Ba	µg/L	283	281
Ca	mg/L	35.01	35.40
Cr	µg/L	*(<1)*	*(<1)*
Cu	µg/L	*(<0.8)*	*(<0.8)*
Fe	µg/L	*(<5)*	*(<5)*
K	mg/L	0.64	0.62
Li	µg/L	2.6	2.6
Mg	mg/L	13.42	13.40
Mn	µg/L	*(<0.3)*	*(<0.3)*
Na	mg/L	1.01	0.97
S	mg/L	1.18	1.15
Si	mg/L	4.67	4.61
Sr	µg/L	63	62
Zn	µg/L	*(<0.2)*	*(<0.2)*

LANDER'S FORK Hyporheic zone samples: Sampler 1 (East bank)
SITE "LC-HZ1", ON 10/19/97

C-4.13

Sample name		LC-HZ1	LC-HZ1	LC-HZ1 field duplicate	LC-HZ1	LC-HZ1	LC-HZ1
Sample depth		5cm	15cm	15cm	35cm	55cm	80cm
Sample date		10/19/97	10/19/97	10/19/97	10/19/97	10/19/97	10/19/97
	Units						
pH	pH scale	8.3	8.3	8.3	8.3	8.3	8.3
Diss. oxygen	mg/L	12	10	10	9	10	9
Spec. Cond.	mS/cm	not meas.	not meas.	not meas.	not meas.	not meas.	not meas.
Water temp.	deg. C	7.8	7.4	7.3	7.3	7.9	7.4
Air temp	deg. C	not meas.	not meas.	not meas.	not meas.	not meas.	not meas.
Inorganic carbon	mg/l	35.3	34.7	34.9	34.7	34.7	34.8
Organic carbon	mg/l	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/l	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/l	3.02	3.01	2.99	3.02	3.04	3.01
As	µg/l	0.5	0.5	0.5	0.5	0.5	0.5
Ba	µg/l	287	285	282	284	287	283
Ca	mg/l	37.92	37.44	36.82	36.61	36.92	36.59
Cr	µg/l	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/l	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/l	7	7	7	7	7	7
K	mg/l	0.53	0.53	0.52	0.54	0.54	0.54
Li	µg/l	2.5	2.5	2.5	2.5	2.5	2.5
Mg	mg/l	12.59	12.52	12.50	12.37	12.41	12.48
Mn	µg/l	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/l	1.41	1.37	1.36	1.36	1.36	1.38
S	mg/l	1.17	1.18	1.17	1.18	1.21	1.19
Si	mg/l	4.17	4.17	4.14	4.14	4.18	4.13
Sr	µg/l	54	53	53	53	53	52
Zn	µg/l	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK Hyporheic zone samples: Sampler 2 (West bank)
SITE "LC-HZ2", ON 10/19/97

C-4.14

Sample name		LC-HZ2	LC-HZ2	LC-HZ2	LC-HZ2	LC-HZ2 field duplicate	LC-HZ2
Sample depth		10cm	20cm	40cm	60cm	60cm	82cm
Sample date		10/19/97	10/19/97	10/19/97	10/19/97	10/19/97	10/19/97
	Units						
pH	pH scale	8.4	8.4	8.4	8.4	8.4	8.4
Diss. oxygen	mg/L	12	10	9	10	9	9
Spec. Cond.	mS/cm	not meas.	not meas.	not meas.	not meas.	not meas.	not meas.
Water temp.	deg. C	not meas.	not meas.	not meas.	not meas.	8.5	not meas.
Air temp	deg. C	not meas.	not meas.	not meas.	not meas.	not meas.	not meas.
Inorganic carbon	mg/L	34.8	34.6	34.7	34.8	34.7	34.8
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.05	3.04	3.02	3.02	3.02	3.05
As	µg/L	0.5	0.6	0.5	0.5	0.5	0.5
Ba	µg/L	280	279	281	283	279	277
Ca	mg/L	37.09	36.90	36.29	37.03	36.71	37.14
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	7	6	7	7	7	7
K	mg/L	0.53	0.53	0.53	0.53	0.53	0.52
Li	µg/L	2.5	2.5	2.5	2.5	2.5	2.5
Mg	mg/L	12.64	12.52	12.39	12.53	12.48	12.61
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	1.50	1.41	1.35	1.44	1.42	1.45
S	mg/L	1.18	1.16	1.18	1.18	1.17	1.15
Si	mg/L	4.15	4.12	4.11	4.16	4.11	4.12
Sr	µg/L	52	52	52	53	52	52
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LD", ON 7/20/97

C-5.1

Sample name		LD-1	LD-2	LD-3	Mean	Std. Dev.
Sample date, approx. time		7/20/97, 14:00	7/20/97, 14:00	7/20/97, 14:00		
	Units					
pH	pH scale	8.4	8.4	8.4	8.4	0.0
Diss. oxygen	mg/L	9.3	9.3	9.3	9.3	0.0
Spec. Cond.	mS/cm	0.22	0.22	0.22	0.2	0.0
Water temp.	deg. C	10.8	10.8	10.8	10.8	0.0
Air temp	deg. C	23.0	23.0	23.0	23.0	0.0
Inorganic carbon	mg/L	29.2	30.1	30.0	29.8	0.5
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	2.92	2.55	2.64	2.7	0.2
As	µg/L	0.6	0.6	0.6	0.6	0.0
Ba	µg/L	195	196	197	196	1
Ca	mg/L	28.01	27.82	27.96	27.93	0.10
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	6	0
K	mg/L	0.39	0.39	0.39	0.39	0.00
Li	µg/L	1.8	1.8	1.8	1.8	0.0
Mg	mg/L	10.26	10.29	10.23	10.26	0.03
Mn	µg/L	0.6	0.6	0.6	0.6	0.0
Na	mg/L	0.75	0.61	0.69	0.68	0.07
S	mg/L	0.88	0.87	0.89	0.88	0.01
Si	mg/L	3.17	3.16	3.17	3.16	0.00
Sr	µg/L	43	43	43	43	0
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LD", ON 8/7/97

C-5.2

Sample name		LD-1	LD-2	LD-3	Mean	Std. Dev.
Sample date, approx. time		8/7/97, 15:00	8/7/97, 15:00	8/7/97, 15:00		
	Units					
pH	pH scale	8.5	8.5	8.5	8.5	0.0
Diss. oxygen	mg/L	10.1	10.1	10.1	10.1	0.0
Spec. Cond.	mS/cm	0.26	0.26	0.26	0.3	0.0
Water temp.	deg. C	13.9	13.9	13.9	13.9	0.0
Air temp	deg. C	28.6	28.6	28.6	28.6	0.0
Inorganic carbon	mg/L	32.3	32.2	31.5	32.0	0.4
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.0	3.0	2.9	3.0	0.0
As	µg/L	0.5	0.5	0.5	0.5	0.0
Ba	µg/L	236	234	234	235	1
Ca	mg/L	33.01	32.81	32.75	32.86	0.14
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	7	7	7	7	0
K	mg/L	0.45	0.45	0.45	0.45	0.00
Li	µg/L	2.2	2.2	2.2	2.2	0.0
Mg	mg/L	11.86	11.81	11.82	11.83	0.03
Mn	µg/L	0.5	0.5	0.5	0.5	0.0
Na	mg/L	0.79	0.88	0.81	0.83	0.05
S	mg/L	0.96	0.96	0.95	0.96	0.01
Si	mg/L	3.55	3.52	3.53	3.53	0.02
Sr	µg/L	50	49	50	50	0
Zn	µg/L	0.4	0.5	1.3	0.7	0.5

LANDER'S FORK
SITE "LD", ON 9/14/97

C-5.3

Sample name		LD-1	LD-2	LD-3	Mean	Std. Dev.
Sample date, approx. time		9/14/97, 11:30	9/14/97, 11:30	9/14/97, 11:30		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	9.8	9.8	9.8	9.8	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	34.4	34.0	33.7	34.0	0.4
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.01	3.01	3.09	3.03	0.04
As	µg/L	0.5	0.5	0.5	0.5	0.0
Ba	µg/L	300	290	297	296	5
Ca	mg/L	36.33	37.08	36.46	36.62	0.40
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	5	6	5	5	0
K	mg/L	0.57	0.55	0.56	0.56	0.01
Li	µg/L	2.6	2.5	2.7	2.6	0.1
Mg	mg/L	12.87	12.77	12.91	12.85	0.07
Mn	µg/L	0.3	0.3	0.3	0.3	0.0
Na	mg/L	1.00	1.29	1.00	1.10	0.17
S	mg/L	1.55	1.37	1.53	1.48	0.10
Si	mg/L	4.16	4.19	4.15	4.17	0.02
Sr	µg/L	58	56	58	57	1
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LD", ON 11/16/97

C-5.4

Sample Name		LD-1	LD-2	LD-3	Mean	Std. Dev.
Sample date, approx. time		11/16/97, 17:30	11/16/97, 17:30	11/16/97, 17:30		
	Units					
pH	pH scale	8.0	8.0	8.0	8.0	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	0.27	0.28	0.27	0.27	0.01
Water temp.	deg. C	5.5	5.5	5.5	5.5	0.0
Air temp	deg. C	1.0	1.0	1.0	1.0	0.0
Inorganic carbon	mg/L	34.8	34.5	34.7	34.7	0.2
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.01	3.01	2.98	3.00	0.02
As	µg/L	0.7	0.7	0.6	0.7	0.0
Ba	µg/L	266	263	267	265	2
Ca	mg/L	34.25	34.33	33.75	34.11	0.32
Cr	µg/L	1.1	1.0	1.1	1.1	0.1
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	6	0
K	mg/L	0.54	0.53	0.54	0.54	0.01
Li	µg/L	2.3	2.3	2.3	2.3	0.0
Mg	mg/L	12.84	12.79	12.71	12.78	0.07
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	0.94	1.20	0.95	1.03	0.15
S	mg/L	1.09	1.09	1.10	1.09	0.01
Si	mg/L	4.10	4.08	4.07	4.08	0.01
Sr	µg/L	56	56	56	56	0
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

LANDER'S FORK
SITE "LD", ON 1/6/98

C-5.5

Sample Name		LD-1	LD-1	LD-1	Mean	Std. Dev.
Sample date, approx. time		1/6/98, 17:30	1/6/98, 17:30	1/6/98, 17:30		
	Units					
pH	pH scale	8.1	8.1	8.1	8.1	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	0.27	0.27	0.27	0.27	0.00
Water temp.	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	33.6	34.0	33.0	33.5	0.5
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	0.05	0.05	0.05	0.05	0.00
Sulfate	mg/L	3.4	3.4	3.3	3.4	0.1
As	µg/L	0.7	0.8	0.7	0.7	0.0
Ba	µg/L	262	260	261	261	1
Ca	mg/L	32.10	32.11	32.83	32.35	0.42
Cr	µg/L	1.4	1.3	1.3	1.3	0.1
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	6	6	6	6	0
K	mg/L	0.53	0.53	0.53	0.53	0.00
Li	µg/L	2.2	2.2	2.3	2.2	0.0
Mg	mg/L	12.03	12.00	12.32	12.12	0.18
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	0.97	0.95	1.19	1.04	0.13
S	mg/L	1.13	1.12	1.10	1.11	0.02
Si	mg/L	4.06	4.07	4.06	4.06	0.01
Sr	µg/L	55	55	56	55	0
Zn	µg/L	0.2	0.3	*(<2)*	*(<2)*	*(<2)*

LANDER'S FORK
SITE "LD", ON 3/8/98

C-5.6

Sample Name		LD-1	LD-1	LD-1	Mean	Std. Dev.
Sample date, approx. time		3/8/98, 16:45	3/8/98, 16:45	3/8/98, 16:45		
	Units					
pH	pH scale	8.0	8.0	8.0	8.0	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	*5.1*	*5.1*	*5.2*	5.1	0.1
Air temp	deg. C	*-2.1*	*-1.8*	*-2*	-2.0	0.2
Inorganic carbon	mg/L	33.6	34.0	33.4	33.7	0.3
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Sulfate	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
As	µg/L	1.0	0.9	0.9	0.9	0.0
Ba	µg/L	265	268	262	265.0	265.1
Ca	mg/L	33.20	*33.36*	*32.91*	33.2	33.1
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.8)*	*(<0.8)*	*(<0.8)*	*(<0.8)*	*(<0.8)*
Fe	µg/L	*(<5)*	*(<5)*	*(<5)*	*(<5)*	*(<5)*
K	mg/L	0.58	0.59	0.58	0.6	0.6
Li	µg/L	2.2	2.2	2.2	2.2	2.2
Mg	mg/L	12.96	12.99	12.85	12.9	12.9
Mn	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Na	mg/L	0.99	0.75	0.90	0.9	0.8
S	mg/L	1.17	1.15	1.12	1.1	1.1
Si	mg/L	4.04	4.08	4.01	4.0	4.0
Sr	µg/L	58	58	57	57.6	57.5
Zn	µg/L	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

HOGUM CREEK- AT HOGUM CREEK BRIDGE
SITE "HC", ON 11/18/97

C-6.1

Sample name		HC-1	HC-2	HC-3	Mean	Std. Dev.
Sample date, approx. time		11/18/97, 16:00	11/18/97, 16:00	11/18/97, 16:00		
	Units					
pH	pH scale	7.5	7.5	7.6	7.6	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	0.18	0.17	0.18	0.18	0.01
Water temp.	deg. C	0.0	0.0	0.0	0.0	0.0
Air temp	deg. C	-1.4	-1.4	-1.4	-1.4	0.0
Inorganic carbon	mg/L	23.3	23.1	23.2	23.2	0.1
Organic carbon	mg/L	1.6	1.9	1.8	1.8	0.2
F	mg/L	0.11	0.11	0.11	0.11	0.00
Sulfate	mg/L	7.99	8.08	8.06	8.04	0.04
As	µg/L	0.3	0.2	0.3	0.3	0.0
Ba	µg/L	146	148	146	147	1
Ca	mg/L	21.92	22.01	22.19	22.04	0.14
Cr	µg/L	1.1	1.1	1.0	1.1	0.0
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	68	65	68	67	2
K	mg/L	0.84	0.84	0.84	0.84	0.00
Li	µg/L	4.4	4.4	4.4	4.4	0.0
Mg	mg/L	7.71	7.72	7.77	7.73	0.03
Mn	µg/L	20.6	20.6	20.7	20.6	0.1
Na	mg/L	5.48	5.56	5.53	5.52	0.04
S	mg/L	2.75	2.77	2.72	2.75	0.02
Si	mg/L	8.69	8.74	8.72	8.72	0.03
Sr	µg/L	433	436	435	435	1
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

HOGUM CREEK- AT HOGUM CREEK BRIDGE
SITE "HC", ON 1/6/98

C-6.2

Sample name		HC-1	HC-2	HC-3	Mean	Std. Dev.
Sample date, approx. time		1/6/98, 14:30	1/6/98, 14:30	1/6/98, 14:30		
	Units					
pH	pH scale	7.6	7.6	7.6	7.6	0.0
Diss. oxygen	mg/L	12.0-13.0			12.0-13.0	
Spec. Cond.	mS/cm	0.20	0.20	0.20	0.20	0.00
Water temp.	deg. C	0.0	0.0	0.0	0.0	0.0
Air temp	deg. C	-0.9	-0.9	-0.9	-0.9	0.0
Inorganic carbon	mg/L	28.8	29.0	29.8	29.2	0.6
Organic carbon	mg/L	1.4	1.5	1.5	1.5	0.1
F	mg/L	0.12	0.12	0.12	0.12	0.00
Sulfate	mg/L	10.10	10.10	10.10	10.10	0.00
As	µg/L	0.2	0.3	0.3	0.2	0.0
Ba	µg/L	140	141	140	141	1
Ca	mg/L	22.02	21.92	21.73	21.89	0.15
Cr	µg/L	1.3	1.3	1.3	1.3	0.0
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	56	56	58	56	1
K	mg/L	0.78	0.77	0.77	0.77	0.00
Li	µg/L	4.6	4.4	4.5	4.5	0.1
Mg	mg/L	7.67	7.62	7.55	7.61	0.06
Mn	µg/L	16.4	16.4	16.3	16.3	0.1
Na	mg/L	5.30	5.33	5.37	5.33	0.03
S	mg/L	2.91	2.96	2.93	2.93	0.03
Si	mg/L	8.04	8.04	7.98	8.02	0.03
Sr	µg/L	436	438	434	436	2
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER- FUTHEST UPSTREAM SITE
SITE "BA", ON 7/4/97

C-7.1

Sample name		BA-1	BA-2	BA-3	Mean	Std. Dev.
Sample date, approx. time		7/4/97, 12:00	7/4/97, 12:00	7/4/97, 12:00		
	Units					
pH	pH scale	8.2	8.2	8.2	8.2	0.0
Diss. oxygen	mg/L	8.7	8.7	8.7	8.7	0.0
Spec. Cond.	mS/cm	0.20	0.20	0.20	0.20	0.00
Water temp.	deg. C	13.1	13.1	13.1	13.1	0.0
Air temp	deg. C	23.0	23.0	23.0	23.0	0.0
Inorganic carbon	mg/L	20.4	20.3	20.5	20.4	0.1
Organic carbon	mg/L	1.8	1.6	1.4	1.6	0.2
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	10.82	10.85	10.82	10.83	0.02
As	µg/L	0.4	0.4	0.4	0.4	0.0
Ba	µg/L	201	200	195	198	3
Ca	mg/L	22.31	22.62	22.19	22.37	0.22
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.8	0.9	0.8	0.8	0.0
Fe	µg/L	40	43	44	43	2
K	mg/L	0.62	0.61	0.60	0.61	0.01
Li	µg/L	1.8	1.8	1.8	1.8	0.0
Mg	mg/L	9.62	9.72	9.64	9.66	0.05
Mn	µg/L	7.4	7.5	7.3	7.4	0.1
Na	mg/L	1.66	1.78	1.73	1.72	0.06
S	mg/L	3.95	3.97	3.87	3.93	0.05
Si	mg/L	5.62	5.66	5.58	5.62	0.04
Sr	µg/L	76	77	75	76	1
Zn	µg/L	25.3	27.7	29.0	27.3	1.9

BLACKFOOT RIVER- FURTHEST UPSTREAM SITE
SITE "BA", ON 7/20/97

C-7.2

Sample name		BA-1	BA-2	BA-3	Mean	Std. Dev.
Sample date, Approx. time		7/20/97, 08:00	7/20/97, 08:00	7/20/97, 08:00		
	Units					
pH	pH scale	7.6	7.6	7.6	7.6	0.0
Diss. oxygen	mg/L	8.7	8.7	8.7	8.7	0.0
Spec. Cond.	mS/cm	0.20	0.20	0.20	0.20	0.0
Water temp.	deg. C	11.4	11.4	11.4	11.4	0.0
Air temp	deg. C	11.7	11.7	11.7	11.7	0.0
Inorganic carbon	mg/L	22.8	22.8	22.8	22.8	0.0
Organic carbon	mg/L	1.6	1.6	1.6	1.6	0.0
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	10.78	10.73	10.76	10.8	0.0
As	µg/L	0.3	0.3	0.3	0.3	0.0
Ba	µg/L	202	203	201	202	1.1
Ca	mg/L	21.11	21.38	20.97	21.15	0.21
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	1.0	0.9	0.9	0.9	0.0
Fe	µg/L	58	56	57	57	1
K	mg/L	0.77	0.76	0.76	0.76	0.01
Li	µg/L	1.9	1.9	1.8	1.9	0.0
Mg	mg/L	9.74	9.81	9.66	9.74	0.08
Mn	µg/L	9.7	9.8	9.6	9.7	0.1
Na	mg/L	2.03	1.77	1.79	1.86	0.14
S	mg/L	4.28	4.27	4.20	4.25	0.04
Si	mg/L	5.85	5.89	5.80	5.84	0.04
Sr	µg/L	84	85	84	85	1
Zn	µg/L	29.4	29.7	30.4	29.9	0.5

BLACKFOOT RIVER- FURTHEST UPSTREAM SITE
SITE "BA", ON 8/8/97

C-7.3

Sample name		BA-1	BA-2	BA-3	Mean	Std. Dev.
Sample date, approx. time		8/8/97, 08:00	8/8/97, 08:00	8/8/97, 08:00		
	Units					
pH	pH scale	8.2	8.2	8.2	8.2	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	0.24	0.24	0.24	0.24	0.00
Water temp.	deg. C	10.1	10.1	10.1	10.1	0.00
Air temp	deg. C	11.5	11.5	11.5	11.5	0.00
Inorganic carbon	mg/L	26.3	26.2	26.5	26.3	0.2
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Fluoride	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	10.61	10.54	10.66	10.60	0.06
As	µg/L	0.3	0.3	0.3	0.3	0.0
Ba	µg/L	231	231	229	231	1
Ca	mg/L	25.83	25.53	25.46	25.61	0.20
Cr	µg/L	*(<1)*	1.1	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.7	0.7	0.6	0.7	0.0
Fe	µg/L	42	42	40	41	1
K	mg/L	0.75	0.74	0.73	0.74	0.01
Li	µg/L	2.3	2.3	2.2	2.3	0.0
Mg	mg/L	11.60	11.50	11.51	11.54	0.06
Mn	µg/L	5.0	4.9	4.8	4.9	0.1
Na	mg/L	2.21	2.21	2.18	2.20	0.02
S	mg/L	3.95	4.03	3.93	3.97	0.05
Si	mg/L	6.33	6.36	6.29	6.33	0.04
Sr	µg/L	97	98	96	97	1
Zn	µg/L	11.1	8.2	8.8	9.4	1.5

BLACKFOOT RIVER- FURTHEST UPSTREAM SITE
SITE "BA", ON 9/13/97

C-7.4

Sample name		BA-1	BA-2	BA-3	Mean	Std. Dev.
Sample date, approx. time		9/13/97, 16:30	9/13/97, 16:30	9/13/97, 16:30		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	9.7	9.8	9.7	9.7	0.1
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	13.3	13.3	13.3	13.3	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	29.1	28.0	28.7	28.6	0.6
Organic carbon	mg/L	1.0	1.0	1.1	28.6	0.6
F	mg/L	0.07	0.07	0.07	0.07	0.00
Sulfate	mg/L	14.6	14.7	14.7	14.7	0.1
As	µg/L	0.4	0.3	0.3	0.3	0.0
Ba	µg/L	279	274	275	276	3
Ca	mg/L	28.50	29.35	29.03	28.96	0.43
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.6	0.3	0.4	0.4	0.1
Fe	µg/L	32	34	33	33	1
K	mg/L	0.93	0.91	0.92	0.92	0.01
Li	µg/L	2.6	2.7	2.6	2.6	0.0
Mg	mg/L	12.57	12.86	12.76	12.73	0.15
Mn	µg/L	4.2	4.3	4.2	4.2	0.1
Na	mg/L	2.83	2.67	2.72	2.74	0.08
S	mg/L	6.08	5.79	5.91	5.92	0.14
Si	mg/L	7.00	7.02	7.02	7.01	0.01
Sr	µg/L	116	116	116	116	0
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER AT HOGUM CREEK ROAD
SITE "BH", ON 7/4/97

C-8.1

Sample name		BH-1	BH-2	BH-3	Mean	Std. Dev.
Sample date, time		7/4/97, 09:00	7/4/97, 09:00	7/4/97, 09:00		
	Units					
pH	pH scale	8.2	8.2	8.2	8.2	0.0
Diss. oxygen	mg/L	9.1	9.1	9.1	9.1	0.0
Spec. Cond.	mS/cm	0.20	0.20	0.20	0.20	0.00
Water temp.	deg. C	12.2	12.2	12.2	12.2	0.0
Air temp	deg. C	18.3	18.3	18.3	18.3	0.0
Inorganic carbon	mg/L	20.2	20.2	20.2	20.2	0.0
Organic carbon	mg/L	1.6	1.4	1.6	1.5	0.1
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	10.83	10.79	10.80	10.81	0.02
As	µg/L	0.4	0.4	0.3	0.4	0.0
Ba	µg/L	207	201	208	205	4
Ca	mg/L	23.66	22.66	23.66	23.33	0.58
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.8	0.9	0.8	0.8	0.0
Fe	µg/L	44	43	42	43	1
K	mg/L	0.63	0.61	0.61	0.62	0.01
Li	µg/L	1.9	1.8	1.9	1.9	0.0
Mg	mg/L	10.04	9.70	9.95	9.90	0.17
Mn	µg/L	7.1	6.8	7.0	6.9	0.2
Na	mg/L	1.74	1.80	1.61	1.72	0.10
S	mg/L	4.06	3.98	4.06	4.03	0.05
Si	mg/L	5.87	5.66	5.84	5.79	0.11
Sr	µg/L	80	78	80	79	1
Zn	µg/L	28.4	20.4	28.2	25.7	4.5

BLACKFOOT RIVER AT HOGUM CREEK ROAD
SITE "BH" ON 7/20/97

C-8.2

Sample name		BH-1	BH-2	BH-3	Mean	Std. Dev.
Sample date, approx. time		7/20/97, 09:30	7/20/97, 09:30	7/20/97, 09:30		
	Units					
pH	pH scale	7.9	7.9	7.9	7.9	0.0
Diss. oxygen	mg/L	8.8	8.8	8.8	8.8	0.0
Spec. Cond.	mS/cm	0.20	0.20	0.20	0.20	0.00
Water temp.	deg. C	11.7	11.7	11.7	11.7	0.0
Air temp	deg. C	15.0	15.0	15.0	15.0	0.0
Inorganic carbon	mg/L	22.8	22.8	22.8	22.8	0.0
Organic carbon	mg/L	1.7	1.5	1.6	1.6	0.1
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	10.77	10.82	10.87	10.82	0.05
As	µg/L	0.5	0.5	0.5	0.5	0.0
Ba	µg/L	204	202	201	202	2
Ca	mg/L	21.45	21.38	21.42	21.42	0.04
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	1.0	1.0	1.0	1.0	0.0
Fe	µg/L	67	69	64	67	3
K	mg/L	0.77	0.77	0.75	0.76	0.01
Li	µg/L	1.9	1.9	1.8	1.9	0.0
Mg	mg/L	9.88	9.85	9.85	9.86	0.02
Mn	µg/L	9.5	9.5	9.5	9.5	0.0
Na	mg/L	1.93	1.74	1.78	1.81	0.10
S	mg/L	4.42	4.31	4.32	4.35	0.06
Si	mg/L	5.95	5.88	5.88	5.90	0.04
Sr	µg/L	86	85	85	85	1
Zn	µg/L	19.7	27.5	15.6	21.0	6.1

BLACKFOOT RIVER AT HOGUM CREEK ROAD
SITE "BH", ON 8/8/97

C-8.3

Sample name		BH-1	BH-2	BH-3	Mean	Std. Dev.
Sample date, approx. time		8/8/97, 09:00	8/8/97, 09:00	8/8/97, 09:00		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	0.24	0.24	0.24	0.24	0.00
Water temp.	deg. C	10.9	10.9	10.9	10.9	0.0
Air temp	deg. C	15.3	15.3	15.3	15.3	0.0
Inorganic carbon	mg/L	26.2	26.0	26.1	26.1	0.1
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	10.51	10.48	10.48	10.49	0.01
As	µg/L	0.4	0.4	0.4	0.4	0.0
Ba	µg/L	237	234	233	234	2
Ca	mg/L	25.82	25.71	26.02	25.85	0.16
Cr	µg/L	1.1	1.0	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.6	0.6	0.6	0.6	0.0
Fe	µg/L	40	40	42	40	1
K	mg/L	0.74	0.74	0.74	0.74	0.00
Li	µg/L	2.3	2.3	2.3	2.3	0.0
Mg	mg/L	11.54	11.58	11.64	11.59	0.05
Mn	µg/L	3.6	3.6	3.6	3.6	0.0
Na	mg/L	2.17	2.15	2.20	2.17	0.02
S	mg/L	4.09	4.00	3.98	4.02	0.06
Si	mg/L	6.39	6.35	6.36	6.37	0.02
Sr	µg/L	99	98	99	99	1
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER AT HOGUM CREEK ROAD
SITE "BH", ON 9/13/97

C-8.4

Sample name		BH-1	BH-2	BH-3	Mean	Std. Dev.
Sample date, approx. time		9/13/97, 17:30	9/13/97, 17:30	9/13/97, 17:30		
	Units					
pH	pH scale	8.3	8.2	8.3	8.3	0.0
Diss. oxygen	mg/L	10.2	10.3	10.1	10.2	0.1
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	13.8	13.8	13.8	13.8	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	28.5	26.7	26.9	27.4	1.0
Organic carbon	mg/L	1.2	1.1	1.1	1.1	0.1
F	mg/L	0.07	0.07	0.07	0.07	0.00
Sulfate	mg/L	14.54	14.50	14.57	14.53	0.04
As	µg/L	0.3	0.3	0.3	0.3	0.0
Ba	µg/L	275	271	263	270	6
Ca	mg/L	29.38	29.13	28.38	28.96	0.52
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.5	0.4	0.5	0.5	0.1
Fe	µg/L	30	31	31	31	0
K	mg/L	0.91	0.91	0.89	0.91	0.01
Li	µg/L	2.7	2.6	2.6	2.6	0.0
Mg	mg/L	12.89	12.77	12.65	12.77	0.12
Mn	µg/L	3.0	3.0	2.8	2.9	0.1
Na	mg/L	2.88	2.81	3.00	2.90	0.10
S	mg/L	5.90	5.81	5.60	5.77	0.15
Si	mg/L	7.04	6.96	6.93	6.98	0.06
Sr	µg/L	116	115	107	113	5
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER AT HOGUM CREEK ROAD
SITE "BH", ON 11/18/97

C-8.5

Sample name		BH-1	BH-2	BH-3	Mean	Std. Dev.
Sample date, approx. time		11/18/97, 17:00	11/18/97, 17:00	11/18/97, 17:00		
	Units					
pH	pH scale	8.0	8.0	8.0	8.0	0.0
Diss. oxygen	mg/L	12.8	12.7	12.5	12.7	0.2
Spec. Cond.	mS/cm	0.25	0.25	0.25	0.3	0.0
Water temp.	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Air temp	deg. C	-1.4	-1.4	-1.4	-1.4	0.0
Inorganic carbon	mg/L	27.6	27.3	27.3	27.4	0.2
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Fluoride	mg/L	0.06	0.06	0.06	0.06	0.00
Sulfate	mg/L	15.19	15.23	15.34	15.26	0.08
As	µg/L	0.3	0.3	0.3	0.3	0.0
Ba	µg/L	229	230	230	229	1
Ca	mg/L	26.82	27.00	26.91	26.91	0.09
Cr	µg/L	1.2	1.3	1.3	1.2	0.1
Cu	µg/L	0.3	0.3	0.3	0.3	0.0
Fe	µg/L	16	16	16	16	0
K	mg/L	0.84	0.83	0.83	0.84	0.01
Li	µg/L	2.1	2.2	2.1	2.1	0.0
Mg	mg/L	12.55	12.57	12.60	12.57	0.03
Mn	µg/L	3.4	3.4	3.5	3.4	0.0
Na	mg/L	2.32	2.43	2.41	2.39	0.06
S	mg/L	5.43	5.46	5.49	5.46	0.03
Si	mg/L	6.55	6.57	6.59	6.57	0.02
Sr	µg/L	106	106	106	106	0
Zn	µg/L	9.5	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER AT HOGUM CREEK ROAD
SITE "BH", ON 1/6/98

C-8.6

Sample name		BH-1	BH-2	BH-3	Mean	Std. Dev.
Sample date, approx. time		1/6/98, 15:00	1/6/98, 15:00	1/6/98, 15:00		
	Units					
pH	pH scale	8.1	8.1	8.1	8.1	0.0
Diss. oxygen	mg/L	18.0-19.0			18.0-19.0	
Spec. Cond.	mS/cm	0.24	0.24	0.25	0.24	0.01
Water temp.	deg. C	0.0	0.0	0.0	0.0	0.0
Air temp	deg. C	-1.7	-1.7	-1.7	-1.7	0.0
Inorganic carbon	mg/L	27.3	26.7	26.7	26.9	0.3
Organic carbon	mg/L	*(<1)*	1.2	*(<1)*	*(<1)*	*(<1)*
Fluoride	mg/L	0.05	0.07	0.07	0.06	0.01
Sulfate	mg/L	14.10	14.00	14.10	14.07	0.06
As	µg/L	0.3	0.3	0.4	0.3	0.0
Ba	µg/L	210	217	222	216	6
Ca	mg/L	25.40	26.12	26.66	26.06	0.63
Cr	µg/L	1.3	1.5	1.4	1.4	0.1
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	12	11	12	12	0
K	mg/L	0.75	0.78	0.80	0.78	0.02
Li	µg/L	2.1	2.1	2.1	2.1	0.0
Mg	mg/L	11.86	12.13	12.38	12.12	0.26
Mn	µg/L	2.5	2.6	2.7	2.6	0.1
Na	mg/L	2.24	2.22	2.34	2.27	0.07
S	mg/L	4.24	4.31	4.21	4.25	0.05
Si	mg/L	6.12	6.23	6.21	6.19	0.06
Sr	µg/L	107	110	113	110	3
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER AT HOGUM CREEK ROAD
SITE "BH", ON 3/8/98

C-8.7

Sample name		BH-1	BH-2	BH-3	Mean	Std. Dev.
Sample date, approx. time		3/8/98, 14:45	3/8/98, 14:45	3/8/98, 14:45		
	Units					
pH	pH scale	8.1	8.1	8.1	8.1	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	0	0.1	0	0.0	0.1
Air temp	deg. C	-3.2	-3.3	-3.3	-3.3	0.1
Inorganic carbon	mg/L	27.8	28.2	27.4	27.8	0.4
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Fluoride	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Sulfate	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
As	µg/L	0.4	0.3	0.3	0.3	0.0
Ba	µg/L	215	211	211	212.4	2.5
Ca	mg/L	26.36	*26.12*	*26.34*	26.27	0.13
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.8)*	*(<0.8)*	*(<0.8)*	*(<0.8)*	*(<0.8)*
Fe	µg/L	8	8	8	8	0
K	mg/L	0.86	0.85	0.83	0.85	0.02
Li	µg/L	2	2.0	2.0	2.0	0.0
Mg	mg/L	12.89	12.81	12.77	12.82	0.06
Mn	µg/L	3.9	3.8	3.8	3.8	0.0
Na	mg/L	2.13	2.13	2.24	2.16	0.07
S	mg/L	4.37	4.32	4.27	4.32	0.05
Si	mg/L	6.08	6.02	5.99	6.03	0.05
Sr	µg/L	114	114	114	113.9	0.5
Zn	µg/L	*(<0.2)*	0.5	0.6	*(<0.2)*	*(<0.2)*

BLACKFOOT RIVER AT ASPEN GROVE CAMPGROUND
SITE "BB", ON 7/4/97

C-9.1

Sample name		BB-1	BB-2	BB-3	Mean	Std. Dev.
Sample date, approx. time		7/4/97, 13:00	7/4/97, 13:00	7/4/97, 13:00		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	8.4	8.4	8.4	8.4	0.0
Spec. Cond.	mS/cm	0.20	0.20	0.20	0.20	0.00
Water temp.	deg. C	14.5	14.5	14.5	14.5	0.0
Air temp	deg. C	19.3	19.3	19.3	19.3	0.0
Inorganic carbon	mg/L	20.1	20.0	20.1	20.0	0.0
Organic carbon	mg/L	1.4	1.7	1.3	1.5	0.2
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	10.45	10.50	10.48	10.48	0.02
As	µg/L	0.6	0.6	0.5	0.6	0.0
Ba	µg/L	190	190	178	186	7
Ca	mg/L	21.80	21.71	20.86	21.46	0.52
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.7	0.7	0.7	0.7	0.0
Fe	µg/L	40	43	38	40	2
K	mg/L	0.62	0.63	0.62	0.62	0.00
Li	µg/L	2.0	2.1	2.1	2.1	0.0
Mg	mg/L	9.36	9.31	9.34	9.34	0.03
Mn	µg/L	5.8	5.9	5.7	5.8	0.1
Na	mg/L	1.83	1.78	1.89	1.83	0.05
S	mg/L	3.68	3.64	3.60	3.64	0.04
Si	mg/L	5.865	5.82	5.67	5.78	0.10
Sr	µg/L	93.81	94	88	92	3
Zn	µg/L	13.5	22.0	11.2	15.6	5.7

BLACKFOOT RIVER AT ASPEN GROVE CAMPGROUND
SITE "BB", ON 7/20/97

C-9.2

Sample name		BB-1	BB-2	BB-3	Mean	Std. Dev.
Sample date, approx. time		7/20/97, 11:00	7/20/97, 11:00	7/20/97, 11:00		
	Units					
pH	pH scale	8.0	8.0	8.0	8.0	0.0
Diss. oxygen	mg/L	8.9	8.9	8.9	8.9	0.0
Spec. Cond.	mS/cm	0.20	0.20	0.20	0.20	0.00
Water temp.	deg. C	12.1	12.1	12.1	12.1	0.0
Air temp	deg. C	18.9	18.9	18.9	18.9	0.0
Inorganic carbon	mg/L	22.6	22.6	23.6	22.9	0.6
Organic carbon	mg/L	1.7	1.6	1.7	1.7	0.1
Fluoride	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	10.68	10.62	10.574	10.626	0.055
As	µg/L	0.5	0.5	0.5	0.5	0.0
Ba	µg/L	194	190	191	192	2
Ca	mg/L	20.85	20.60	20.61	20.69	0.14
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.9	0.9	0.8	0.9	0.0
Fe	µg/L	66	60	52	59	7
K	mg/L	0.76	0.74	0.75	0.75	0.01
Li	µg/L	2.1	2.1	2.1	2.1	0.0
Mg	mg/L	9.43	9.35	9.38	9.39	0.04
Mn	µg/L	8.1	7.5	7.5	7.7	0.4
Na	mg/L	1.97	2.07	1.95	2.0	0.1
S	mg/L	4.08	4.01	4.04	4.04	0.04
Si	mg/L	6.09	6.01	6.03	6.04	0.04
Sr	µg/L	104	102	103	103	1
Zn	µg/L	18.9	15.1	16.3	16.8	1.9

BLACKFOOT RIVER AT ASPEN GROVE CAMPGROUND
SITE "BB", ON 8/7/97

C-9.3

Sample Name, Date		BB-1	BB-2	BB-3	Mean	Std. Dev.
Sample date, approx. time		8/7/97, 17:00	8/7/97, 17:00	8/7/97, 17:00		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	9.8	9.8	9.8	9.8	0.0
Spec. Cond.	mS/cm	0.23	0.23	0.23	0.23	0.00
Water temp.	deg. C	16.7	16.7	16.7	16.7	0.0
Air temp	deg. C	15.1	15.1	15.1	15.1	0.0
Inorganic carbon	mg/L	25.3	25.3	25.4	25.3	0.1
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	10.13	10.06	10.21	10.13	0.07
As	µg/L	0.4	0.4	0.4	0.4	0.0
Ba	µg/L	226	229	220	225	4
Ca	mg/L	24.94	25.04	24.10	24.69	0.52
Cr	µg/L	*(<1)*	1.0	1.0	*(<1)*	*(<1)*
Cu	µg/L	0.5	0.6	0.6	0.6	0.1
Fe	µg/L	42	44	41	42	1
K	mg/L	0.79	0.79	0.79	0.79	0.00
Li	µg/L	2.8	2.6	2.6	2.7	0.1
Mg	mg/L	10.78	10.85	10.79	10.81	0.04
Mn	µg/L	13.6	2.6	2.8	6.3	6.3
Na	mg/L	2.38	2.30	2.24	2.31	0.07
S	mg/L	3.74	3.82	3.68	3.75	0.07
Si	mg/L	6.60	6.58	6.45	6.55	0.08
Sr	µg/L	132	126	122	127	5
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER AT ASPEN GROVE CAMPGROUND
SITE "BB", ON 9/13/97

C-9.4

Sample name		BB-1	BB-2	BB-3	Mean	Std. Dev.
Sample date, approx, time		9/13/97, 18:30	9/13/97, 18:30	9/13/97, 18:30		
	Units					
pH	pH scale	8.1	8.1	8.1	8.1	0.0
Diss. oxygen	mg/L	9.8	10.0	9.8	9.9	0.1
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	13.6	13.6	13.6	13.6	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	27.9	27.4	27.5	27.6	0.3
Organic carbon	mg/L	1.1	1.0	1.2	27.6	0.3
F	mg/L	0.07	0.07	0.07	0.07	0.00
Sulfate	mg/L	14.04	14.11	14.03	14.06	0.04
As	µg/L	0.4	0.4	0.4	0.4	0.0
Ba	µg/L	254	258	253	255	3
Ca	mg/L	29.72	29.64	29.35	29.57	0.19
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.4	0.3	0.5	0.4	0.1
Fe	µg/L	33	35	34	34	1
K	mg/L	0.87	0.88	0.87	0.87	0.01
Li	µg/L	2.7	2.7	2.8	2.7	0.0
Mg	mg/L	12.01	12.11	12.09	12.07	0.05
Mn	µg/L	1.6	1.7	1.7	1.7	0.0
Na	mg/L	3.01	2.72	2.99	2.91	0.16
S	mg/L	4.97	5.07	4.98	5.00	0.06
Si	mg/L	7.14	7.19	7.17	7.16	0.03
Sr	µg/L	127	128	127	127	1
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER AT ASPEN GROVE CAMPGROUND
SITE "BB", ON 10/25/97

C-9.5

Sample name		BB-1	BB-2	BB-3	Mean	Std. Dev.
Sample date, approx. time		10/25/97, 10:30	10/25/97, 10:30	(no sample)		
	Units					
pH at 10:30	pH scale	8.3	8.3	8.3	8.3	0.0
pH at 15:30	pH scale	8.1	8.1	8.2	8.1	0.0
Diss. oxygen	mg/L	13.0	12.9	13.0	13.0	0.1
Spec. Cond.	mS/cm	0.24	0.24	0.24	0.24	0.00
Water temp. at 10:30	deg. C	1.1	1.1	1.1	1.1	0.0
Water temp. at 15:30	deg. C	3.5	3.5	3.5	3.5	0.0
Air temp	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	27.5	28.3	*(NA)*	27.9	0.6
Organic carbon	mg/L	*(<1)*	*(<1)*	*(NA)*	*(<1)*	*(<1)*
F	mg/L	0.7	0.7	*(NA)*	0.7	0.0
Sulfate	µg/L	13.40	13.40	*(NA)*	13.40	0.00
As	µg/L	0.3	0.3	*(NA)*	0.3	0.0
Ba	mg/L	226	206	*(NA)*	216	14
Ca	µg/L	27.70	25.12	*(NA)*	26.41	1.82
Cr	µg/L	*(<1)*	*(<1)*	*(NA)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(NA)*	*(<0.3)*	*(<0.3)*
Fe	mg/L	26	23	*(NA)*	25	2
K	µg/L	0.74	0.67	*(NA)*	0.70	0.05
Li	mg/L	2.4	2.3	*(NA)*	2.3	0.1
Mg	µg/L	11.16	10.22	*(NA)*	10.69	0.66
Mn	mg/L	2.2	2.0	*(NA)*	2.1	0.1
Na	mg/L	2.56	2.43	*(NA)*	2.50	0.09
S	mg/L	5.25	5.46	*(NA)*	5.35	0.14
Si	µg/L	7.00	6.85	*(NA)*	6.92	0.11
Sr	µg/L	112	102	*(NA)*	107	7
Zn	µg/l	*(<8)*	*(<8)*	*(NA)*	*(<8)*	*(<8)*

BLACKFOOT RIVER AT ASPEN GROVE CAMPGROUND
SITE "BB", ON 11/16/97

C-9.6

Sample name		BB-1	BB-2	BB-3	Mean	Std. Dev.
Sample date, approx, time		11/16/97, 14:30	11/16/97, 14:30	11/16/97, 14:30		
	Units					
pH	pH scale	8.1	8.1	8.1	8.1	0.0
Diss. oxygen	mg/L	13.5-21.0			13.5-21.0	
Spec. Cond.	mS/cm	0.26	0.26	0.26	0.26	0.00
Water temp.	deg. C	0.1	0.1	0.1	0.1	0.0
Air temp	deg. C	2.3	2.3	2.3	2.3	0.0
Inorganic carbon	mg/L	29.0	29.5	28.5	29.0	0.5
Organic carbon	mg/L	1.2	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	0.07	0.07	0.07	0.07	0.00
Sulfate	mg/L	15.65	15.72	15.84	15.74	0.10
As	µg/L	0.4	0.3	0.3	0.3	0.0
Ba	µg/L	233	232	228	231	3
Ca	mg/L	28.07	28.05	28.52	28.21	0.27
Cr	µg/L	1.2	1.2	1.1	1.2	0.1
Cu	µg/L	0.4	0.3	0.3	0.3	0.1
Fe	µg/L	15	15	14	15	0
K	mg/L	0.91	0.91	0.90	0.90	0.01
Li	µg/L	2.4	2.4	2.4	2.4	0.0
Mg	mg/L	13.14	13.11	13.20	13.15	0.05
Mn	µg/L	3.6	3.5	3.5	3.5	0.1
Na	mg/L	2.69	2.57	2.82	2.69	0.12
S	mg/L	5.67	5.59	5.48	5.58	0.10
Si	mg/L	7.01	7.00	6.98	6.99	0.01
Sr	µg/L	126	126	126	126	0
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER AT ASPEN GROVE CAMPGROUND- Hyporheic zone sampler 1
SITE "BB-HZ1", ON 10/25/97

C-9.7

Sample name		BB-HZ1	BB-HZ1	BB-HZ1	BB-HZ1	BB-HZ1
Sample depth		10cm	20cm	40cm	60cm	74cm
Sample date, approx. time		10/25/97, 15:30	10/25/97, 15:30	10/25/97, 10:30	10/25/97, 10:30	10/25/97, 15:30
	Units					
pH	pH scale	8.3	8.2	8.3	8.3	7.9
Diss. oxygen	mg/L	11.5-12.0	11.0-12.0	10.0-11.0	10.0-10.5	9.0-10.0
Spec. Cond.	mS/cm	0.25	0.25	0.24	0.25	0.24
(Surface water temp)	deg. C	3.5	3.5	1.1	1.1	3.5
Hyp. zone water temp.	deg. C	4.1	5.6	1.1	1.1	4.8
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	28.0	27.7	27.2	26.7	27.0
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	1.0	1.4
F	mg/L	0.07	0.09	0.06	0.07	0.08
Sulfate	mg/L	12.39	12.31	13.52	13.51	12.98
As	µg/L	0.3	0.3	0.3	*(NA)*	0.3
Ba	µg/L	251	251	247	244	209
Ca	mg/L	30.15	30.23	30.52	30.17	28.74
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.3	*(<0.3)*	0.3	0.3	0.7
Fe	µg/L	23	24	24	17	11
K	mg/L	0.80	0.79	0.77	0.78	0.67
Li	µg/L	2.6	2.7	2.6	2.5	2.3
Mg	mg/L	11.87	11.91	12.16	12.07	11.64
Mn	µg/L	1.6	1.4	0.9	1.0	0.3
Na	mg/L	3.01	3.08	3.34	3.47	5.08
S	mg/L	4.80	4.82	5.18	5.15	4.94
Si	mg/L	7.13	7.15	7.14	7.09	6.67
Sr	µg/L	129	129	124	123	119
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER AT ASPEN GROVE CAMPGROUND- Hyporheic zone sampler 2
SITE "BB-HZ2", ON 10/25/97

C-9.8

Sample name		BB-HZ2	BB-HZ2	BB-HZ2	BB-HZ2	BB-HZ2
Sample depth		10cm	20cm	35cm	55cm	85cm
Sample date, approx. time		10/25/97 16:30	10/25/97 16:30	10/25/97 16:30	10/25/97 16:30	10/25/97 16:30
	Units					
pH (rdg stds 0.2 units high)	pH scale	8.1	8.3	8.2	8.3	7.6
Diss. oxygen	mg/L	10.5-11.0	*(NA)*	10.0-11.0	*(NA)*	8.2
Spec. Cond.	mS/cm	0.24	0.24	0.24	0.24	0.24
Water temp.	deg. C	3.9	*(NA)*	4.0	3.6	4.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	27.6	27.7	27.2	27.3	26.8
Organic carbon	mg/L	*(<1)*	*(<1)*	*1*	*(<1)*	*(<1)*
F	mg/L	0.07	0.06	0.07	0.06	0.07
Sulfate	mg/L	12.70	12.59	12.53	12.67	14.33
As	µg/L	0.3	0.3	0.3	0.3	0.2
Ba	µg/L	249	251	248	251	222
Ca	mg/L	30.25	30.16	30.59	30.23	29.41
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	1.0
Fe	µg/L	23	24	24	23	13
K	mg/L	0.80	0.82	0.80	0.81	0.60
Li	µg/L	2.6	2.6	2.6	2.6	2.3
Mg	mg/L	11.95	11.95	12.04	11.97	11.61
Mn	µg/L	2.0	2.0	1.9	1.5	*(<0.3)*
Na	mg/L	3.00	2.94	3.02	2.96	4.28
S	mg/L	4.74	4.81	4.70	4.83	5.40
Si	mg/L	7.11	7.10	7.11	7.10	6.44
Sr	µg/L	128	126	128	126	124
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

APPENDIX C-10

BLACKFOOT RIVER- JUST ABOVE CONFLUENCE WITH LANDER'S FORK
SITE "BC", ON 7/20/97

C-10.1

Sample name		BC-1	BC-2	BC-3	Mean	Std. Dev.
Sample date, approx. time		7/20/97, 13:00	7/20/97, 13:00	7/20/97, 13:00		
	Units					
pH	pH scale	7.9	7.9	7.9	7.9	0.0
Diss. oxygen	mg/L	8.5	8.5	8.5	8.5	0.0
Spec. Cond.	mS/cm	0.21	0.21	0.21	0.21	0.00
Water temp.	deg. C	12.6	12.6	12.6	12.6	0.0
Air temp	deg. C	19.3	19.3	19.3	19	0
Inorganic carbon	mg/L	23.8	23.7	23.6	23.7	0.1
Organic carbon	mg/L	1.4	*(NA)*	1.6	1.5	0.1
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	10.52	10.62	10.74	10.63	0.11
As	µg/L	0.5	0.5	0.5	0.5	0.0
Ba	µg/L	192	194	193	193	1
Ca	mg/L	21.46	21.08	21.29	21.28	0.19
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.8	0.8	0.8	0.8	0.0
Fe	µg/L	48	46	49	48	2
K	mg/L	0.77	0.76	0.76	1	0
Li	µg/L	2.3	2.2	2.2	2.2	0.0
Mg	mg/L	9.65	9.55	9.62	9.60	0.06
Mn	µg/L	5.2	5.2	5.2	5.2	0.0
Na	mg/L	2.17	1.98	2.15	2.10	0.10
S	mg/L	3.92	3.99	4.00	3.97	0.04
Si	mg/L	6.05	6.01	6.05	6.04	0.02
Sr	µg/L	106	106	106	106	0
Zn	µg/L	*(<8)*	11.2	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER- JUST ABOVE CONFLUENCE WITH LANDER'S FORK
SITE "BC", ON 8/7/97

C-10.2

Sample name		BC-1	BC-2	BC-3	Mean	Std. Dev.
Sample date, approx. time		8/7/97,	8/7/97,	8/7/97,		
	Units					
pH	pH scale	8.1	8.1	8.1	8.1	0.0
Diss. oxygen	mg/L	9.2	9.2	9.2	9.2	0.0
Spec. Cond.	mS/cm	0.23	0.23	0.23	0.23	0.00
Water temp.	deg. C	14.8	14.8	14.8	14.8	0.0
Air temp	deg. C	16.1	16.1	16.1	16.1	0.0
Inorganic carbon	mg/L	26.2	26.1	25.6	26.0	0.3
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	10.11	10.03	10.04	10.06	0.04
As	µg/L	0.4	0.4	0.4	0.4	0.0
Ba	µg/L	233	230	248	237	10
Ca	mg/L	26.23	25.58	27.77	26.53	1.12
Cr	µg/L	1.0	1.0	1.0	1.0	0.0
Cu	µg/L	0.4	0.4	0.6	0.5	0.1
Fe	µg/L	28	28	29	28	0
K	mg/L	0.82	0.82	0.86	0.83	0.02
Li	µg/L	2.8	2.8	2.9	2.9	0.1
Mg	mg/L	11.24	11.06	11.88	11.39	0.43
Mn	µg/L	1.8	1.8	2.0	1.89	0.08
Na	mg/L	2.46	2.41	2.43	2.43	0.03
S	mg/L	3.93	3.93	3.65	3.83	0.16
Si	mg/L	6.67	6.61	6.61	6.63	0.03
Sr	µg/L	133	131	141	135	5
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER- JUST ABOVE CONFLUENCE WITH LANDER'S FORK
SITE "BC", ON 9/14/97

C-10.3

Sample name		BC-1	BC-2	BC-3	Mean	Std. Dev.
Sample date, approx. time		9/14/97, 10:00	9/14/97, 10:00	9/14/97, 10:00		
	Units					
pH	pH scale	7.9	7.9	7.9	7.9	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	9.0	9.0	9.0	9.0	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	27.6	28.9	*(NA)*	28.3	0.9
Organic carbon	mg/L	1.1	*(<1)*	*(NA)*	*(<1)*	*(NA)*
F	mg/L	0.07	0.07	*(NA)*	0.07	0.0
Sulfate	mg/L	13.57	13.50	*(NA)*	13.53	0.1
As	µg/L	0.4	0.3	*(NA)*	0.4	0.0
Ba	µg/L	253	245	*(NA)*	249	5.7
Ca	mg/L	29.65	29.87	*(NA)*	29.76	0.2
Cr	µg/L	*(<1)*	*(<1)*	*(NA)*	*(<1)*	*(<1)*
Cu	µg/L	0.3	*(<0.3)*	*(NA)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	19	18	*(NA)*	19	0.6
K	mg/L	0.86	0.84	*(NA)*	0.85	0.01
Li	µg/L	2.9	2.9	*(NA)*	2.9	0.0
Mg	mg/L	12.07	12.04	*(NA)*	12.06	0.02
Mn	µg/L	0.9	0.9	*(NA)*	0.9	0.0
Na	mg/L	2.83	2.69	*(NA)*	2.76	0.10
S	mg/L	4.90	4.66	*(NA)*	4.78	0.17
Si	mg/L	7.17	7.02	*(NA)*	7.09	0.10
Sr	µg/L	129	127	*(NA)*	128	1.63
Zn	µg/L	*(<8)*	*(<8)*	*(NA)*	*(<8)*	*(<8)*

BLACKFOOT RIVER- JUST ABOVE CONFLUENCE WITH LANDER'S FORK
SITE "BC", ON 10/25/97

C-10.4

Sample name		BC-1	BC-2	BC-3	Mean	Std. Dev.
Sample date, approx. time		10/25/97, 12:00	10/25/97, 12:00	10/25/97, 12:00		
	Units					
pH	pH scale	7.8	7.9	7.9	7.9	0.02
Diss. oxygen	mg/L	12.0	11.8	11.8	11.9	0.1
Spec. Cond.	mS/cm	0.24	0.24	0.24	0.24	0.00
Water temp.	deg. C	3.5	3.5	3.5	3.5	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	27.7	27.9	27.9	27.8	0.1
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	0.07	0.07	0.07	0.07	0.00
Sulfate	mg/L	13.39	13.41	13.36, 13.45	13.40	0.01
As	µg/L	0.3	0.3	0.3	0.3	0.0
Ba	µg/L	263	205	221	230	30
Ca	mg/L	32.43	24.84	27.62	28.30	3.84
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	20	17	18	19	2
K	mg/L	0.84	0.65	0.71	0.73	0.10
Li	µg/L	2.8	2.4	2.5	2.6	0.2
Mg	mg/L	12.68	9.95	10.96	11.20	1.38
Mn	µg/L	0.9	0.7	0.8	0.8	0.1
Na	mg/L	2.97	2.46	2.65	2.69	0.26
S	mg/L	4.54	5.81	5.33	5.23	0.64
Si	mg/L	7.04	6.98	6.98	7.00	0.04
Sr	µg/L	135	106	115	118	15
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER- JUST ABOVE CONFLUENCE WITH LANDER'S FORK
SITE "BC", ON 11/16/97

C-10.5

Sample name		BC-1	BC-2	BC-3	Mean	Std. Dev.
Sample date, approx. time		11/16/97, 16:30	11/16/97, 16:30	11/16/97, 16:30		
	Units					
pH	pH scale	7.8	7.8	7.8	7.8	0.0
Diss. oxygen	mg/L	13.5-14.0			13.5-14.0	
Spec. Cond.	mS/cm	0.25	0.25	0.25	0.25	0.00
Water temp.	deg. C	0.4	0.4	0.4	0.4	0.0
Air temp	deg. C	3.1	3.1	3.1	3.1	0.0
Inorganic carbon	mg/L	28.8	28.2	27.9	28.3	0.5
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	0.07	0.07	0.08	0.07	0.01
Sulfate	mg/L	14.28	14.32	14.24	14.28	0.04
As	µg/L	0.3	0.3	0.3	0.3	0.0
Ba	µg/L	226	227	228	227	1
Ca	mg/L	27.24	27.09	27.30	27.21	0.11
Cr	µg/L	1.3	1.3	1.3	1.3	0.0
Cu	µg/L	0.6	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	10	10	10	10	0
K	mg/L	0.84	0.84	0.84	0.84	0.00
Li	µg/L	2.5	2.5	2.5	2.5	0.0
Mg	mg/L	12.37	12.28	12.35	12.33	0.05
Mn	µg/L	0.7	0.7	0.7	0.7	0.0
Na	mg/L	2.70	2.83	2.46	2.66	0.19
S	mg/L	5.20	5.27	5.21	5.23	0.04
Si	mg/L	6.75	6.74	6.76	6.75	0.01
Sr	µg/L	134	134	134	134	0
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER- JUST ABOVE CONFLUENCE WITH LANDER'S FORK
SITE "BC", ON 1/6/98

C-10.6

Sample name		BC-1	BC-2	BC-3	Mean	Std. Dev.
Sample date, approx. time		1/6/97, 16:30	1/6/97, 16:30	1/6/97, 16:30		
	Units					
pH	pH scale	7.8	7.8	7.8	7.8	0.0
Diss. oxygen	mg/L	16.0-17.0			16.0-17.0	
Spec. Cond.	mS/cm	0.25	0.25	0.25	0.25	0.00
Water temp.	deg. C	1.6	1.6	1.6	1.6	0.0
Air temp	deg. C	-2.7	-2.7	-2.7	-2.7	0.0
Inorganic carbon	mg/L	27.5	27.6	27.3	27.5	0.1
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	0.08	0.08	0.07	0.08	0.01
Sulfate	mg/L	15.00	15.10	15.20	15.10	0.10
As	µg/L	0.4	0.4	0.3	0.4	0.0
Ba	µg/L	222	219	220	220	1
Ca	mg/L	27.23	27.16	27.46	27.28	0.16
Cr	µg/L	1.4	1.5	1.3	1.4	0.1
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	9	9	9	9	0
K	mg/L	0.82	0.81	0.81	0.81	0.00
Li	µg/L	2.5	2.5	2.5	2.49	0.03
Mg	mg/L	12.12	12.07	12.11	12.10	0.03
Mn	µg/L	0.4	0.4	0.4	0.4	0.0
Na	mg/L	2.46	2.78	2.57	2.60	0.16
S	mg/L	4.46	4.45	4.40	4.44	0.03
Si	mg/L	6.39	6.36	6.35	6.36	0.02
Sr	µg/L	137	137	137	137	0
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

APPENDIX C-10

BLACKFOOT RIVER- JUST ABOVE CONFLUENCE WITH LANDER'S FORK
SITE "BC", ON 3/8/98

C-10.7

Sample name		BC-1	BC-2	BC-3	Mean	Std. Dev.
Sample date, approx. time		3/8/98, 16:00	3/8/98, 16:00	3/8/98, 16:00		
	Units					
pH	pH scale	7.9	7.8	7.9	7.9	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	0.4	0.4	0.3	0.4	0.1
Air temp	deg. C	-2.2	-2.3	-2.2	-2.2	0.1
Inorganic carbon	mg/L	27.9	27.5	27.6	27.6	0.2
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Sulfate	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
As	µg/L	0.3	0.3	0.3	0.3	0.0
Ba	µg/L	208	215	209	210.5	3.7
Ca	mg/L	26.33	26.49	26.15	26.32	0.17
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.8)*	*(<0.8)*	*(<0.8)*	*(<0.8)*	*(<0.8)*
Fe	µg/L	*(<5)*	*(<5)*	*(<5)*	*(<5)*	*(<5)*
K	mg/L	0.80	0.84	0.81	0.82	0.02
Li	µg/L	2.3	2.3	2	2.3	0.0
Mg	mg/L	12.34	12.59	12.28	12.40	0.16
Mn	µg/L	0.6	0.6	0.6	0.6	0.0
Na	mg/L	2.43	2.32	2.34	2.36	0.06
S	mg/L	4.38	4.52	4.45	4.45	0.07
Si	mg/L	6.00	6.15	5.99	6.04	0.09
Sr	µg/L	140	141	138	140	2
Zn	µg/L	0.2	*(<0.2)*	*(<0.2)*	*(<0.2)*	*(<0.2)*

BLACKFOOT RIVER- JUST ABOVE CONFLUENCE WITH LANDER'S FORK
SITE "BC-HZ", ON 10/25/97

C-10.8

Sample name		BC-HZ	BC-HZ	BC-HZ
Sample depth		10cm	30cm	74cm
Sample date, approx. time		10/25/97, 12:00	10/25/97, 12:00	10/25/97, 12:00
	Units			
pH	pH scale	8.0	7.9	7.8
Diss. oxygen	mg/L	11	11	10
Spec. Cond.	mS/cm	0.25	0.24	0.25
Water temp.	deg. C	3.5	2.9	4.1
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	28.05	27.95	27.34
Organic carbon	mg/L	*(<1)*	*(<1)*	1.2
F	mg/L	0.07	0.07	0.09
Sulfate	mg/L	13.59	13.68	14.07
As	µg/L	0.3	0.3	0.3
Ba	µg/L	249	245	225
Ca	mg/L	30.33	30.18	29.93
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	0.3
Fe	µg/L	18	18	16
K	mg/L	0.80	0.79	0.71
Li	µg/L	2.7	2.7	2.6
Mg	mg/L	11.93	11.84	11.74
Mn	µg/L	0.8	0.8	*(<0.3)*
Na	mg/L	2.91	2.87	5.48
S	mg/L	5.19	5.01	5.15
Si	mg/L	7.06	7.00	6.82
Sr	µg/L	128	126	123
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER-BELOW CONFLUENCE WITH LANDER'S FORK
SITE "BD", ON 7/3/97

C-11.1

Sample name		BD-1 7/3/97	BD-2 7/3/97	BD-3 7/3/97	Mean	Std. Dev.
Sample date, approx. time		7/3/97, 15:00	7/3/97, 15:00	7/3/97, 15:00		
	Units					
pH	pH scale	8.4	8.4	8.4	8.4	0.0
Diss. oxygen	mg/L	9.0	9.0	9.0	9.0	0.0
Spec. Cond.	mS/cm	0.21	0.21	0.21	0.21	0.00
Water temp.	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	24.0	23.5	23.3	23.6	0.4
Organic carbon	mg/L	*(<1)*	1.4	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	3.76	5.12	5.51	4.80	0.92
As	µg/L	0.6	0.6	0.6	0.6	0.0
Ba	µg/L	181	185	172	180	7
Ca	mg/L	26.46	26.36	23.89	25.57	1.46
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.4	0.4	0.4	0.4	0.0
Fe	µg/L	10	14	15	13	3
K	mg/L	0.42	0.46	0.45	0.44	0.03
Li	µg/L	1.7	1.8	1.7	1.7	0.1
Mg	mg/L	9.45	9.67	9.06	9.39	0.31
Mn	µg/L	1.0	1.7	1.8	1.5	0.4
Na	mg/L	0.77	1.07	1.15	1.00	0.20
S	mg/L	1.25	1.71	1.76	1.57	0.28
Si	mg/L	3.40	3.90	3.78	3.69	0.26
Sr	µg/L	49	59	57	55	5
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER-BELOW CONFLUENCE WITH LANDER'S FORK
SITE "BD", ON 7/20/97

C-11.2

Sample name		BD-1	BD-2	BD-3	Mean	Std. Dev.
Sample date, approx. time		7/20/97, 16:30	7/20/97, 16:30	7/20/97, 16:30		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	8.7	8.7	8.7	8.7	0.0
Spec. Cond.	mS/cm	0.22	0.22	0.22	0.22	0.00
Water temp.	deg. C	13.6	13.6	13.6	13.6	0.0
Air temp	deg. C	23.7	23.7	23.7	23.7	0.0
Inorganic carbon	mg/L	27.8	27.5	27.2	27.5	0.3
Organic carbon	mg/L	1.0	0.7	*(NA)*	0.7	0.3
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	5.54	5.82	6.30	5.9	0.4
As	µg/L	0.6	0.6	0.6	0.6	0.0
Ba	µg/L	189	192	190	190	2
Ca	mg/L	25.50	25.55	25.11	25.39	0.24
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.3	0.4	0.4	0.4	0.0
Fe	µg/L	17	19	20	19	2
K	mg/L	0.47	0.50	0.52	0.50	0.02
Li	µg/L	2.0	2.0	2.1	2.0	0.0
Mg	mg/L	9.99	10.07	10.01	10.02	0.04
Mn	µg/L	1.7	2.0	2.1	1.9	0.2
Na	mg/L	0.99	1.04	1.01	1.01	0.02
S	mg/L	1.64	1.83	1.94	1.80	0.15
Si	mg/L	3.83	4.05	4.16	4.01	0.16
Sr	µg/L	58	63	66	62	4
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

BLACKFOOT RIVER-BELOW CONFLUENCE WITH LANDER'S FORK
SITE "BD", ON 8/7/97

C-11.3

Sample name		BD-1	BD-2	BD-3	Mean	Std. Dev.
Sample date, approx. time		8/7/97, 19:00	8/7/97, 19:00	8/7/97, 19:00		
	Units					
pH	pH scale	8.3	8.3	8.3	8.3	0.0
Diss. oxygen	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Spec. Cond.	mS/cm	0.25	0.25	0.25	0.25	0.00
Water temp.	deg. C	12.1	12.1	12.1	12.1	0.0
Air temp	deg. C	16.7	16.7	16.7	16.7	0.0
Inorganic carbon	mg/L	29.7	30.2	29.9	29.9	0.2
Organic carbon	mg/L	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
F	mg/L	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	5.62	5.63	5.31	5.52	0.18
As	µg/L	0.4	0.4	0.4	0.4	0.0
Ba	µg/L	221	219	233	224	7
Ca	mg/L	29.00	29.89	30.57	29.82	0.79
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	0.3	0.3	0.4	0.3	0.0
Fe	µg/L	12	12	12	12	0
K	mg/L	0.56	0.55	0.55	0.55	0.01
Li	µg/L	2.4	2.4	2.4	2.4	0.0
Mg	mg/L	11.29	11.51	11.50	11.43	0.12
Mn	µg/L	0.9	0.9	0.9	0.9	0.0
Na	mg/L	1.29	1.31	1.20	1.27	0.06
S	mg/L	1.79	1.68	1.73	1.73	0.05
Si	mg/L	4.32	4.26	4.33	4.30	0.04
Sr	µg/L	72	70	72	71	1
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

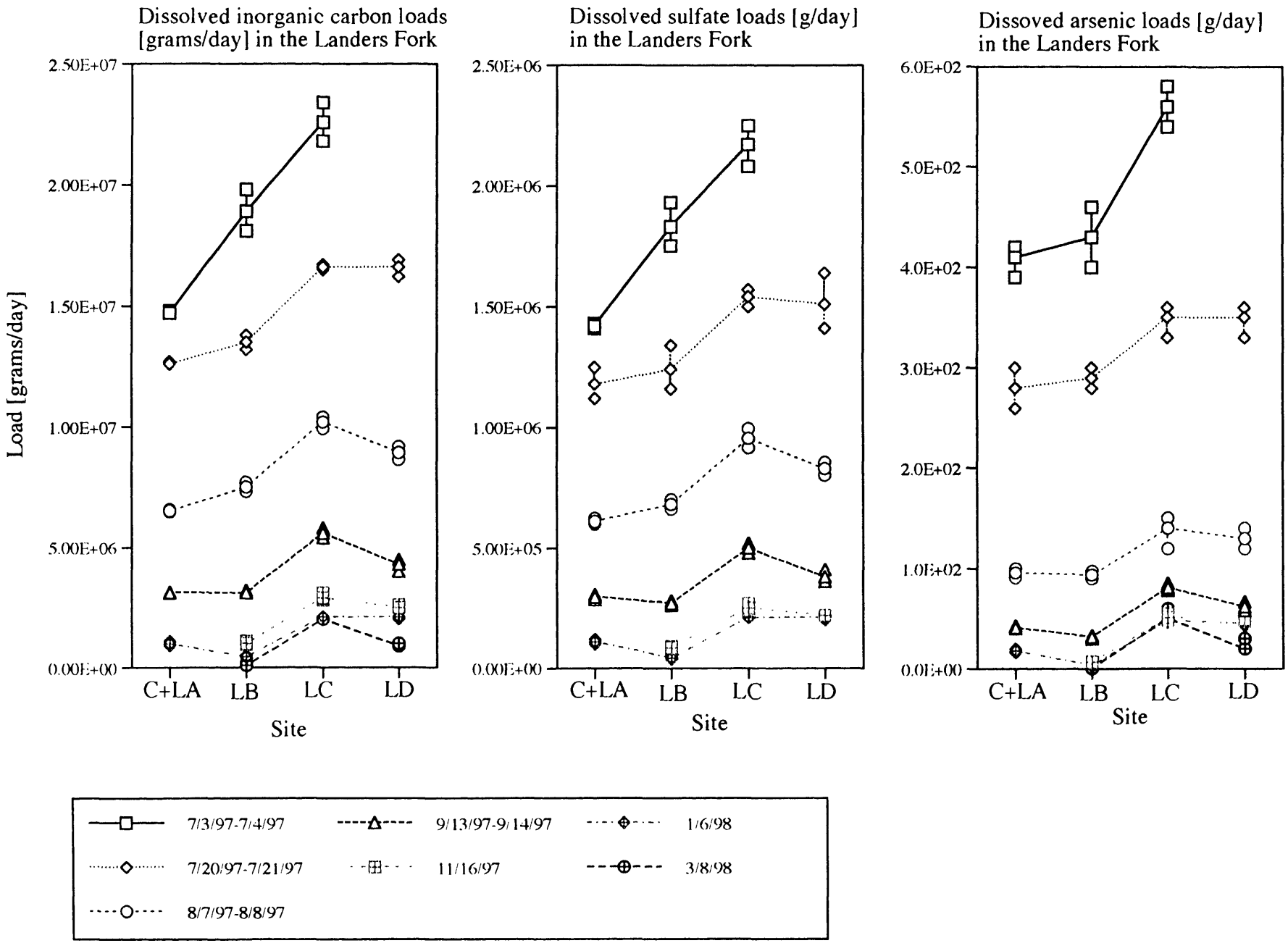
BLACKFOOT RIVER-BELOW CONFLUENCE WITH LANDER'S FORK
SITE "BD", ON 9/14/97

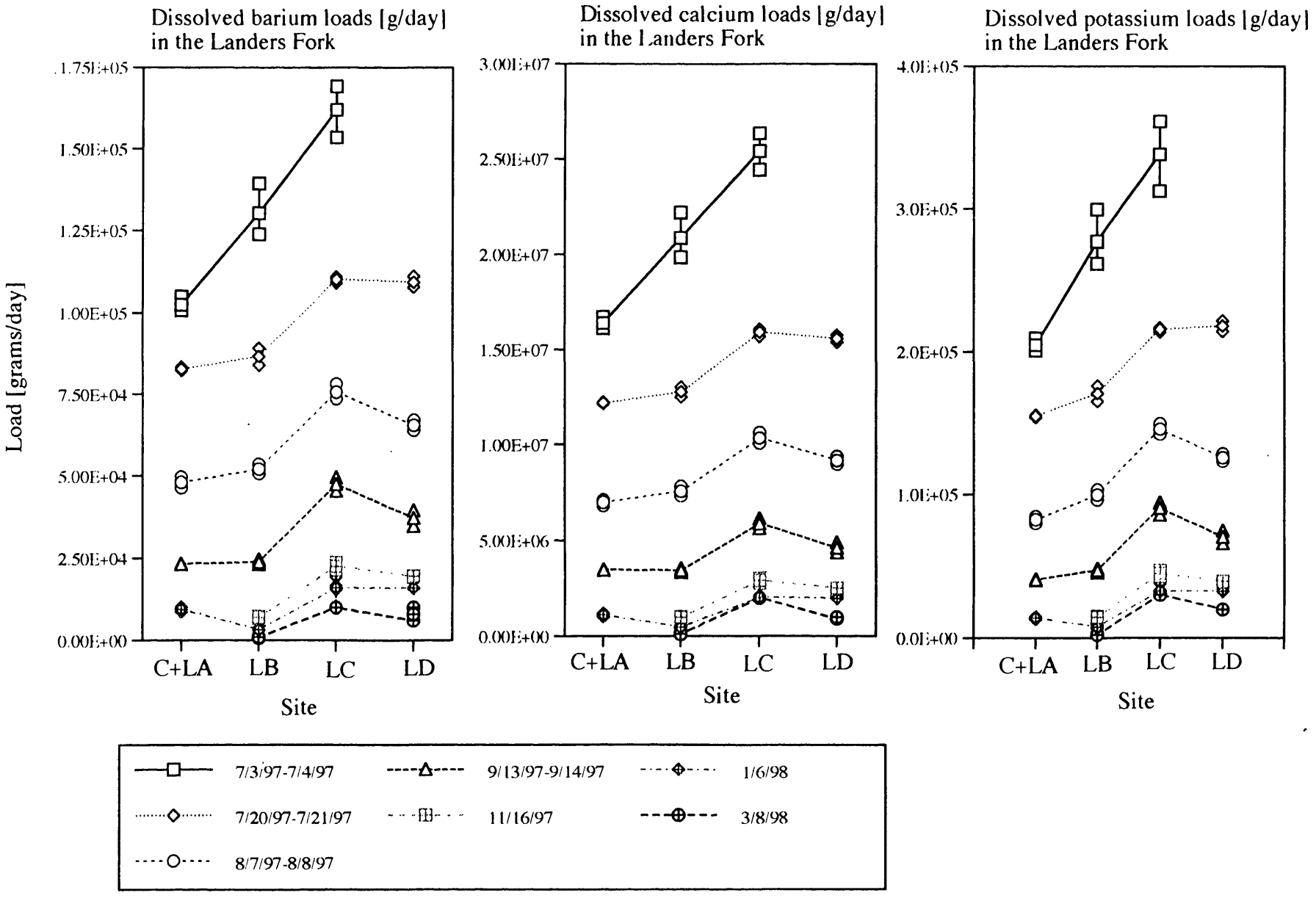
C-11.4

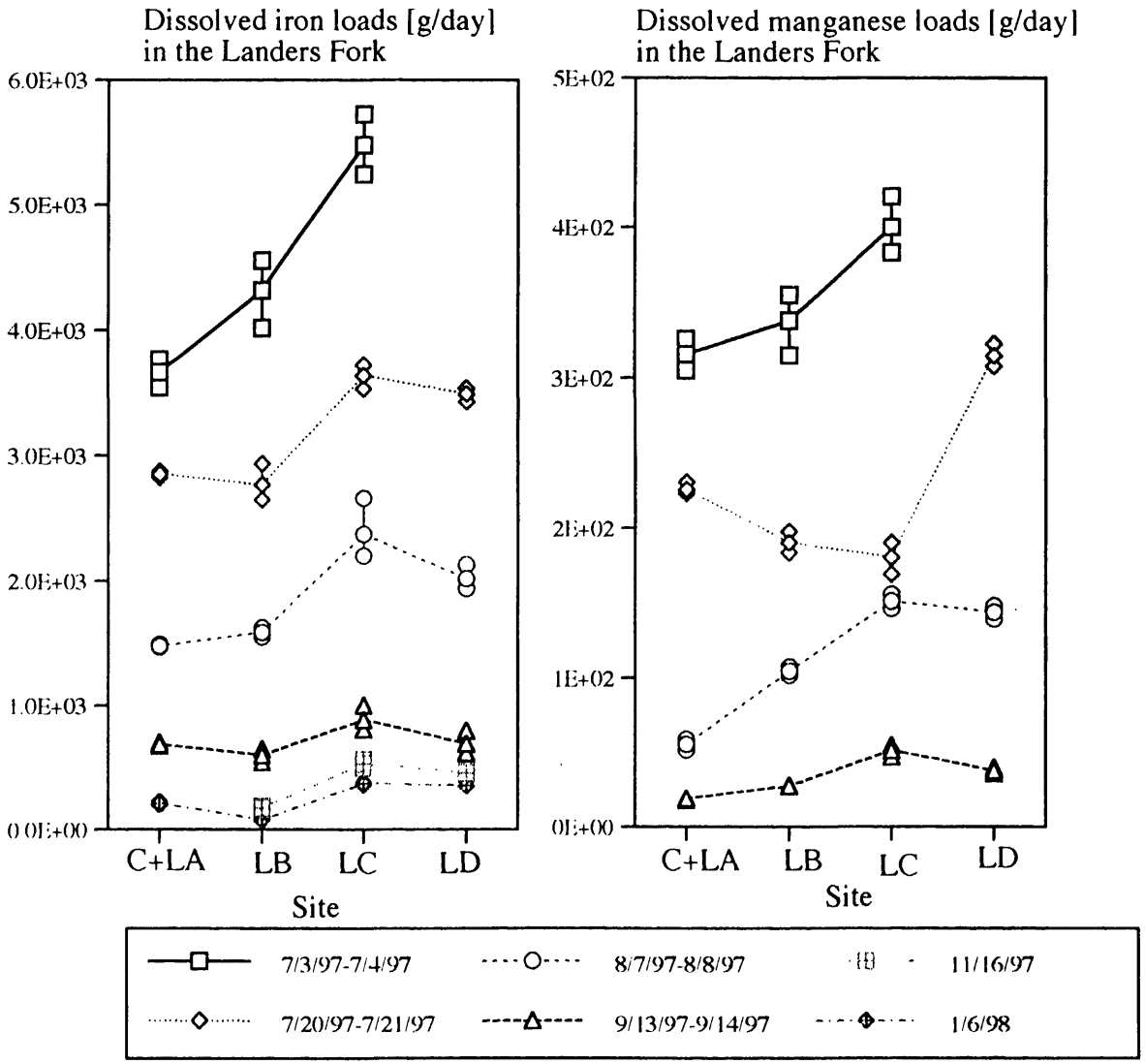
Sample name		BD-1	BD-2	BD-3	Mean	Std. Dev.
Sample date, approx. time		9/14/97, 08:30	9/14/97, 08:30	9/14/97, 08:30		
	Units					
pH	pH scale	8.2	8.2	8.2	8.2	0.0
Diss. oxygen	mg/L	11.2	11.2	11.4	11.3	0.1
Spec. Cond.	mS/cm	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Water temp.	deg. C	7.5	7.5	7.5	7.5	0.0
Air temp	deg. C	*(NA)*	*(NA)*	*(NA)*	*(NA)*	*(NA)*
Inorganic carbon	mg/L	33.6	33.4	33.1	33.4	0.3
Organic carbon	mg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
F	mg/L	*(<0.05)*	0.05	0.05	*(<0.05)*	*(<0.05)*
Sulfate	mg/L	6.85	6.36	6.13	6.45	0.37
As	µg/L	0.4	0.4	0.4	0.4	0.0
Ba	µg/L	273	272	272	273	1
Ca	mg/L	34.35	34.49	35.23	34.69	0.47
Cr	µg/L	*(<1)*	*(<1)*	*(<1)*	*(<1)*	*(<1)*
Cu	µg/L	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*	*(<0.3)*
Fe	µg/L	12	11	11	11	0
K	mg/L	0.65	0.64	0.62	0.64	0.02
Li	µg/L	2.6	2.6	2.6	2.6	0.0
Mg	mg/L	12.39	12.35	12.48	12.41	0.07
Mn	µg/L	0.4	0.4	0.4	0.4	0.0
Na	mg/L	1.87	1.96	1.69	1.84	0.14
S	mg/L	2.56	2.41	2.24	2.40	0.16
Si	mg/L	5.21	5.09	5.02	5.11	0.10
Sr	µg/L	80	77	75	77	3
Zn	µg/L	*(<8)*	*(<8)*	*(<8)*	*(<8)*	*(<8)*

Appendix D.

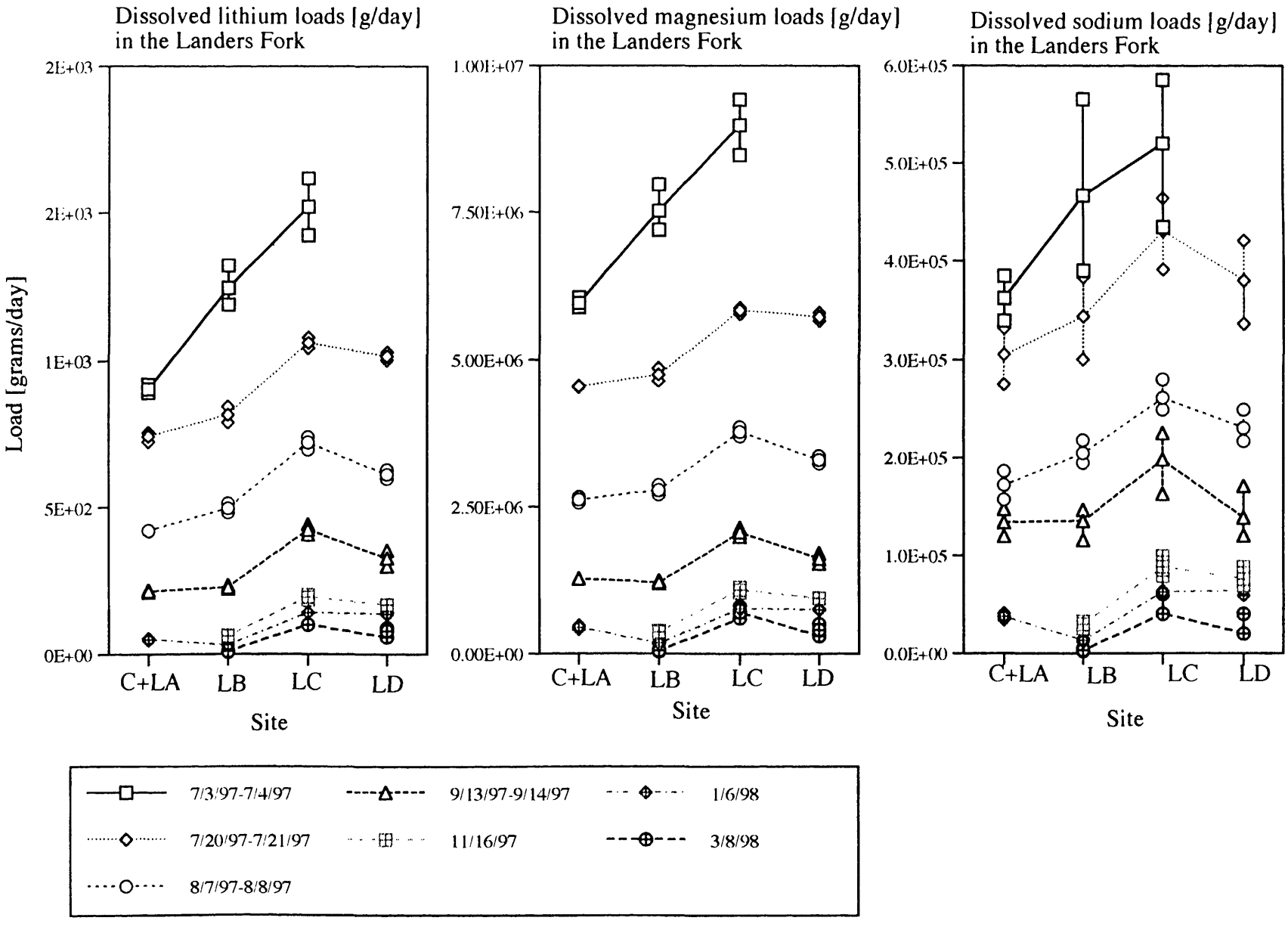
Graphs of constituent load versus sample site location for Copper Creek and Landers Fork sites on each date sampled.

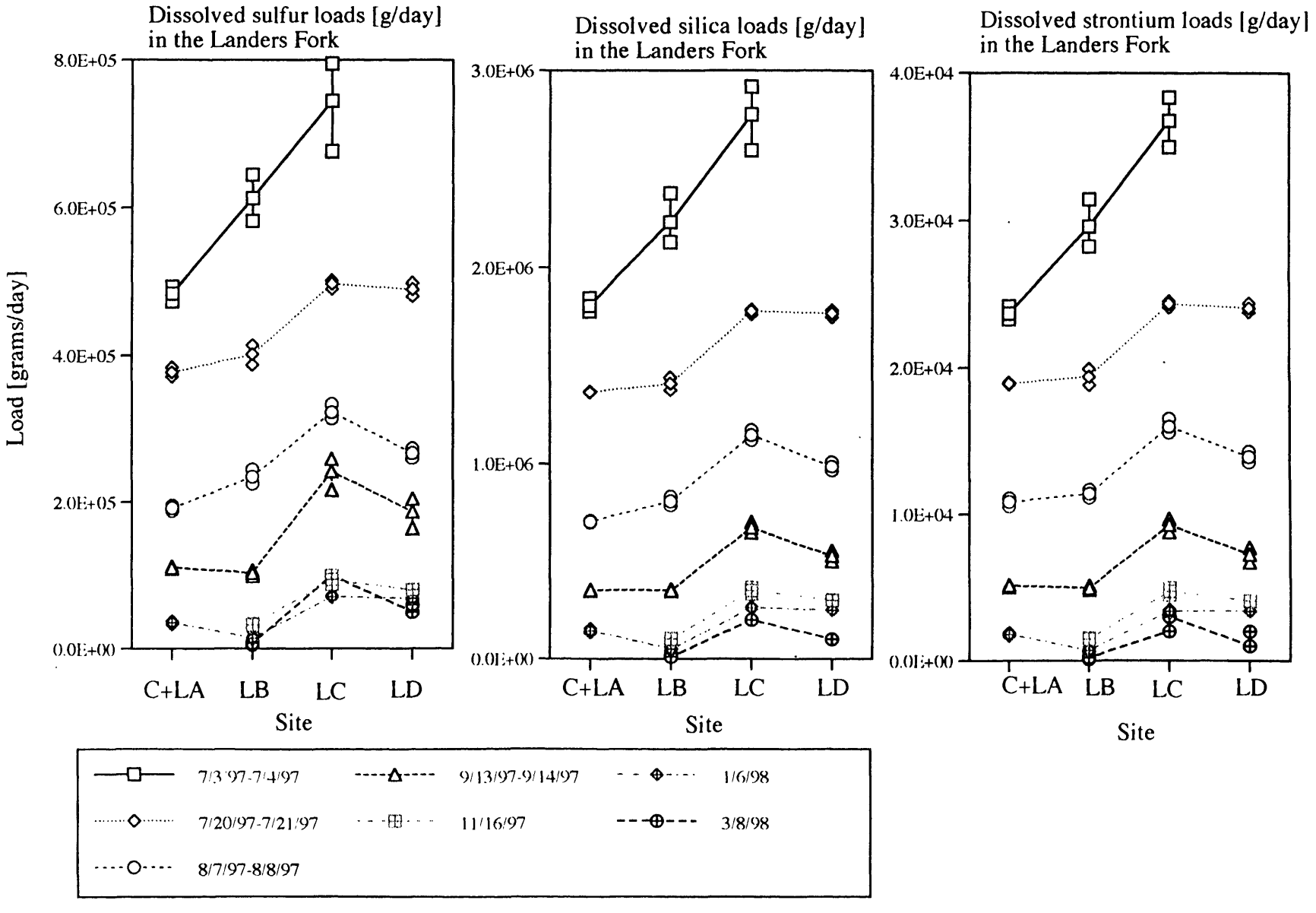

Dissolved inorganic carbon loads [grams/day] in the Landers Fork
Dissolved sulfate loads [g/day] in the Landers Fork
Dissoved arsenic loads [g/day] in the Landers Fork
Load [grams/day]
2.50E+07
2.00E+07
1.50E+07
1.00E+07
5.00E+06
0.00E+00
2.50E+06
2.00E+06
1.50E+06
1.00E+06
5.00E+05
6.0E+02
5.0E+02
4.0E+02
3.0E+02
2.0E+02
1.0E+02
0.0E+00
C+LA
LB
LC
LD
Site
7/3/97-7/4/97
9/13/97-9/14/97
1/6/98
7/20/97-7/21/97
11/16/97
3/8/98
8/7/97-8/8/97


Dissolved barium loads [g/day] in the Landers Fork
Dissolved calcium loads [g/day] in the Landers Fork
Dissolved potassium loads [g/day] in the Landers Fork
Load [grams/day]
1.75E+05
1.50E+05
1.25E+05
1.00E+05
7.50E+04
5.00E+04
2.50E+04
0.00E+00
3.00E+07
2.50E+07
2.00E+07
1.50E+07
1.00E+07
5.00E+06
0.00E+00
4.0E+05
3.0E+05
2.0E+05
1.0E+05
0.0E+00
C+LA
LB
LC
LD
Site
7/3/97-7/4/97
9/13/97-9/14/97
1/6/98
7/20/97-7/21/97
11/16/97
3/8/98
8/7/97-8/8/97



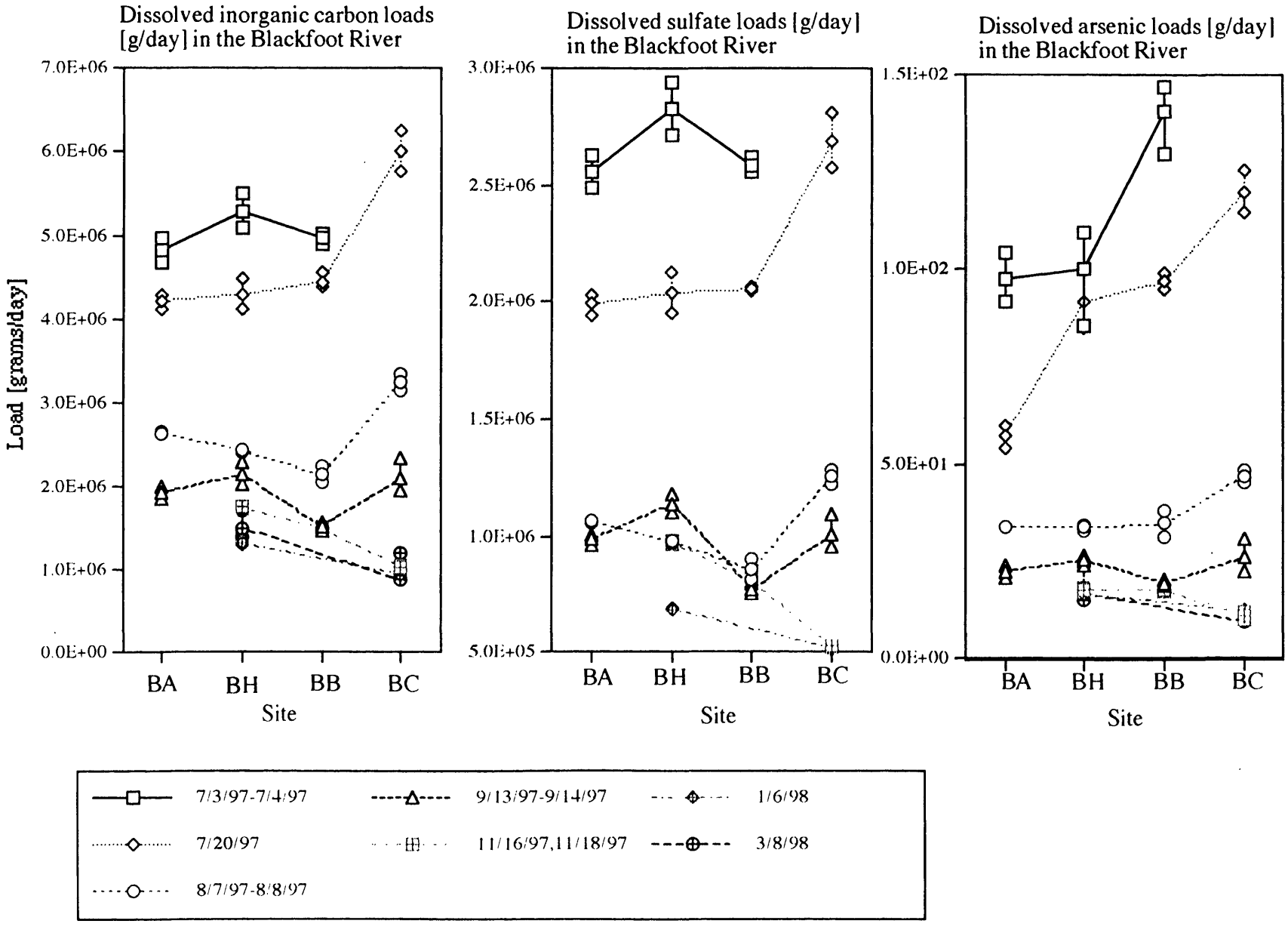
(Fe and Mn concentrations were below detection on 3/8/98)


Dissolved lithium loads [g/day] in the Landers Fork
Dissolved magnesium loads [g/day] in the Landers Fork
Dissolved sodium loads [g/day] in the Landers Fork
Load [grams/day]
2E+03
2E+03
1E+03
5E+02
0E+00
1.00E+07
7.50E+06
5.00E+06
2.50E+06
0.00E+00
6.0E+05
5.0E+05
4.0E+05
3.0E+05
2.0E+05
1.0E+05
0.0E+00
C+LA
LB
LC
LD
Site
7/3/97-7/4/97
9/13/97-9/14/97
1/6/98
7/20/97-7/21/97
11/16/97
3/8/98
8/7/97-8/8/97

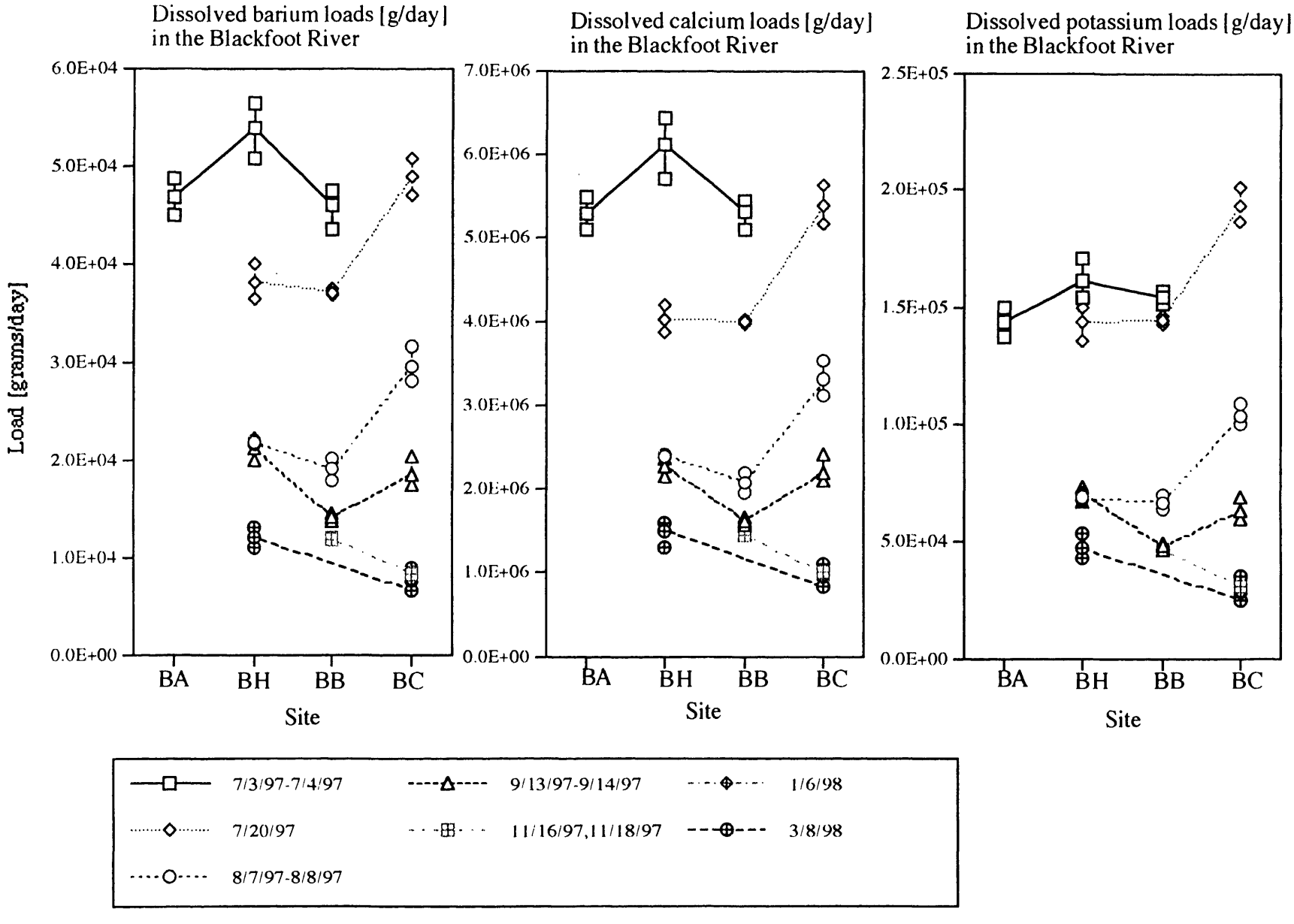

Dissolved sulfur loads [g/day] in the Landers Fork
Dissolved silica loads [g/day] in the Landers Fork
Dissolved strontium loads [g/day] in the Landers Fork
Load [grams/day]
8.0E+05
6.0E+05
4.0E+05
2.0E+05
0.0E+00
3.0E+06
2.0E+06
1.0E+06
0.0E+00
4.0E+04
3.0E+04
2.0E+04
1.0E+04
0.0E+00
C+LA
LB
LC
LD
Site
7/3/97-7/4/97
7/20/97-7/21/97
8/7/97-8/8/97
9/13/97-9/14/97
11/16/97
1/6/98
3/8/98

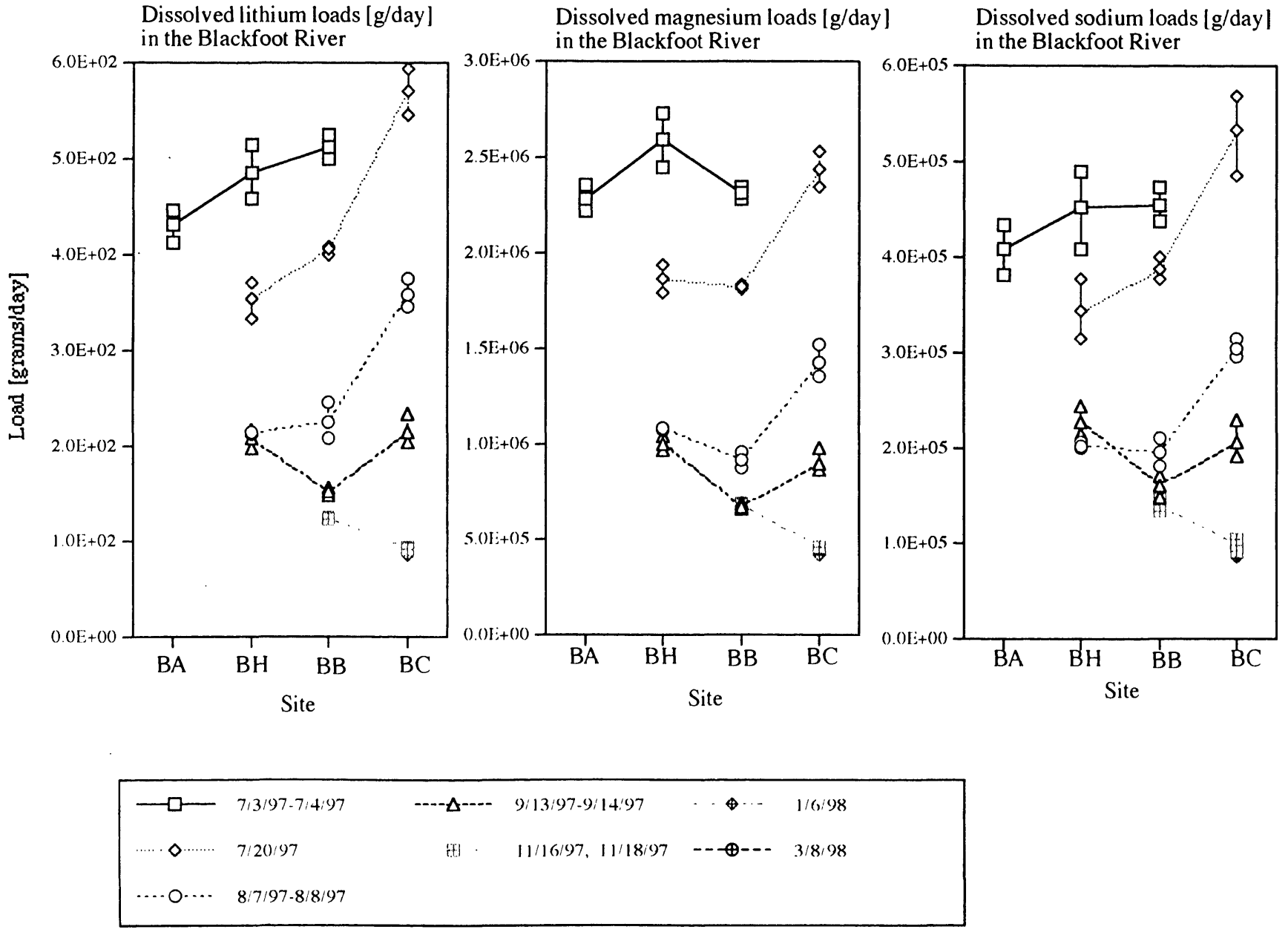
Appendix E.

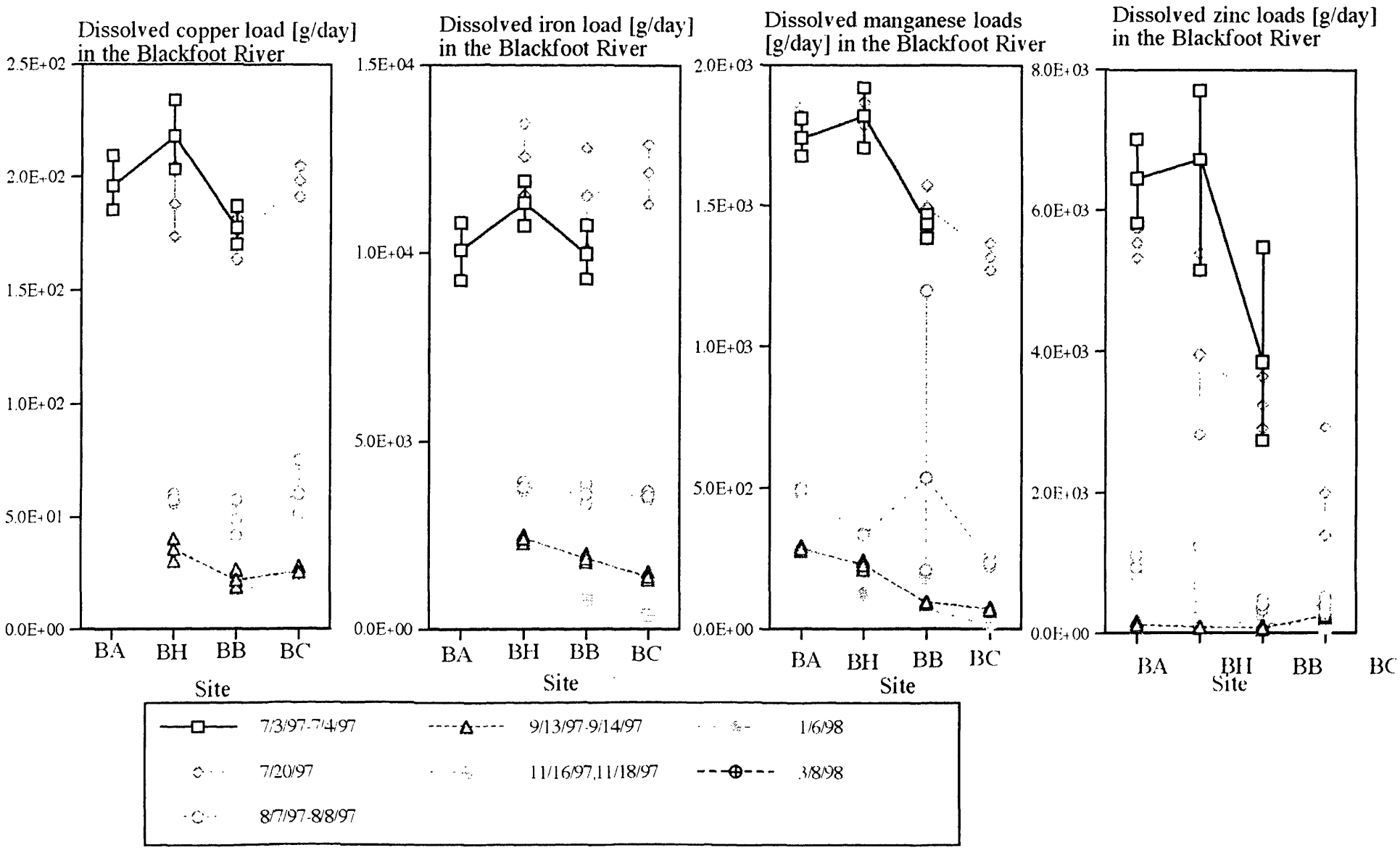
Graphs of constituent load versus sample site location for Blackfoot River sites on each date sampled.

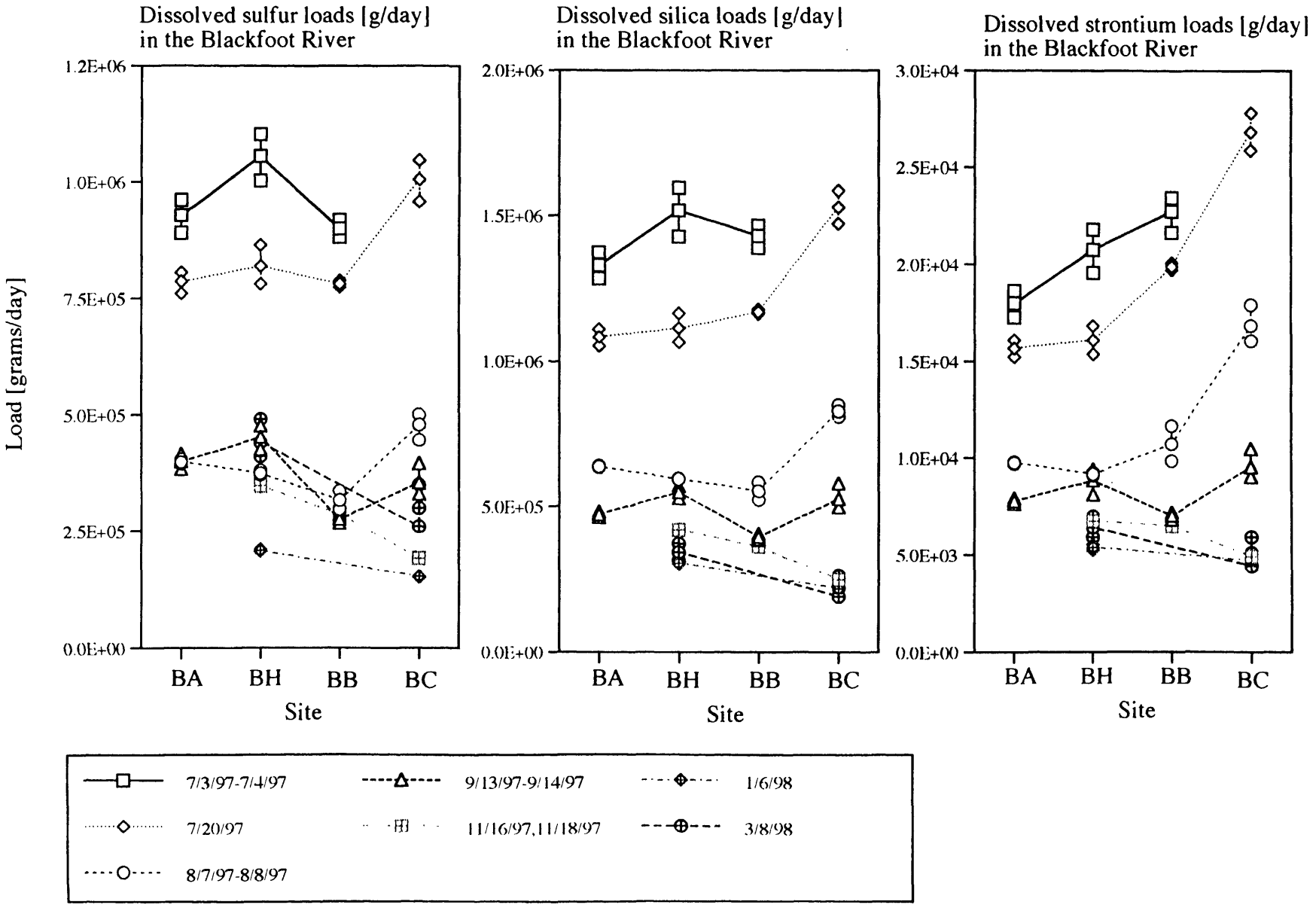

Dissolved inorganic carbon loads [g/day] in the Blackfoot River
Load [grams/day]
7.0E+06
6.0E+06
5.0E+06
4.0E+06
3.0E+06
2.0E+06
1.0E+06
0.0E+00
BA
BH
BB
BC
Site
Dissolved sulfate loads [g/day] in the Blackfoot River
3.0E+06
2.5E+06
2.0E+06
1.5E+06
1.0E+06
5.0E+05
BA
BH
BB
BC
Site
Dissolved arsenic loads [g/day] in the Blackfoot River
1.5E+02
1.0E+02
5.0E+01
0.0E+00
BA
BH
BB
BC
Site
7/3/97-7/4/97
9/13/97-9/14/97
1/6/98
7/20/97
11/16/97,11/18/97
3/8/98
8/7/97-8/8/97

Appendix E


Dissolved barium loads [g/day] in the Blackfoot River
Dissolved calcium loads [g/day] in the Blackfoot River
Dissolved potassium loads [g/day] in the Blackfoot River
Load [grams/day]
6.0E+04
5.0E+04
4.0E+04
3.0E+04
2.0E+04
1.0E+04
0.0E+00
7.0E+06
6.0E+06
5.0E+06
4.0E+06
3.0E+06
2.0E+06
1.0E+06
0.0E+00
2.5E+05
2.0E+05
1.5E+05
1.0E+05
5.0E+04
0.0E+00
BA
BH
BB
BC
Site
7/3/97-7/4/97
9/13/97-9/14/97
1/6/98
7/20/97
11/16/97,11/18/97
3/8/98
8/7/97-8/8/97


Dissolved lithium loads [g/day] in the Blackfoot River
Dissolved magnesium loads [g/day] in the Blackfoot River
Dissolved sodium loads [g/day] in the Blackfoot River
Load [grams/day]
6.0E+02
5.0E+02
4.0E+02
3.0E+02
2.0E+02
1.0E+02
0.0E+00
3.0E+06
2.5E+06
2.0E+06
1.5E+06
1.0E+06
5.0E+05
6.0E+05
5.0E+05
4.0E+05
3.0E+05
2.0E+05
1.0E+05
BA
BH
BB
BC
Site
7/3/97-7/4/97
9/13/97-9/14/97
1/6/98
7/20/97
11/16/97, 11/18/97
3/8/98
8/7/97-8/8/97


Dissolved copper load [g/day] in the Blackfoot River
2.5E+02
2.0E+02
1.5E+02
1.0E+02
5.0E+01
0.0E+00
BA
BH
BB
BC
Site
Dissolved iron load [g/day] in the Blackfoot River
1.5E+04
1.0E+04
5.0E+03
0.0E+00
BA
BH
BB
BC
Site
Dissolved manganese loads [g/day] in the Blackfoot River
2.0E+03
1.5E+03
1.0E+03
5.0E+02
0.0E+00
BA
BH
BB
BC
Site
Dissolved zinc loads [g/day] in the Blackfoot River
8.0E+03
6.0E+03
4.0E+03
2.0E+03
0.0E+00
BA
BH
BB
BC
Site
7/3/97-7/4/97
9/13/97-9/14/97
1/6/98
7/20/97
11/16/97,11/18/97
3/8/98
8/7/97-8/8/97


Dissolved sulfur loads [g/day] in the Blackfoot River
Dissolved silica loads [g/day] in the Blackfoot River
Dissolved strontium loads [g/day] in the Blackfoot River
Load [grams/day]
1.2E+06
1.0E+06
7.5E+05
5.0E+05
2.5E+05
0.0E+00
2.0E+06
1.5E+06
1.0E+06
5.0E+05
0.0E+00
3.0E+04
2.5E+04
2.0E+04
1.5E+04
1.0E+04
5.0E+03
0.0E+00
BA
BH
BB
BC
Site
7/3/97-7/4/97
9/13/97-9/14/97
1/6/98
7/20/97
11/16/97,11/18/97
3/8/98
8/7/97-8/8/97