CLARK FORK-ROCK CREEK SUPPLEMENTAL MONITORING PROGRAM

2006 Monitoring Summary Report

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EXECUTIVE SUMMARY

This report summarizes the results of chemical, physical and biological water quality monitoring performed in 2006 on the lower Clark Fork River and in the Rock Creek drainage near Noxon, Montana by the Tri-State Water Quality Council (Council). The Council's long term monitoring of the Clark Fork-Pend Oreille Watershed returned to a basic monitoring program for the Clark Fork main stem in 2006, but was supplemented with additional monitoring on Rock Creek and the Clark Fork River to address citizen concerns about potential cumulative effects of a proposed major metals mine in the Rock Creek drainage near Noxon. This report presents only the results of the supplemental mine-related monitoring program. Results of the basic monitoring program are presented in an additional interpretive report (PBSJ 2007).

Data gathered during this project will help establish a baseline to which future monitoring can be compared. The potential effects of mining and milling operations on water quality in adjacent water bodies may include increases in the concentrations of dissolved and particulate metals, suspended sediments, and algal nutrients. The monitoring program described in this report focuses on these variables. Individual program elements included:

1) monthly monitoring for water column metals, suspended solids, nutrients, streamflow, and field constituents at three locations in the Rock Creek drainage;
2) monthly monitoring for water column metals, nutrients, streamflow, and field constituents in the Clark Fork River at the Noxon Bridge (this is a standard component of the Council's basic monitoring program);
3) annual monitoring for concentrations of metals in fine grained streambed sediments in Rock Creek (three stations) and in Clark Fork River crayfish (two stations);
4) annual monitoring for chlorophyll *a* concentrations in benthic algae in Rock Creek (three stations) and the Clark Fork River (three stations);
5) annual monitoring of macroinvertebrate (aquatic insect) community structure in the Clark Fork River below Cabinet Gorge Dam (one station); and
6) data analysis and reporting.

Nutrient monitoring variables included total phosphorus, total nitrogen (computed from total Kjeldahl nitrogen and nitrate + nitrite nitrogen), total soluble inorganic nitrogen (nitrate + nitrite plus ammonia nitrogen), and soluble reactive phosphorus. Water column metals included total recoverable and dissolved fractions of copper, zinc, cadmium, lead and arsenic. Streambed fine sediment samples were analyzed for total recoverable concentrations of copper, zinc, cadmium, lead, arsenic and silver. Crayfish tissue, including exoskeleton, gill and hepatopancreas, were isolated from individual specimens and analyzed for total recoverable copper, zinc, and cadmium. Chlorophyll *a* was measured in periphyton (attached algae) collected from natural substrate samples. Macroinvertebrate organisms were sampled using a method designed for large rivers, and constituent species were identified and enumerated by a taxonomic laboratory.

Concentrations of nitrogen variables in the Rock Creek drainage, including total nitrogen and total soluble inorganic nitrogen, were highest in the East Fork of Rock Creek. Phosphorus variables, including total phosphorus and soluble reactive phosphorus, were highest in the West Fork of Rock Creek.

Median concentrations of water column total recoverable and dissolved metals (copper, zinc, cadmium, lead and arsenic) were below the limits of analytical detection at all sites in the Rock Creek drainage during 2006, except for dissolved zinc. Several individual water samples showed measurable concentrations of total recoverable zinc (2 samples), copper (1 sample), or lead (1 sample). These instances generally occurred during runoff events and none of the measured total recoverable metals concentrations exceeded water quality standards for the protection of aquatic life. All of the dissolved metals analyses for the Rock Creek monitoring stations except zinc were below the respective analytical detection limits. Dissolved zinc analyses showed consistent low level readings which were attributed to trace level contamination from the membrane filters used to prepare the samples for analysis. This quality assurance problem has since been resolved for the 2007 monitoring program.

Concentrations of total recoverable copper, zinc, cadmium, lead, arsenic, and silver in fine grained bottom sediments in Rock Creek during 2006 varied by metal and sampling location with no consistent spatial pattern. The West Fork of Rock Creek had the highest concentrations of arsenic and zinc in sediment, and the East Fork of Rock Creek had the highest concentrations of cadmium, copper and lead. Concentrations of silver in streambed sediments were non-detectable at all sample sites during 2006. Recommended threshold sediment metals concentrations to prevent impacts to aquatic life were exceeded for arsenic in the West Fork of Rock Creek (137% of the threshold), for cadmium in the East Fork of Rock Creek (123% of the threshold), and for copper in the East Fork of Rock Creek and in Rock Creek near its mouth (230% and 113% of the threshold, respectively)). Concentrations of total recoverable lead in West Fork and East Fork Rock Creek streambed sediments approached the threshold values (90% and 95% of the threshold, respectively). The significance of these exceedances to aquatic life is unknown.

Concentrations of heavy metals in crayfish tissue collected in 2006 were generally quite variable and did not suggest a significant spatial pattern between the two sampling areas. This was especially true for copper and zinc in all tissue types. Cadmium in crayfish exoskeleton and gill tissue was below the analytical detection limit (<1.00 ug/g) for all samples. Median concentrations of cadmium in crayfish hepatopancreas tissue were higher in the Clark Fork site below Rock Creek.

Periphyton chlorophyll *a* concentrations measured in the Clark Fork and Rock Creek during 2006 were highest in the Clark Fork River at the stations above and below Rock Creek, and lowest in the Clark Fork River below Cabinet Gorge Dam, in Rock Creek near its mouth, and in the West Fork of Rock Creek. Chlorophyll *a* concentrations were intermediate in the East Fork of Rock Creek The Clark Fork site below Rock Creek produced the highest individual replicate concentrations during 2006. Two of the ten replicate samples for this site produced values which exceeded the maximum instream concentration of 150 mg/m^2 that has been set as a state water

quality standard for the segment of the Clark Fork River above the confluence of the Flathead River.

The macroinvertebrate community in the Clark Fork River below Cabinet Gorge Dam during 2006 was dominated by net-spinning caddisflies, midges, and blackfly larvae. The assemblage was typical of a site downstream of a reservoir outflow since it was dominated by filter-feeders. Despite the riffle/run nature of the sample location, several lentic species, including cladocerans and copepods, were found in the composite sample. The macroinvertebrate sample was evaluated using three bioassessment methods, including Montana MMI, the Montana O/E model, and the MVFP index. Two of the bioassessment methods suggested that this site was unimpaired based on the resident macroinvertebrate community, but the MVFP Index suggested the site suffered from moderate impairment.

The 2006 Clark Fork-Rock Creek supplemental monitoring program was the first year of a planned two-year data collection effort. A continuation of the supplemental monitoring program is planned for 2007, with some modifications.

1.0 INTRODUCTION

1.1 Project Background

The mission of the Tri-State Water Quality Council has been to develop a management strategy to restore and protect designated water uses within the Clark Fork-Pend Oreille Basin. The Tri-State Water Quality Council's Clark Fork-Pend Oreille watershed water quality monitoring program was begun in 1998 and employs a statistically-based sampling design derived from an analysis of previous water quality monitoring data collected for the watershed by Montana state agencies. Through this design approach, sampling frequencies and monitoring locations have been optimized to provide reliable information for watershed management decision-making while minimizing operational costs.

The 2003-2007 monitoring program represents the second five-year increment of monitoring managed by the Tri-State Water Quality Council. The previous five-year monitoring program, conducted from 1998-2002, provided the basis for a statistical analysis of water quality time trends reflected in the data set (Land & Water, 2004). The 2003 and 2004 sampling years consisted of a limited basic monitoring program, and the 2005 monitoring program was expanded to include previous agency monitoring stations within the watershed and three additional monitoring locations on Lost Creek in the Clark Fork River headwaters. A metals comparability study was also conducted during 2005 to compare different analytical methods for metals. Furthermore, several additional heavy metal parameters (cadmium, arsenic and lead) were added to the sampling program in 2005. These additional data are intended to provide a baseline of conditions throughout the watershed prior to the planned phased removal of Milltown Dam upstream of Missoula which began in 2006.

The 2006-2007 monitoring program was phased back to the basic monitoring program for the Clark Fork main stem, but also includes the supplemental monitoring of Rock Creek and the Clark Fork River near Noxon, Montana intended to address citizen concerns about potential cumulative effects of a proposed major metals mine in the Rock Creek drainage. This report presents only the results of the results of the supplemental mine-related monitoring program. Results of the basic monitoring program are presented in an additional summary report (PBSJ 2007).

Data gathered through the Clark Fork-Rock Creek supplemental monitoring project will help establish a baseline to which future monitoring can be compared. Citizen concerns related to the proposed mine development include the potential for negative effects on adjacent water bodies due to increased concentrations of dissolved and particulate metals, suspended sediment, and algal nutrients. The supplemental monitoring program focuses on these variables. Individual program elements include:

1) monthly monitoring for water column metals, suspended solids, nutrients, streamflow, and field constituents at three locations in the Rock Creek drainage;

2) monthly monitoring for water column metals, nutrients, streamflow, and field constituents in the Clark Fork River at the Noxon Bridge (this is a standard component of the Council's basic monitoring program);
3) annual monitoring for concentrations of metals in fine grained streambed sediments in Rock Creek (three stations) and in Clark Fork River crayfish (two stations);
4) annual monitoring for chlorophyll *a* concentrations in benthic algae in Rock Creek (three stations) and the Clark Fork River (three stations);
5) annual monitoring of macroinvertebrate (aquatic insect) community structure in the Clark Fork River below Cabinet Gorge Dam (one station); and
6) data analysis and reporting.

1.2 Project Description

This section provides a summary of the study area and a description of the tasks involved in the monitoring program. More detailed descriptions of the program design, sampling methods, sample handling procedures and analytical methods are provided in the project quality assurance project plan (PBS&J 2006).

The study area includes monitoring locations on Rock Creek and the Clark Fork River within the Clark Fork-Pend Oreille watershed. A summary of monitoring locations, monitoring components at each station, and the associated rationale are provided in **Table 1-1**. Maps of the study area and monitoring locations are provided in **Appendix A**.

Table 1-1. ***Clark Fork-Rock Creek supplemental monitoring program* monitoring locations, monitoring elements and rationale.**

Site	Name	Latitude	Longitude	Monitoring Component	Rationale
28.1	West Fork Rock Creek	48.0270	115.7072	Monthly water quality, annual sediment metals, annual periphyton chlorophyll *a*	Located in same drainage as proposed mining and milling operations
28.2	East Fork Rock Creek	48.0245	115.7052	Monthly water quality, annual sediment metals, annual periphyton chlorophyll *a* Monthly water quality, sediment	Control tributary which drains undeveloped national forest lands
28.3	Rock Creek near mouth	47.9744	115.7291	Monthly water quality, annual sediment metals, annual periphyton chlorophyll *a* Monthly water quality, sediment	Downstream test site which integrates cumulative potential effects of proposed mining, milling, and related activities within Rock Creek drainage
29.1	Clark Fork above Rock Creek	47.9684	115.7391	Annual periphyton chlorophyll *a* and biota metals (crayfish)	Clark Fork River control site located below Noxon Dam and above the Rock Creek confluence

Site	Name	Latitude	Longitude	Monitoring Component	Rationale
29.2	Clark Fork below Rock Creek	47.9935	115.7601	Monthly water quality, annual periphyton chlorophyll *a* and biota metals (crayfish)	Clark Fork River test site located at Noxon Bridge and below the Rock Creek confluence
30	Clark Fork below Cabinet Gorge Dam	48.0937	116.1019	Monthly water quality, annual periphyton chlorophyll *a* and macroinvertebrates	Clark Fork River test site in Idaho representing primary source of inflow to Lake Pend Oreille

Monthly water samples were collected for nutrient analysis at each of the above stations except 29.1. Nutrient monitoring variables included total phosphorus (TP), soluble reactive phosphorus (SRP), total Kjeldahl nitrogen (TKN), nitrate + nitrite nitrogen (NO_3+NO_2-N), and total ammonia nitrogen (NH_3+NH_4-N). Values for total nitrogen (TN) and total soluble inorganic nitrogen (TSIN) were calculated as follows:

TN = NO_3+NO_2-N plus TKN TSIN = NO_3+NO_2-N plus NH_3+NH_4-N

The three sites in the Rock Creek drainage (sites 28.1, 28.2, and 28.3) were also sampled monthly for total suspended solids. Water column samples for analysis of metals, including total recoverable and dissolved fractions of arsenic (As), copper (Cu), cadmium (Cd), lead (Pb), and zinc (Zn), were collected on a monthly basis at each of the Rock Creek sites and at Clark Fork sites 29.2 and 30. Metals samples were also analyzed for total hardness.

Field constituents were routinely measured at each site during each monitoring event and included: water temperature (˚C), dissolved oxygen (mg/l), pH (standard units), redox potential (mv), specific conductance (µs/cm), total dissolved solids (mg/l), and turbidity (NTU). Streamflows (instantaneous, cubic feet per second (cfs)) and river stage (ft) were also measured when possible, or derived from gauging station records.

Fine-grained bottom sediment samples for metals analysis were collected in early summer at each of the three stations in the Rock Creek drainage. Analytes included total recoverable concentrations of arsenic, cadmium, copper, lead, silver and zinc. Crayfish tissue samples (exoskeleton, gill, hepatopancreas) from Clark Fork River sites 29.1 and 29.2 were collected and analyzed for total recoverable concentrations of cadmium, copper and zinc. Replicate periphyton chlorophyll *a* samples were collected from natural substrates at each of the Clark Fork and Rock Creek six monitoring stations once in late-summer. Lastly, a traveling kicknet composite macroinvertebrate sample was collected once in late summer in the Clark Fork River below Cabinet Gorge Dam and analyzed for community structure variables.

1.3 Sampling Methods

This section provides a summary of the sampling methods utilized in the Clark Fork-Rock Creek supplemental monitoring program. More detailed descriptions of methods, procedures and data

quality objectives are included in the Clark Fork-Rock Creek supplemental monitoring program quality assurance project plan (PBS&J 2006).

1.3.1 Field Constituents

Field constituents, including water temperature (˚C), dissolved oxygen (mg/l), pH (standard units), redox (mv), conductivity (µs/cm), and total dissolved solids (mg/l), were measured in the field using a Hydrolab Quanta water quality probe. Turbidity (NTU) was measured using a Hach 2100P turbidimeter. Field instruments were calibrated the day of sampling, and instrument calibration was verified periodically throughout the sampling day.

Sample water for measuring field constituents was collected in a 500ml polyethylene bottle, which was rinsed twice with river water before sample collection. Field constituents were measured and recorded immediately after sampling to ensure variables do not deviate from time of sampling.

1.3.2 Nutrients and Metals

Water samples for total phosphorus (TP), soluble reactive phosphorus (SRP), total Kjeldahl nitrogen (TKN), nitrate plus nitrite-nitrogen (NO_2+NO_3-N), total ammonia-nitrogen (NH_3+NH_4-N), cadmium (Cd), copper (Cu), lead (Pb), zinc (Zn), hardness and total suspended solids (TSS) were collected using a grab sampling technique by wading in a well-mixed portion of the river. Samples were taken in the upstream direction to avoid entrainment of sediment disturbed by wading.

Water samples for TP, TKN, hardness, and total recoverable As, Cd, Cu, Pb and Zn were collected directly in 250ml wide-mouthed polyethylene bottles which were pre-washed and provided by the analytical laboratory. Bottles were rinsed three times with native water prior to sampling. Samples for TP and TKN were contained within one 250 ml bottle, while samples for total recoverable As, Cd, Cu, Pb, Zn, and hardness were contained in another 250 ml bottle. During sample collection, the sample bottle opening was directed upstream and was drawn through the water column once while carefully avoiding disturbance of bottom sediments.

Samples were then preserved by adding concentrated sulfuric acid (H_2SO_4) for nutrient samples and concentrated nitric acid (HNO_3) for metal samples. Acid preservatives were provided by the analytical laboratory, and were pre-filled with the appropriate volume of preservative for each sample. Nutrient samples (TP and TKN) were acidified first to avoid any nitrogen contamination from the nitric acid used to preserve metal samples.

Water for soluble nutrient constituents (NO_2+NO_3, NH_3+NH_4, and SRP) and dissolved metal constituents (As, Cu, Zn, Pb, Cd) were collected for filtration in a 1000 ml transfer vessel. The transfer vessel was rinsed three times with native river water before sample collection. River water was filtered from the transfer vessel in the field using a filtering lid and a new disposable 0.45 µm Clearwater Engineering® filter. A small volume of filtrate (30-50 ml) was discarded before the samples were collected.

Dissolved nutrient and metals samples were collected in 250 ml polyethylene bottles which had been pre-rinsed with filtered water. Sample bottles will be supplied by the laboratory. Dissolved

nitrogen samples (NO_2+NO_3 and NH_3+NH_4) were contained in one 250 ml bottle, and soluble reactive phosphorus (SRP) samples were contained another 250 ml polyethylene bottle. All nutrient samples were stored on ice in a clean cooler before transport to the analytical laboratory. Nutrient samples were cooled to 4°C or less, and were delivered to the analytical laboratory within 48 hours of collection. SRP samples were frozen or analyzed within 48 hours of collection. Dissolved metal samples were contained within another 250 ml sample bottle, and were preserved with concentrated nitric acid supplied by the laboratory. Dissolved metals samples were stored at room temperature and delivered to the analytical laboratory for analysis within their accepted holding time (6 months).

Water to be analyzed for total suspended solids (TSS) was collected directly into 1000 ml polyethylene bottles supplied by the laboratory. Sample bottles were rinsed three times with native river water before sample collection. Samples for TSS did not receive any preservative, but were stored on ice and cooled to 4°C or less immediately following sample collection. TSS samples remained chilled and were delivered to the analytical laboratory prior to their allotted holding time (7 days).

One duplicate quality assurance sample for each constituent was collected at one site during each monthly sampling run using the same sampling protocol. Duplicate samples were split from the original sample to ensure that they represented the same water as the original. Field quality assurance blanks were also collected using the same sampling protocol, but using de-ionized water as a sample. A field blank was prepared for all monitoring constituents except TSS.

A summary of sampling protocols is provided in **Table 1-2**.

Table 1-2. ***Clark Fork-Rock Creek supplemental monitoring program water column sample volumes, containers, preservation and holding times.***

Analyte	Sample Volume	Container	Preservation and Storage	Holding Time
TP and TKN	250 ml	Acid-washed polyethylene	H_2SO_4 , cool to <4°C	28 days
Total recoverable Cu, Zn, Cd, Pb, As and hardness	250 ml	Acid-washed polyethylene	HNO_3	6 months
NO_2+NO_3 and NH_3+NH_4	250 ml	Acid-washed polyethylene	Filter, H_2SO_4, cool to <4°C	28 days
SRP	250 ml	Acid-washed polyethylene	Filter, cool to <4°C or freeze	48 hours (28 days if frozen)
Dissolved Cu, Zn, Cd, Pb and As	250 ml	Acid-washed polyethylene	Filter, HNO_3	6 months
Total Suspended Solids	1000 ml	Acid-washed polyethylene	cool to <4°C	7 days

1.3.3 Sediment Metals

Sediment metals samples were collected following methods described in Section VII-B of Montana DEQ's *Field Procedures Manual for Water Quality Assessment Monitoring* (Montana

DEQ 2005). Samples were collected from at least five depositional areas that best represented the stream reach. Samples were collected over an area of 50 to 100 square meters with a turkey baster or non-metallic spoon and sieved through a 630 micrometer nylon screen. Samples were digested in the laboratory and analyzed for total recoverable arsenic, cadmium, copper, lead, silver and zinc. The digestion and analytical methods employed on the sediment samples was the same as those used on the monthly water samples.

1.3.4 Crayfish

Pacific crayfish (*Pacifastacus trowbridgi*) were collected from paired locations in the Clark Fork River upstream and downstream of the Rock Creek confluence and the proposed location of the mine direct discharge to the Clark Fork River. Sampling was performed in late summer to avoid the crayfish spring molting period, and any recently molted individual crayfish were excluded from the sample. Crayfish were collected from the entire channel cross-section at each site by hand or by deploying baited crayfish traps. Divers were employed to assist in crayfish collection or trap retrieval. Immediately following collection, crayfish were stored live on ice in a clean cooler for transport.

The sex and length (measured as rostrum to carapace grove) of each crayfish was recorded. Eight to ten individual crayfish representing the 70^{th} to 80^{th} percentile size class of the current population (i.e. large, mature specimens) was selected for analysis. The sample composite included 50% male and 50% female specimens. Crayfish tissues, including exoskeleton, hepatopancreas and gill, were isolated from the specimens and analyzed separately for concentrations of heavy metals. Dissection and analytical methods are provided in **Section 1.4**.

1.3.5 Macroinvertebrates

Macroinvertebrate samples were collected in the Clark Fork River below Cabinet Gorge Dam using a timed traveling kicknet sampling procedure developed specifically for large rivers by U.S. EPA's Environmental Monitoring and Assessment Program (EMAP) (Lazorchak et al. 2000). A sampling location was selected in workable stream bottom substrate material between Cabinet Gorge Dam and the river delta on Pend Oreille Lake. Sub-samples were composited on site and preserved according to EMAP guidelines for transport to the laboratory. Samples were collected in late-summer (mid-August).

1.3.6 Periphyton

Ten replicate chlorophyll samples were collected in mid-August from natural substrates at each of the six monitoring locations described in Table 1-1. Chlorophyll samples were collected from natural substrates with the aid of a 28.6 cm^2 cylindrical PVC sampling frame. The sampling frame was attached to the substrate creating a water tight seal, and any biomass within the frame was removed by physical means (scraping, brushing, etc.) and placed in a capped 50 ml plastic centrifuge tube. A 30 ml volume of methanol solvent was added in small increments to the interior of the sampling frame and a stiff bristled brush was used to dislodge remaining periphyton and to extract the chlorophyll pigments from each replicate. The aliquots of solvent were withdrawn from the sampling frame with a disposable pipette and transferred to the sample tube. This was repeated, using up to the 30 ml volume of methanol, until the fluid withdrawn from the frame was completely clear (i.e. colorless). Each replicate sample container was labeled, wrapped in foil to eliminate any light from reaching the sample, and placed in a covered

cooler on dry ice for transport to the analytical laboratory. Chlorophyll samples were delivered to the Montana Department of Public Health Chemistry Laboratory within 24 hours of collection for analysis of chlorophyll *a* pigment.

1.4 Analytical Methods

This section provides a summary of the methods used for analysis of water column, biota and sediment samples collected under the Clark Fork-Rock Creek supplemental monitoring program in 2006.

1.4.1 Nutrients and Metals – Water and Sediment

All nutrient and metals analyses were performed by a state-certified laboratory using standard methods. The analytical methods and detection limits for water and sediment samples are summarized in **Table 1-3**. The listed analytical detection limits are applicable only to the water column samples. Analytical detection limits for metals in sediment are quite variable based on the nature of the sediment, and must be determined individually for each sample.

1.4.2 Crayfish

Crayfish tissue, including exoskeleton (carapace), hepatopancreas, and gill, were isolated from individual specimens by hand dissection and analyzed separately at the analytical laboratory for concentrations of total metals. Animal dissection was performed using clean instruments and equipment (scalpel, tweezers, scissors, and latex gloves) for each sample. The carapace was removed by cutting with scissors all the way through to the rostrum and cutting the connective tissue. The gills are located under the carapace on both lateral sides, and were removed by cutting at the base. The hepatopancreas is located on the ventral side on both sides of the gonads and contains two lobes. Both lobes of the hepatopancreas were kept intact. Tissues were stored in glass jars and frozen until analysis.

Digestion was performed following an "acid digestion-oxidation under elevated temperature and pressure in a closed system" microwave procedure, consistent with EPA Method 3051. Samples were prepared by weighing, freeze-drying, and homogenizing. Sample wet weight was measured, and following the freeze-drying the samples were dehydrated and re-reweighed. Wet-weight and dry-weight measurements were used to calculate percent moisture content of each tissue sample. The dehydrated samples were ground to a homogenous meal. From the homogenous meal a sub-sample was digested, and the remaining material was stored. Analysis for metals was performed following EPA method 200.8 utilizing inductively coupled plasma mass spectrometry (ICP-MS). EPA method 200.7 may also have been used based on the laboratory's discretion.

Table 1-3. ***Clark Fork-Rock Creek supplemental monitoring program analytical methods and detection limits for water and sediment samples.***

Analyte	Medium	Method	Analytical Detection Limit	Analytical Laboratory
Total Phosphorus (TP)	Water	EPA 365.3	1 µg/l	Missoula WWTP
Total Kjeldahl Nitrogen (TKN)	Water	EPA 351.2	100 µg/l	Missoula WWTP
Nitrate + Nitrite-Nitrogen (NO_2+NO_3)	Water	EPA 353.2	100 µg/l	Missoula WWTP
Total Ammonia-Nitrogen (NH_3+NH_4)	Water	EPA 350.1	10 µg/l	Missoula WWTP
Soluble Reactive Phosphorus (SRP)	Water	EPA 365.3	1 µg/l	Missoula WWTP
Total Recoverable Arsenic (As)	Water, Sediment	EPA 200.8	1 µg/l	Montana DPHHS
Total Recoverable Cadmium (Cd)	Water, Sediment	EPA 200.8	0.08 µg/l	Montana DPHHS
Total Recoverable Copper (Cu)	Water, Sediment	EPA 200.7	1 µg/l	Montana DPHHS
Total Recoverable Lead (Pb)	Water, Sediment	EPA 200.8	0.5 µg/l	Montana DPHHS
Total Recoverable Silver (Ag)	Sediment	EPA 200.7	Not available	Montana DPHHS
Total Recoverable Zinc (Zn)	Water, Sediment	EPA 200.7	0.5 µg/l	Montana DPHHS
Dissolved Arsenic (As)	Water	EPA 200.8	1 µg/l	Montana DPHHS
Dissolved Cadmium (diss Cd)	Water	EPA 200.9	0.08 µg/l	Montana DPHHS
Dissolved Copper (diss Cu)	Water	EPA 200.9	1 µg/l	Montana DPHHS
Dissolved Lead (diss Pb)	Water	EPA 200.8	0.5 µg/l	Montana DPHHS
Dissolved Zinc (diss Zn)	Water	EPA 200.7	0.5 µg/l	Montana DPHHS
Total Hardness as $CaCO_3$	Water	EPA 200.7	1 mg/L	Montana DPHHS
Total Suspended Solids (TSS)	Water	SM 2540 D	1 mg/L	Montana DPHHS

1.4.3 Periphyton

Benthic algae samples were analyzed for chlorophyll *a* by the Montana Department of Public Health Chemistry (DPHHS) laboratory using EPA method CLPH.

1.4.4 Macroinvertebrates

The composited macroinvertebrate sample was sorted and organisms were identified and enumerated by a suitable laboratory according to taxa levels provided by Idaho DEQ. The composited sample was split with a caton tray for picking. A minimum of 500 organisms were picked from the caton cells, and picking continued until two full caton cells failed to yield any new taxa. A taxa list with counts was constructed, and standard metric calculations for aquatic invertebrate assemblages were performed on the data. Additionally, a reference and voucher collection was provided by the laboratory.

1.5 Statistical Methods

This report includes summary statistics and boxplots for visual comparisons of the analytical results. Statistics used include median, mean, minimum, maximum and standard deviation values. Boxplots were used to compare data from different monitoring locations (i.e. spatial comparison) or at the same station for different sampling years (i.e. temporal comparison). The shapes of the boxplots are based on median, interquartile, and extreme values reflected within the data sets. The box encloses the interquartile range, which contains the middle 50 percent of the values. The median value is displayed as the centerline of the box. The top and bottom whiskers display the maximum and minimum observed values, excluding outliers and extreme values. Outliers, defined as values that are 1.5 to 3 times greater than or less than values in the interquartile range, are displayed as circles (○). Extreme values, or those more than 3 times the values in the interquartile range, are displayed with an asterisk (*). The boxplot construction is shown graphically in **Figure 1-1**.

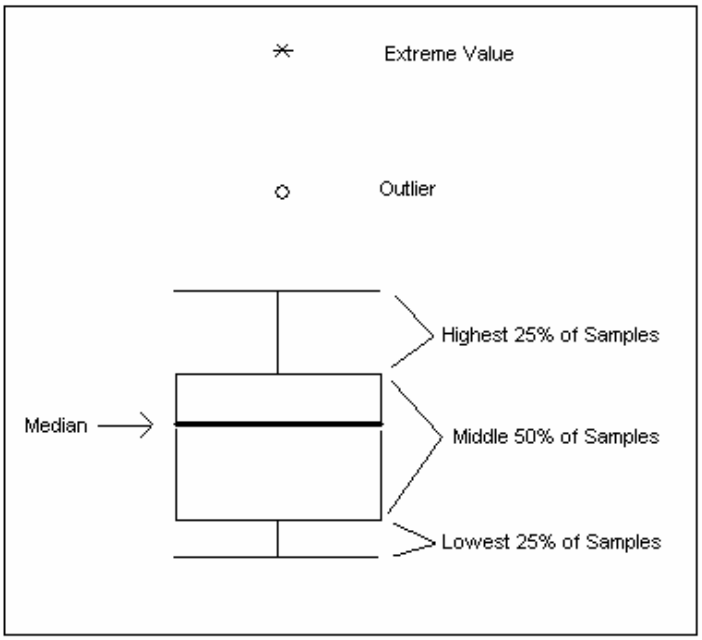


Figure 1-1. ***Typical boxplot construction***

2.0 WATER COLUMN MONITORING RESULTS

Water quality sampling and field measurements were performed at each of the three Rock Creek sites on a monthly basis during 2006 except when the sites were inaccessible due to snow or the streamflow went dry. The upper Rock Creek sites on the West Fork and East Fork of Rock Creek were sampled seven times during 2006, including events in March, May, June, July, August, November and December. The sites were inaccessible due to snow during February and April, and were too low to sample during September and October. The Rock Creek site near the mouth was sampled during March, April, May, June, July, August, September, November and December. The site was dry in October.

2.1 Rock Creek Field Measurement Results

Field constituents were recorded monthly at the three sample locations in 2006. Measured constituents include stream temperature (^{o}C), pH, specific conductance (µs/cm), dissolved oxygen (mg/L), turbidity (NTU), and streamflow (instantaneous, CFS). Spatial boxplots presenting 2006 field constituent data are provided in **Appendix B**, and summary statistics are provided in **Appendix C**.

2.1.1 Temperature

Median stream temperature varied from 7.3 ^{o}C in the West Fork to a high of 9.4 ^{o}C in Rock Creek near its mouth. The maximum stream temperature measured during 2006 was 15.3 ^{o}C in Rock Creek near its mouth during August. The highest measured stream temperatures were recorded in August for all sample locations, and the lowest stream temperatures occurred in December.

2.1.2 pH

Median pH values were highest in the West Fork of Rock Creek (8.27) and lowest in Rock Creek near mouth (7.97). Extreme values were recorded for the West Fork (9.54) and East Fork (9.52) during December.

2.1.3 Conductivity

Conductivity is an indirect measure of dissolved ion concentrations. Measured values were consistently low at all Rock Creek sites and typical of very clean water with low quantities of dissolved ions. Of the three stations, the highest conductivity value was measured in the West Fork (61 µs/cm) and lowest value was observed in the East Fork (14 µs/cm).

2.1.4 Dissolved Oxygen

Median dissolved oxygen concentrations (DO) in 2006 were highest in the West Fork of Rock Creek (9.90 mg/L) and lowest in the East Fork (9.12 mg/L). DO measurements were quite consistent during 2006, and varied from a low of 7.9 mg/L (East Fork of Rock Creek during August 2006) to 11.8 mg/L (Rock Creek near mouth during March 2006).

2.1.5 Turbidity

Mean turbidity was highest in the West Fork of Rock Creek (2.2 NTU) and lowest in the East Fork of Rock Creek (0.85 NTU), although all of the mean values can be considered to be quite low and indicative of highly transparent water. The highest individual values were recorded at all sites during May, including 10.0 NTU at the West Fork site, 2.3 NTU in the East Fork, and 5.3 NTU in Rock Creek near its mouth.

2.1.6 Streamflow

Measured streamflows at the Rock Creek monitoring locations during 2006 are presented below in **Table 2-1**. Streamflows were typically highest in Rock Creek near its mouth; however, the East Fork had the highest flow during November and December. Peak streamflows appeared to occur during the May sampling event, although flows were too high to safely gauge in the East Fork of Rock Creek and Rock Creek near its mouth during each of the May and June sampling events. The West Fork and East Fork Rock Creek sites were inaccessible during April because of deep snow, and were completely dry during September. Rock Creek near its mouth was too

low to measure its streamflow during September, and the West Fork of Rock Creek was too low to measure during November and December. All sites were completely dry during October.

Table 2-1. ***Streamflow measurement data for Rock Creek monitoring stations.***

Date	Streamflow (CFS)		
	West Fork Rock Creek	East Fork Rock Creek	Rock Creek near mouth
03/14/06	1.76	7.84	9.33
04/12/06	snow	snow	86.90
05/16/06	39.80	high	high
06/13/06	12.70	high	high
07/13/06	2.46	8.80	11.41
08/17/06	0.69	1.37	3.39
09/13/06	dry	dry	low
11/16/06	low	45.79	31.68
12/11/06	low	6.27	1.84

2.2 Rock Creek Total Suspended Solids Concentrations

Median concentrations of total suspended solids (TSS) were below the analytical detection limit (<1.0 mg/L) at all sites during 2006. However, each of the three sites had one or more individual measurements that were above detection. The West Fork of Rock Creek exhibited TSS concentrations of 15.4 mg/l during May 2006 and 10.3 mg/L during December 2006. The East Fork of Rock Creek had only one sample above detection during 2006 (2.7 mg/L during May 2006). The highest measured TSS concentration of 12.6 mg/L was noted at Rock Creek near its mouth during the May 2006 sampling event.

2.3 Rock Creek Nutrient Concentrations

Water column samples collected at the three sites in the Rock Creek drainage during 2006 were analyzed for nutrient constituents, including total nitrogen (calculated by summing measured concentrations of total Kjeldahl nitrogen and nitrate+nitrite nitrogen), total soluble inorganic nitrogen (calculated by summing nitrate+nitrite nitrogen and total ammonia nitrogen), total phosphorus, and soluble reactive phosphorus. Boxplots provide a visual comparison of spatial patterns in nutrient concentrations during 2006 (**Appendix B**). Summary statistics including mean, median, minimum, maximum, and standard deviation, as well as the number of samples are provided in **Appendix C**. For boxplot presentations, stations were ordered (left to right) in the upstream to downstream direction.

2.3.1 Total Nitrogen

Median total nitrogen (TN) concentrations were highest in the East Fork of Rock Creek (0.096 mg/L) and lowest in the West Fork of Rock Creek (below detection, < 0.110 mg/L). Measured values for total Kjeldahl nitrogen were generally below the analytical detection limit (<0.10

mg/L), but higher values were recorded for all three sites during runoff sampling in May (0.106 – 0.123 mg/L). Nitrate+nitrate nitrogen concentrations fluctuated spatially similar to total nitrogen and showed no extreme values.

2.3.2 Total Soluble Inorganic Nitrogen

Median total soluble inorganic nitrogen (TSIN) concentrations were highest in the East Fork of Rock Creek (0.0516 mg/L) and lowest in West Fork of Rock Creek (below detection, < 0.02 mg/L). Sample results for total ammonia were below the analytical detection limit (<0.01 mg/L) for all samples except one during 2006.

2.3.3 Total Phosphorus

Median total phosphorus (TP) concentrations were highest in the West Fork of Rock Creek (0.0062 mg/L) and lowest in the East Fork of Rock Creek (below detection, <0.004 mg/L). Higher individual values were recorded for the West Fork and near mouth sample sites during May (0.0231 - 0.0235 mg/L).

2.3.4 Soluble Reactive Phosphorus

Median soluble reactive phosphorus (SRP) concentrations were highest in the West Fork of Rock Creek (0.0058 mg/L) and lowest in the East Fork (below detection, <0.004 mg/L). SRP concentrations were quite consistent throughout the sampling period with no major outliers or extreme values.

2.4 Rock Creek Metals Concentrations

Monthly samples collected during 2006 were analyzed for total recoverable and dissolved fractions of copper, zinc, cadmium, lead and arsenic. Samples were also analyzed for water hardness for use in computing toxicity criteria values. Boxplots graphically displaying the 2006 metals analysis data are included in **Appendix B**. Summary statistics including mean, median, minimum, maximum, standard deviation, and number of analyses are provided in **Appendix C**.

2.4.1 Total Recoverable Copper

Median total recoverable copper concentrations were below detection (<0.001 mg/L) for all sites during 2006. Only one sample at each of three sites produced a value above the detection limit during 2006. The Rock Creek site near its mouth showed a measured total recoverable copper value of 0.002 mg/L during the May sampling event, which was the highest measured value among the Rock Creek sites during 2006.

2.4.2 Total Recoverable Zinc

Median concentrations of total recoverable zinc were below detection (<0.0005 mg/L) for all sites during 2006. Only two individual samples from all of the three Rock Creek stations showed values that were above detection during 2006. The Rock Creek site near its mouth showed a concentration of 0.0006 mg/L total recoverable zinc during the May 2006 sampling event, and the West Fork site produced a concentration of 0.0012 mg/L during the same monitoring event.

2.4.3 Total Recoverable Cadmium

All total recoverable cadmium (Cd) samples produced results that were below the analytical detection limit (<0.00004 mg/L) for all Rock Creek sample locations during 2006.

2.4.4 Total Recoverable Lead

Median concentrations of total recoverable lead (Pb) were below the analytical detection limit (<0.0005 mg/L) for all three of the Rock Creek sample locations during 2006. The West Fork of Rock Creek site had one sample above detection (0.0008 mg/L) during May, but all samples at all other sites were below the analytical detection limit during 2006.

2.4.5 Total Recoverable Arsenic

All total recoverable arsenic (As) sample analysis results were below the analytical detection limit (<0.001 mg/L) for all sample locations during 2006.

2.4.6 Dissolved Metals

Rock Creek dissolved metals samples were analyzed for dissolved copper, zinc, cadmium, lead, and arsenic. All dissolved metal sample analyses were below the analytical detection limit at all sites for dissolved copper, dissolved cadmium, dissolved lead, and dissolved arsenic. Median concentrations of dissolved zinc ranged from 0.0025 mg/L in the East Fork of Rock Creek to 0.0099 mg/L in the West Fork of Rock Creek. Dissolved zinc analysis results were consistently higher than the total recoverable zinc analysis results and field quality assurance sample analysis results point to zinc contamination in the field filter units as the cause (see **Section 6.0** for more discussion).

2.4.7 Heavy Metals Standards Comparison

Heavy metals concentrations measured in 2006 at the three Rock Creek monitoring sites were compared to the Montana acute and chronic toxicity water quality standards for the protection of aquatic life, which were calculated based on the measured water hardness at the time of sampling (Montana DEQ 2007). All samples at all Rock Creek locations during 2006 showed metals concentrations that were below the calculated acute and chronic toxicity standards for metals toxicity. A comparison of metals concentrations versus calculated standards for Rock Creek are provided in **Appendix C**.

3.0 STREAMBED SEDIMENT AND BIOTA METALS MONITORING RESULTS

Sampling was performed during 2006 to gather baseline data on concentrations of heavy metals in sediment and in resident biota, including fine sediment sampling in the three Rock Creek sites, and sampling of crayfish tissues in two Clark Fork sites above and below the confluence of Rock Creek. Sediment samples were digested in the laboratory and analyzed for total recoverable arsenic, cadmium, copper, lead, silver and zinc. Crayfish tissues, including hepatopancreas, gill, and exoskeleton were isolated from the crayfish specimens and analyzed for total recoverable concentrations of copper, zinc and cadmium. Fine sediment sampling was performed during July following the decline of the spring runoff hydrograph. Crayfish sampling was performed during September.

3.1 Stream Bottom Sediment Metals Concentrations

Results of total recoverable metals analyses on fine sediments are presented below in **Table 3-1**. Concentrations of heavy metals in fine sediment fluctuated between sample locations without any obvious spatial pattern. The West Fork of Rock Creek had the highest concentrations of arsenic (8.23 µg/g) and zinc in sediment (71.3 µg/g), and the East Fork of Rock Creek had the highest concentrations of cadmium (0.74 µg/g), copper (80.5 µg/g) and lead (33.2 µg/g). Concentrations of silver in sediment were below the analytical detection limit (<2.0 µg/g) at all sample sites during 2006.

Table 3-1. ***Total recoverable metals in fine grained stream bottom sediment in Rock Creek.***

Site	Name	Silver in Sediment (µg/g)	Arsenic in Sediment (µg/g)	Cadmium in Sediment (µg/g)	Copper in Sediment (µg/g)	Lead in Sediment (µg/g)	Zinc in Sediment (µg/g)
28.1	West Fork of Rock Cr	<2.0	8.23	0.40	14.3	31.5	71.3
28.2	East Fork of Rock Cr	<2.0	3.00	0.74	80.5	33.2	67.5
28.3	Rock Cr near mouth	<2.0	4.13	0.28	39.6	27.1	59.1

Since Montana has no narrative standard for sediment metals concentrations, published guidance for probable effects threshold levels (Maret and Skinner 2000, Buchman 1999) are used to evaluate the possibility of aquatic life impacts in Rock Creek (**Table 3-2**). Threshold values were exceeded for arsenic in the West Fork of Rock Creek, for cadmium in the East Fork of Rock Creek, and for copper in the East Fork of Rock Creek and near mouth.

Table 3-2. ***Guidelines for metals concentrations in sediment to protect aquatic life.***

Parameter	Probable Effects Threshold Concentration (µg/g)*
Arsenic	6
Cadmium	0.6
Copper	35
Lead	35
Zinc	123

*The probable effects threshold concentration is defined as the concentration above which adverse effects to aquatic life are predicted to occur frequently.

3.2 Crayfish Tissue Metals Concentrations

Results of total recoverable metals analyses on crayfish tissue samples are provided in **Appendix D** and include sample results, summary statistics and boxplots depicting spatial distribution of metal concentrations.

Crayfish specimens were collected in mid-September at locations above and below the confluence of Rock Creek **(Appendix A, Figure 1)**. Eight replicates from each site were analyzed for heavy metals in tissue samples. A 50/50 mix of male and female specimens were selected for analysis. Crayfish length varied from 58 to 60 mm, as measured from tip of rostrum to end of carapace, representing the 70th to 80th percentile size class. Crayfish tissues, including exoskeleton, gill and hepatopancreas, were isolated from each animal and analyzed separately for total recoverable concentrations of cadmium, copper and zinc. A summary of crayfish tissue results is provided below in **Table 3-2**.

Table 3-3. ***Summary of 2006 Clark Fork River crayfish tissue metals analysis results.***

Tissue	Analyte	Clark Fork above Rock Creek			Clark Fork below Rock Creek		
		Min	Max	Mean	Min	Max	Mean
Exoskeleton	Length (mm)	58	59	58.6	59	60	59.5
	Cadmium (µg/g)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Copper (µg/g)	4.9	8.3	6.5	3.4	16.1	7.3
	Zinc (µg/g)	18.9	25.4	21.8	16.0	27.8	19.0
	Moisture (%)	50.4	56.7	54.4	49.2	60.1	52.5
Gill	Cadmium µ (µg/g)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Copper (µg/g)	245	362	319.9	238	411	324.8
	Zinc (µg/g)	46.8	60.5	51.5	43.8	59.7	53.1
	Moisture (%)	87.8	91.7	89.6	88.1	94.5	90.2
Hepatopancreas	Cadmium (µg/g)	5.5	18.5	8.4	4.2	8.0	5.5
	Copper (µg/g)	1390	2900	2234	1520	3310	2554
	Zinc (µg/g)	118	737	308	164	392	314
	Moisture (%)	69.5	83.1	78.0	67.9	82.7	77.0

Concentrations of heavy metals in crayfish tissue were generally quite variable during the 2006 sampling event and did not display any discernible spatial pattern. This was especially true for copper and zinc in all tissue types. Cadmium in crayfish tissue was below the analytical detection limit (<1.00 µg/g) for all exoskeleton and gill samples. Median cadmium concentrations in hepatopancreas tissues were higher in the site below Rock Creek.

4.0 PERIPHYTON CHLOROPHYLL *a* MONITORING RESULTS

Three Clark Fork River stations and three Rock Creek stations were sampled for periphyton standing crops during August 2006 (**Appendix A, Figure 1**). Ten replicate samples were collected at each station and analyzed for chlorophyll *a* (mg/m^2).

Sample results and boxplots depicting spatial variations in periphyton data for the Clark Fork River and Rock Creek in 2006 are provided in **Appendix E**. Summary statistics, including mean, median, minimum, maximum and standard deviation are also provided in **Appendix E** and summarized below in **Table 4-1**.

Table 4-1. ***Summary of periphyton chlorophyll a analysis results for Clark Fork-Rock Creek monitoring locations.***

Station	Chlorophyll *a* (mg/m^2)				
	Mean	**Median**	**Minimum**	**Maximum**	**Std. Dev.**
Clark Fork above Rock Creek	83.8	84.7	53.3	97.5	12.36
West Fork of Rock Creek	23.1	23.4	12.5	31.2	5.96
East Fork of Rock Creek	68.2	67.8	11.6	114.0	30.17
Rock Creek near mouth	18.5	17.7	9.7	31.1	6.63
Clark Fork at Noxon	100.1	92.1	44.8	158.0	39.86
Clark Fork below Cabinet Gorge Dam	17.7	17.1	10.3	28.2	5.84

Mean periphyton concentrations were highest in the Clark Fork River at Noxon (100.1 mg/m^2) and lowest in Clark Fork River below Cabinet Gorge (17.7 mg/m^2) and Rock Creek near mouth (18.5 mg/m^2). The Clark Fork at Noxon had the highest individual replicate concentrations (156.0 and 158.0 mg/m^2) during 2006. These two replicates were the only samples which exceeded annual maximum instream concentration (150 mg/m^2) established for the Clark Fork River above the confluence of the Flathead River. These targets were developed by the Tri-State Water Quality Council and subsequently adopted as site-specific water quality standards by the State of Montana (ARM 17.30.631), and although not applicable to this stretch of river, the 150 mg/m^2 target is generally considered a threshold value for nuisance algae growth.

Aquatic plant field sheets were completed during periphyton sampling to help characterize the types of primary production at each sample location, and are provided in **Appendix E**. Information recorded includes type of growth, relative percent cover, amount of growth, color, condition, and relative amount of bare substrates. Microalgae was the dominant plant type at all sites, ranging from 70-90% cover. Algae growth was described as "moderate" at Clark Fork River sites, and as a "light film" in the Rock Creek sites. Algae color was generally golden brown or light green, and the condition described as mature or mature/decaying.

5.0 MACROINVERTEBRATE COMMUNITY STRUCTURE MONITORING RESULTS

Macroinvertebrate samples were collected during August 2006 in the Clark Fork River below Cabinet Gorge Dam following EPA Environmental Monitoring and Assessment Program (EMAP) methods developed specifically for large rivers. A taxa list with counts was constructed, and standard metric calculations for aquatic invertebrate assemblages were performed on the data. The laboratory taxa list and an interpretation of results are provided in **Appendix F**.

The macroinvertebrate assemblage was dominated by net-spinning caddisflies, midges, and blackfly larvae. The assemblage was typical of a site downstream of a reservoir outflow since it was dominated by filter-feeders. Despite the riffle/run nature of the sample location, several lentic species, including cladocerans and copepods, were found in the composite sample. The macroinvertebrate sample was evaluated using three bioassessment methods, including Montana MMI, the Montana O/E model, and the MVFP index. Results of these assessments are summarized below in **Table 5-1**. Two of the bioassessment methods suggest the site is unimpaired based on macroinvertebrate assemblage, but the MVFP Index suggests the site is moderately impaired.

Table 5-1. ***Macroinvertebrate bioassessment scores for the Clark Fork below Cabinet Gorge Dam during mid-August 2006.***

Method	Score	Impairment Classification
Montana MMI	68.0	Unimpaired
O/E Model	0.89	Unimpaired
MVFP Index	33%	Moderate impairment

An aquatic habitat assessment field form for riffle/run streams was completed on site in order to characterize macroinvertebrate habitat. Numeric scores were assigned for various habitat parameters including riffle development, benthic substrate, embeddedness, channel alteration, sediment deposition, channel flow status, bank stability, bank vegetation protection, and riparian vegetation zone width. Numeric scores assigned for each parameter range from either 0-10 or 0-20 based on the quality of each parameter. Scores are ranked as optimal, sub-optimal, marginal, and poor quality. Results of the habitat parameter assessment are provided below in **Table 5-2**.

In general, habitat parameters scored as optimal or sub-optimal, but some parameters scored as marginal, including riffle development and riparian vegetation zone width. Scores were rated as marginal due to weak riffle development that was dominated by cobble sized substrate, and a sparse riparian vegetation zone. Overall, the habitat parameter scores totaled 106 points out of a possible 160, suggesting that macroinvertebrate colonization may be somewhat limited due to habitat constraints.

Table 5-2. ***Macroinvertebrate habitat parameter assessment scores for the Clark Fork below Cabinet Gorge Dam during mid-August 2006.***

Habitat Parameter	Score	Quality	Description
Riffle Development	3/10	Marginal	Reduced riffle area that is not as wide as stream and its length less than two times width.
Benthic Substrate	8/10	Sub-optimal	Diverse substrate dominated by cobble.
Embeddedness	16/20	Optimal	Gravel, cobble, or boulder particles are between 0-25 percent surrounded by fine sediment.
Channel Alteration (channelization, dredging, etc.)	15/20	Sub-optimal	Some channel alteration present, usually in areas of crossings, evidence of past channel alterations (prior to past 20 years) may be present, but more recent
Sediment Deposition	16/20	Optimal	Little or no enlargement of bars and less than 5% of bottom affected by sediment deposition.
Channel Flow Status	16/20	Optimal	Water fills baseflow channel, minimal amount of channel substrate is exposed.
Bank Vegetation Protection	8/10 left	Sub-optimal	70-90% of bank covered by native vegetation; disruption minimal or not evident; almost all plants allowed to grow naturally.
	8/10 right	Optimal	
Bank Stability	9/10 left	Optimal	Banks stable; no evidence of erosion or bank failure; little potential for future problems.
	9/10 right	Optimal	
Riparian Vegetation Zone Width	4/10 left	Marginal	Width of vegetated zone 10-30 feet
	4/10 right	Marginal	

6.0 DATA QUALITY ASSURANCE REVIEW

Data collected during 2006 were compared against data quality objectives specifically established for the basic monitoring program (PBS&J, 2006). Data quality objectives include precision, accuracy, representiveness, completeness, and comparability. An analysis of blank sample results was also performed to detect any possible contamination of laboratory samples. An evaluation of each data quality objective for the 2006 data is provided below.

6.1 Precision

Precision refers to the degree of variability in replicate measurements. Precision for laboratory samples was evaluated by examining relative percent differences (RPDs) of duplicate samples. A duplicate sample was collected from one site each month and analyzed for nutrients and metals. For this project, a precision goal of +/- 15% was established for water chemistry samples. Out of 176 duplicate samples collected throughout the sampling year, 19 had RPDs greater than +/- 15%, which is 10.8% of the duplicate samples.

6.2 Accuracy

Accuracy is a measure of confidence that describes how close an analytical measurement is to its "true" value, or the combination of high precision and low bias. Potential bias in the program procedures were minimized through appropriate site selection and strict adherence to the QAPP. Because the "true" value of a field sample cannot be known, the primary tool for assessing accuracy of laboratory analyses is the percent recovery of matrix spikes and control standards run against the field sample.

For this project, an initial accuracy goal of 10 percent was established for water chemistry and sediment metals analyses. Percent recovery of laboratory matrix spikes was outside the acceptable range of accuracy for dissolved zinc during the May sampling event, and for silver during the sediment metals sampling event; however, silver concentrations in sediment metals samples were below the analytical detection limit at all sites.

6.3 Representiveness

Representativeness is the extent to which the measurements actually represent the true environmental conditions. For this monitoring effort, the sample locations were chosen to best represent the stream or lake segment of interest and minimize site-specific bias. Samplers adhered to all sampling guidelines provided in the QAPP during 2006, and did not deviate from designated sample locations.

6.4 Completeness

Completeness is the comparison between the amount of data that has been planned to be collected versus how much usable data was actually collected. This DQO is evaluated by looking at the each monitoring variable for each station during each sampling event. Two TKN samples were discarded from the dataset for not passing the laboratory's internal QA procedures; otherwise, all samples intended for laboratory analysis were received, analyzed, and reported by the lab. For field measurements, turbidity was not measured during the June 13 sampling run due to equipment availability, and dissolved oxygen was not measured during the September 13 sampling run due to poor calibration. No sites were sampled during February because the upper sites were inaccessible due to snow. The upper sites (West Fork and East Fork of Rock Creek) were also not sampled during April due to snow. Flow could not be measured in the East Fork of Rock Creek or Rock Creek near mouth during May and June due to high flow. Flow could not be measured at any sites during September and October due to low flow, and flows could not be measured during November and December at West Fork of Rock Creek due to low flow. Samples were not collected for the West Fork and East Fork of Rock Creek during September, and samples were not collected at any sites during October due to low flow.

6.5 Comparability

Comparability was achieved for this project through consistent sampling locations, procedures, and analyses as outlined in the QAPP.

6.6 Analysis of Blanks

Field blanks were collected using the same sampling protocol as river samples, but deionized water was submitted as a sample. Field blanks are intended to detect any possible contamination which could occur from sample bottles, storage coolers, sample filters, or from environmental fallout. For nutrient samples, field blanks exceeded analytical detection limits twice for total phosphorus, and twice for total Kjeldahl nitrogen. For metals samples, field blanks exceeded analytical detection limits once for total recoverable cadmium, and four times for dissolved zinc.

Zinc contamination from disposable filters has been a recurring problem with this sampling program, and corrective actions have been employed to help alleviate zinc contamination from filters. For future sampling efforts starting in 2007, filters will now be flushed with 100 ml of deionized water and 100 ml of sample water prior to collection.

7.0 REFERENCES

Administrative Rules of Montana. 2002. Numeric Algal Biomass and Nutrient Standards for the Clark Fork River. ARM 17.30.631, Effective August 16, 2002.

APHA/AWWA/WEF. 1998. Standard Methods for the Examination of Water and Wastewater, 20th Ed. American Public Health Association. Washington, D.C.

Buchman, M. F. 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1. Coastal Protection and Restoration Division. National Oceanic and Atmospheric Administration. Seattle Washington.

Land & Water Consulting, Inc. 1995. Water quality status and trends monitoring system for the Clark Fork-Pend Oreille Watershed. Prepared for the Tri-State Implementation Council. Missoula, MT.

Land & Water Consulting, Inc. 2003. Water Quality Status and Trends Monitoring System for the Clark Fork-Pend Oreille Watershed – Quality Assurance Project Plan. Prepared for Tri-State Water Quality Council. Missoula, MT.

Land & Water Consulting, Inc. 2004. Water Quality Status and Trends Monitoring System for the Clark Fork-Pend Oreille Watershed – Trends Analysis from 1984-2002. Prepared for Tri-State Water Quality Council. Missoula, MT.

Lazorchak , J.M., Hill, B.H., Averill, D.K., Peck, D.V., and D.J. Klemm (editors). 2000. Environmental Monitoring and Assessment Program – Surface Waters: Field Operations and Methods for Measuring the Ecological Condition of Non-Wadeable Rivers and Streams. U.S. Environmental Protection Agency, Cincinnati, OH.

Maret, T.R.; Skinner, K.D. 2000. Concentrations of Selected Trace Elements in Fish Tissue and Streambed Sediment in the Clark Fork-Pend Oreille and Spokane River Basins, Washington, Idaho, Montana, 1998. Water-Resources Investigations Report 00-4159. U.S. Geological Survey. Boise Idaho.

Montana Department of Environmental Quality. 2005. Field Procedures Manual For Water Quality Assessment Monitoring. WQPBWQM-020. Water Quality Planning Bureau, Helena, MT.

PBS&J. 2006. Clark Fork-Pend Oreille Watershed Water Quality Status and Trends Monitoring Program - Quality Assurance Project Plan (QAPP) for Supplemental Monitoring of Potential Mine Effects near Noxon, MT. Prepared for Tri-State Water Quality Council and Idaho Department of Environmental Quality. Helena, MT.

PBS&J. 2007. Water Quality Status and Trends Monitoring System for the Clark Fork-Pend Oreille Watershed – Summary Monitoring Report 2006. Prepared for the Tri-State Water Quality Council. Helena, MT.

Phillips, Glenn R. 1985. Evaluation of Copper Concentrations in Crayfish (*Pacifastacus trowbridgi*) from Various Segments of the Clark Fork River Drainage, Montana. Montana Department of Fish, Wildlife and Parks. Pollution Control Information Series Technical Report No. 3. Helena, MT.

Appendix A

2006 ROCK CREEK MONITORING STATIONS

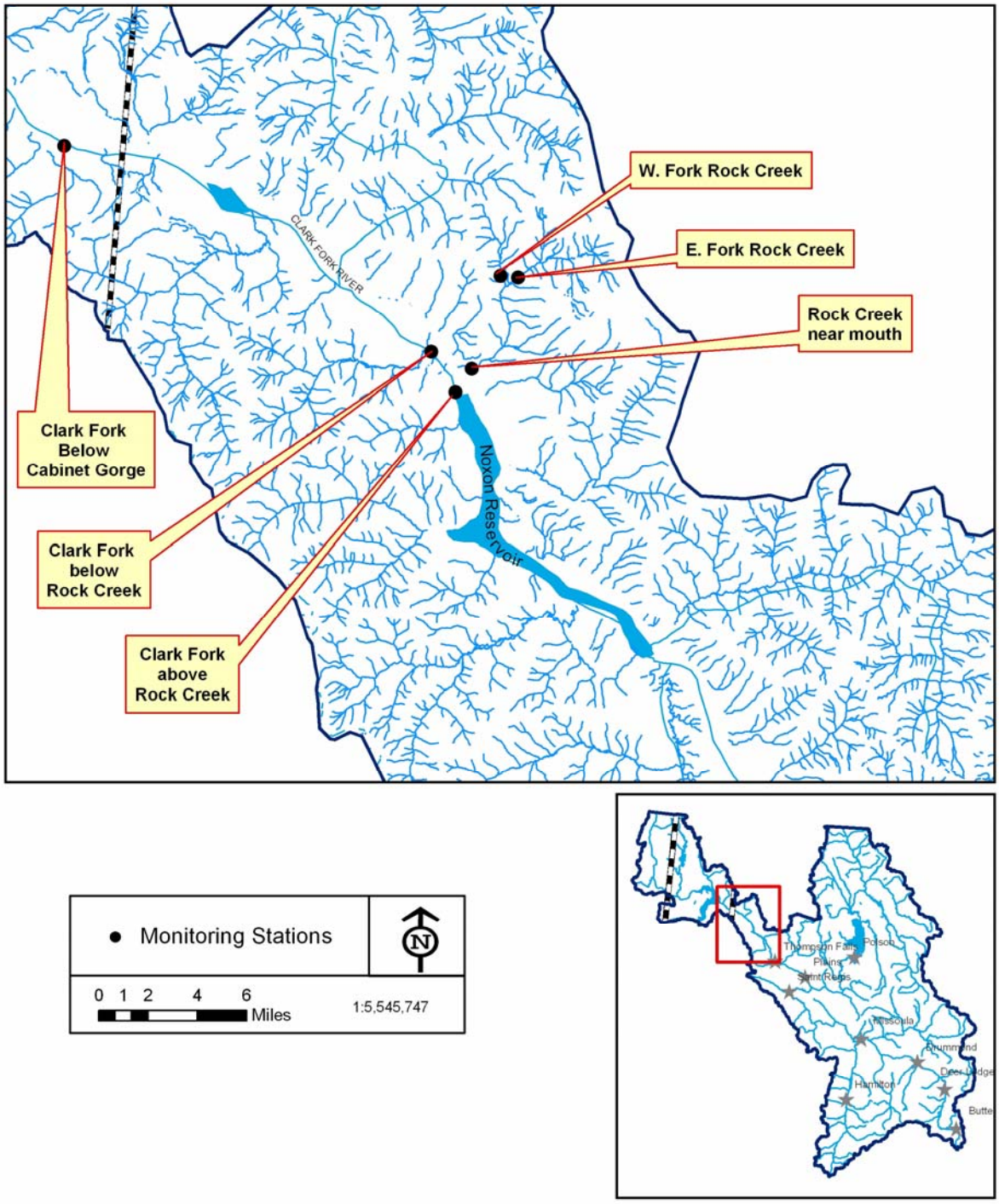
2006 Report for Supplemental Monitoring of Potential Mine Effects near Noxon, MT

Appendix A, Table 1. ***2006 monitoring locations, components, and rationale.***

Site	Name	Latitude	Longitude	Monitoring Component	Rationale
28.1	West Fork of Rock Creek	48.0270	115.7072	Monthly water quality, sediment metals, benthic algae	Located in same drainage as proposed mining operations
28.2	East Fork of Rock Creek	48.0245	115.7052	Monthly water quality, sediment metals, benthic algae	Drains roadless and/or wilderness designated national forest lands, control site
28.3	Rock Creek near mouth	47.9744	115.7291	Monthly water quality, sediment metals, benthic algae	Integrates cumulative effects of mining, milling, and road activities within Rock Creek above Hwy 200
29.1	Clark Fork above Rock Creek	47.9684	115.7391	Benthic algae, sediment metals (crayfish)	Below Noxon Dam and above Rock Creek confluence, upstream control for Clark Fork above Rock Creek
29.2	Clark Fork below Rock Creek	47.9935	115.7601	Benthic algae, sediment metals (crayfish)	Below Rock Creek, reflects influence of Rock Creek on Clark Fork water quality
30	Clark Fork below Cabinet Gorge	48.0937	116.1019	Macroinvertebrate sampling, benthic algae	Represents loading into Lake Pend Oreille

Figure 1.
Monitoring Stations

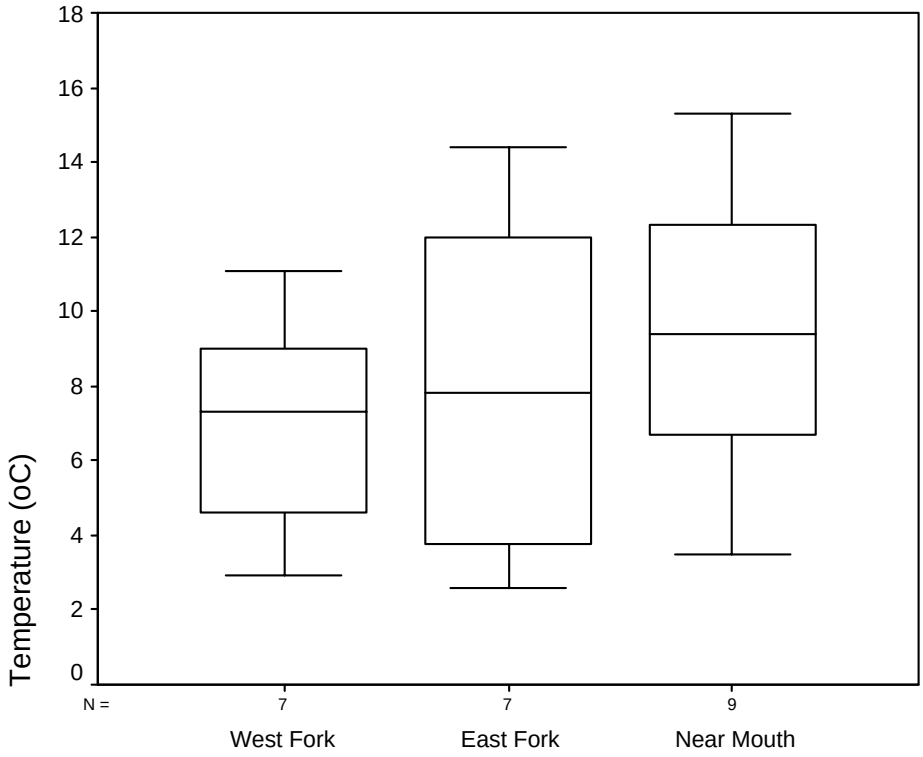
Clark Fork - Pend Oreille Basin

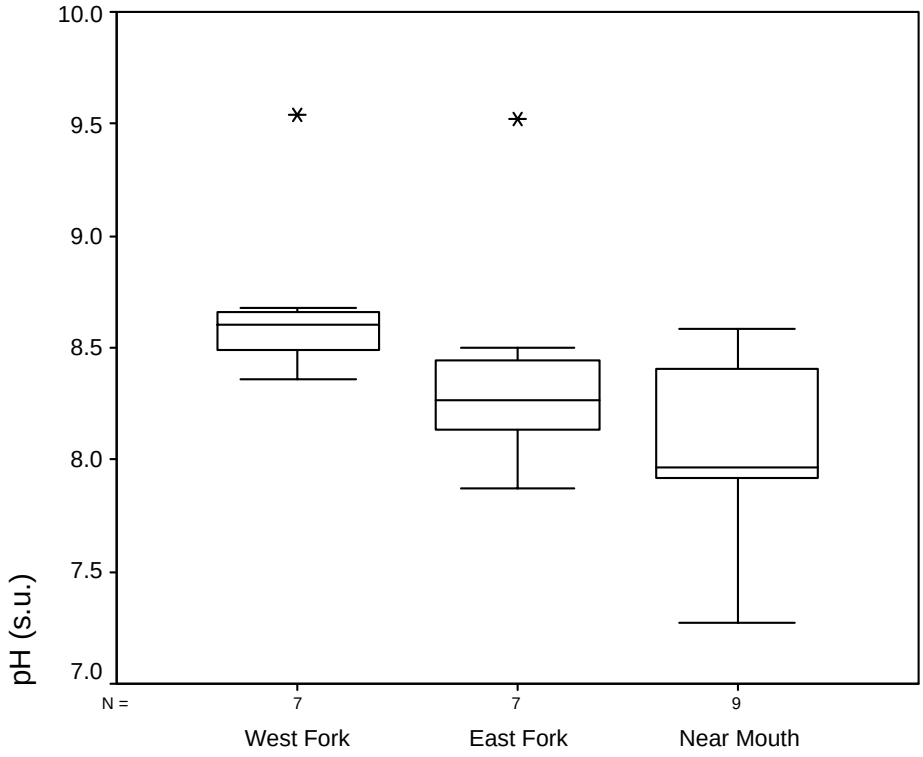


Appendix B

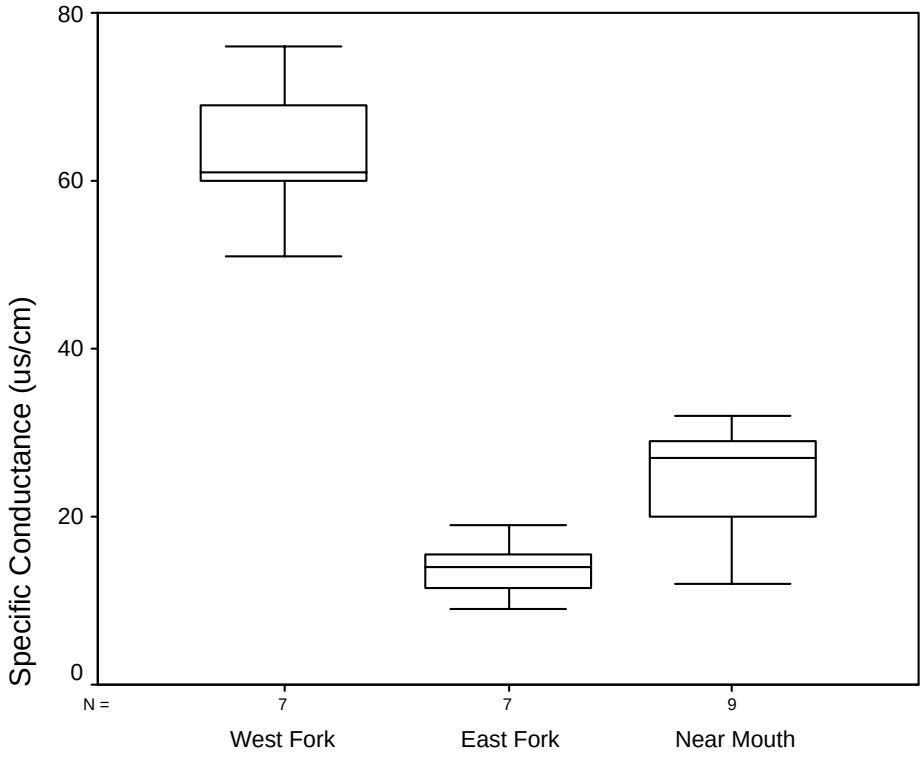
2006 ROCK CREEK WATER QUALITY SPATIAL BOXPLOTS

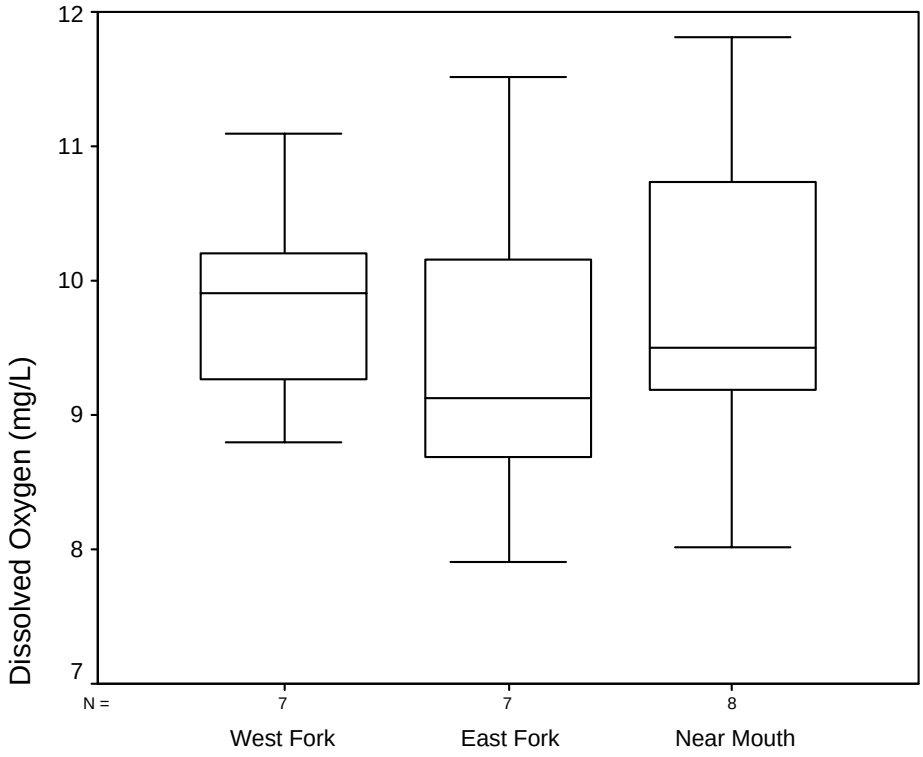
2006 Report for Supplemental Monitoring of Potential Mine Effects near Noxon, MT



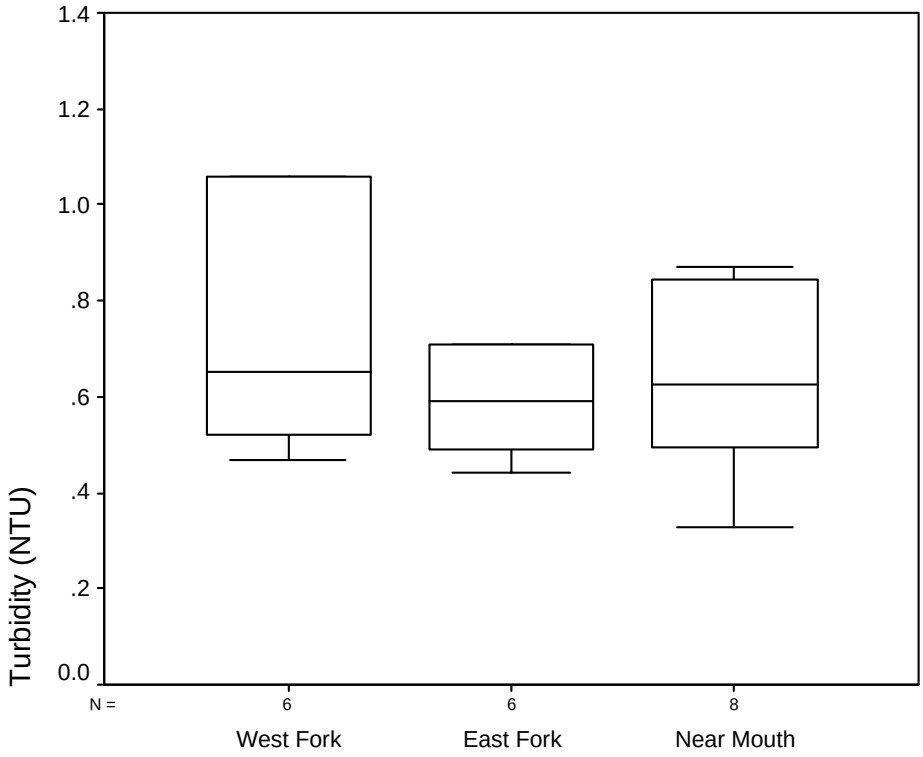


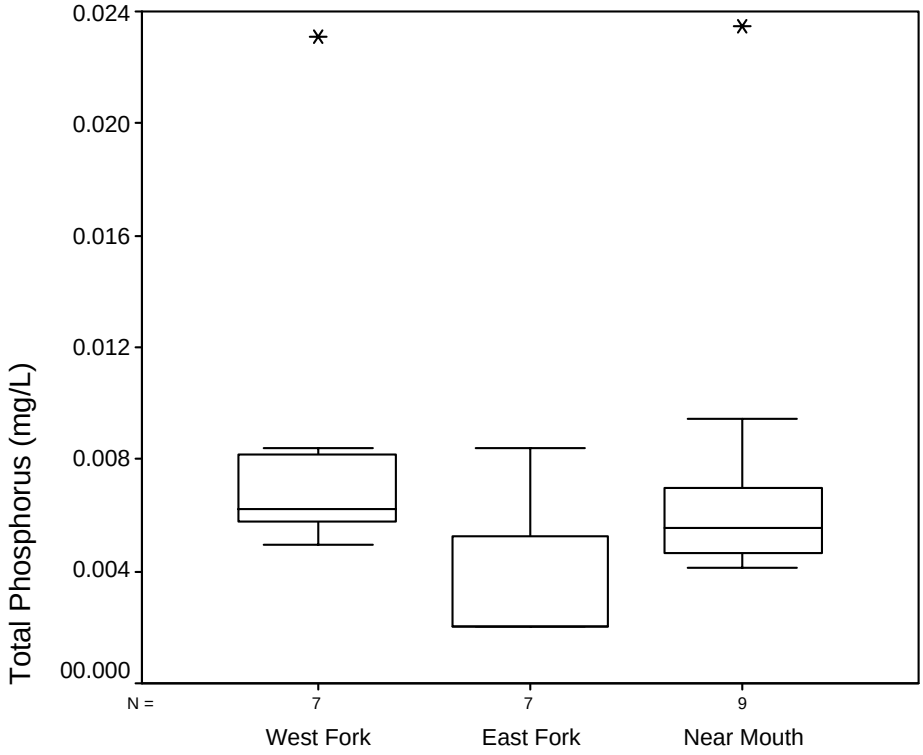
Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.



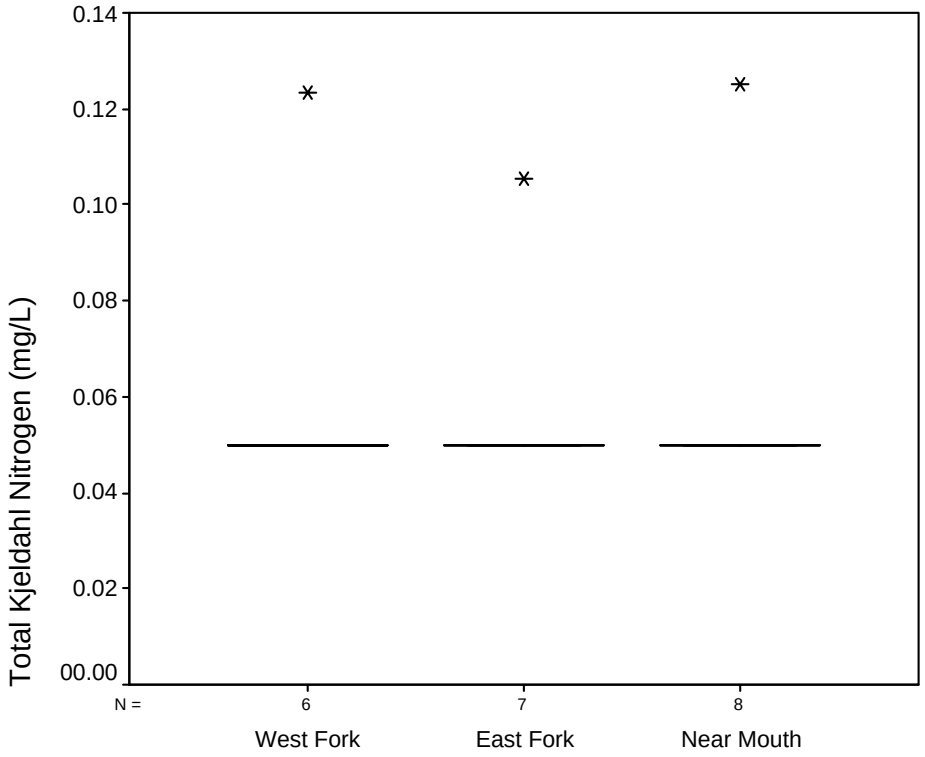


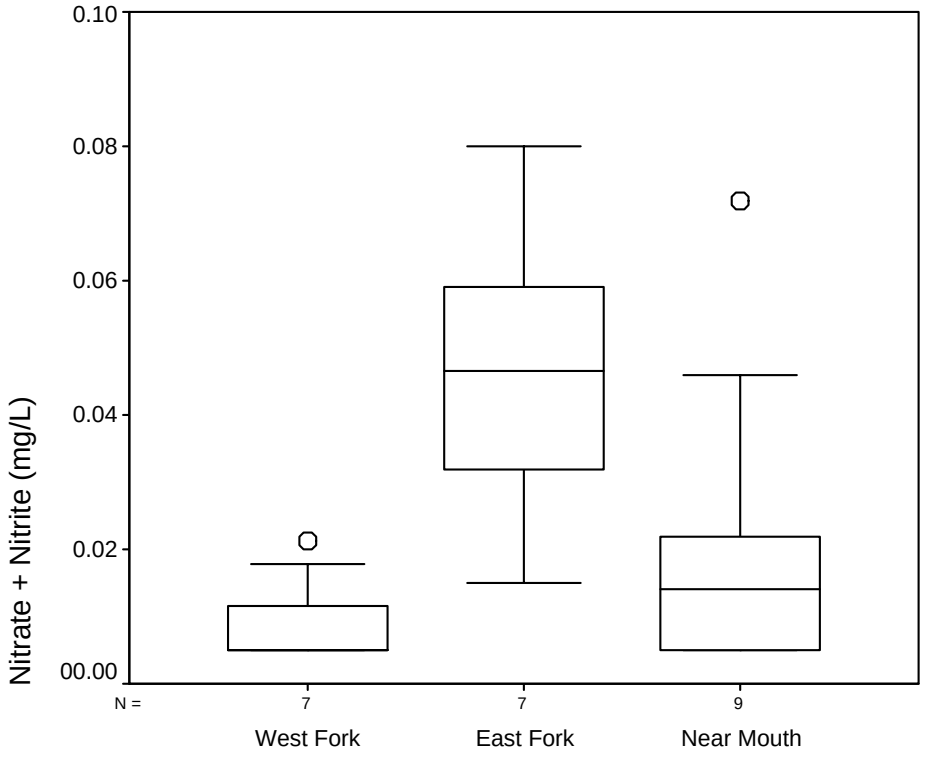
Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.



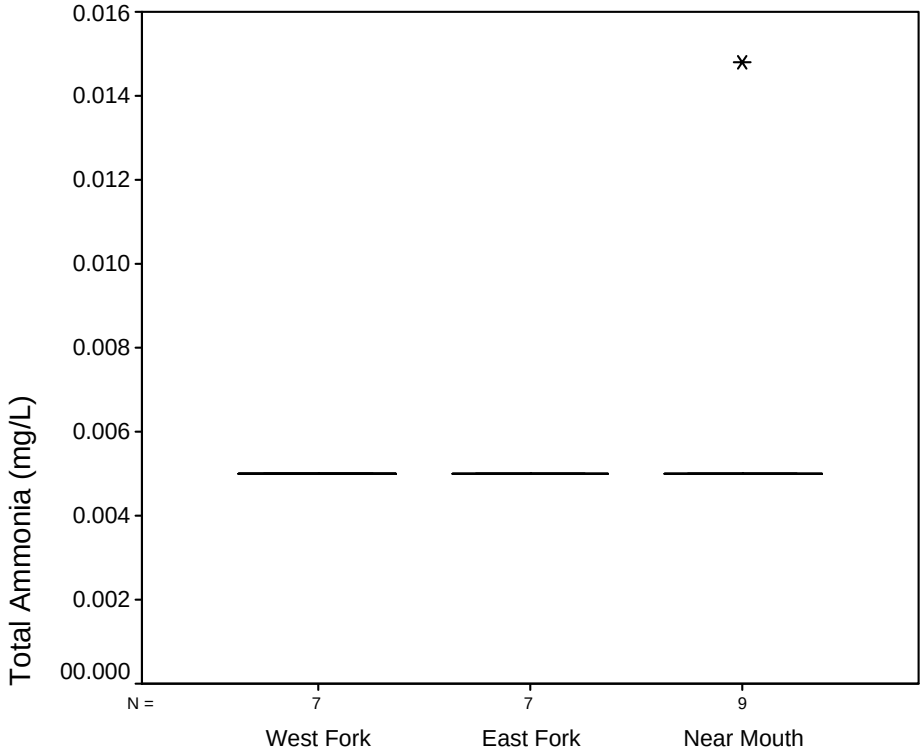


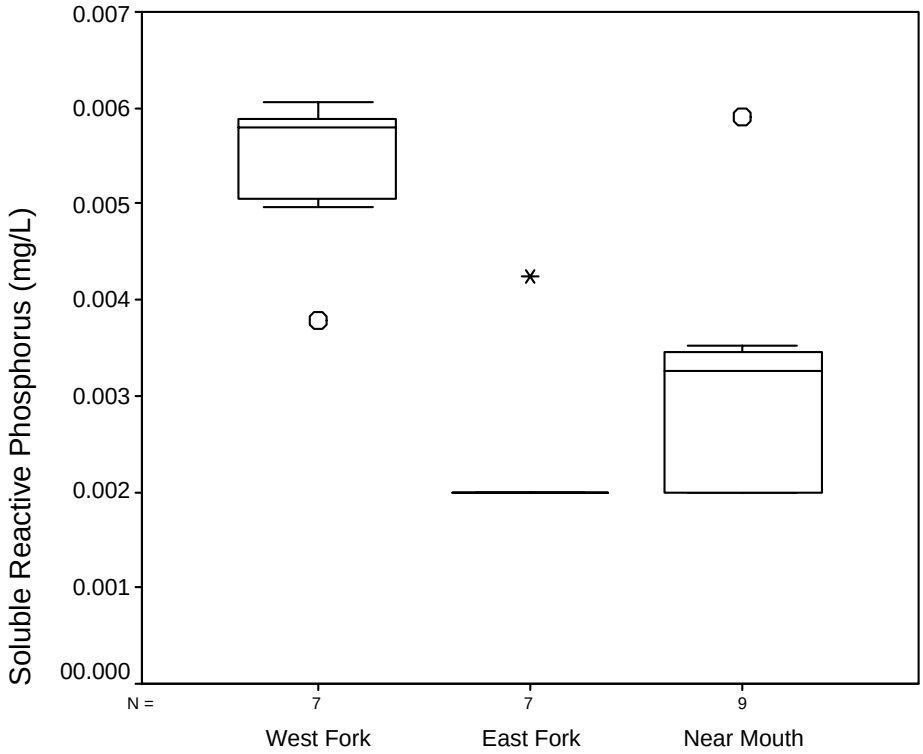
Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.



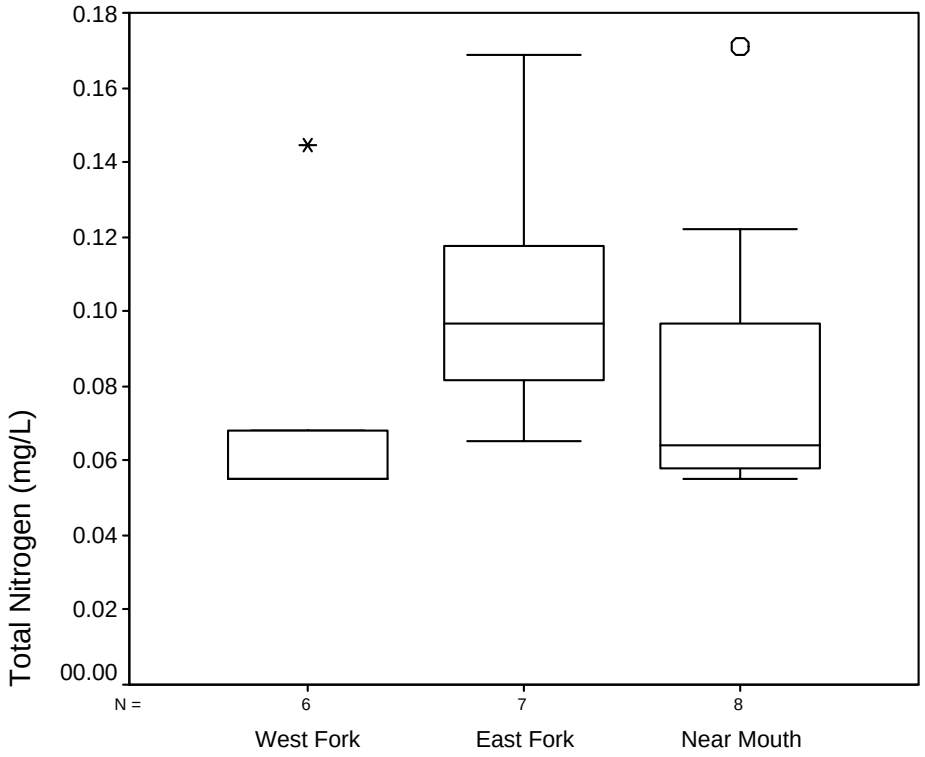


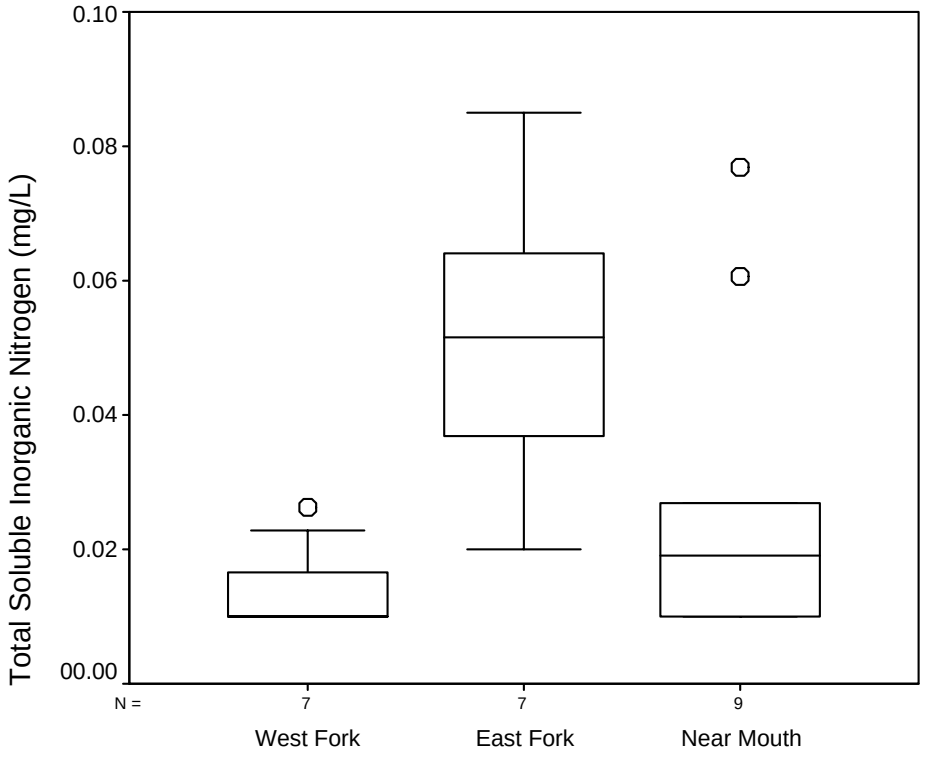
Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.



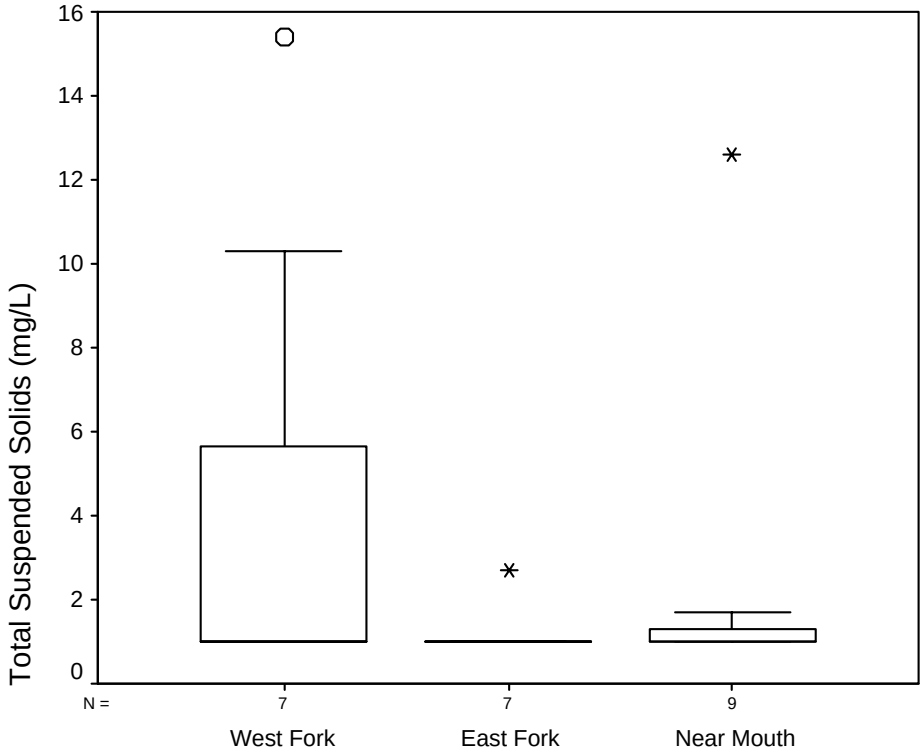


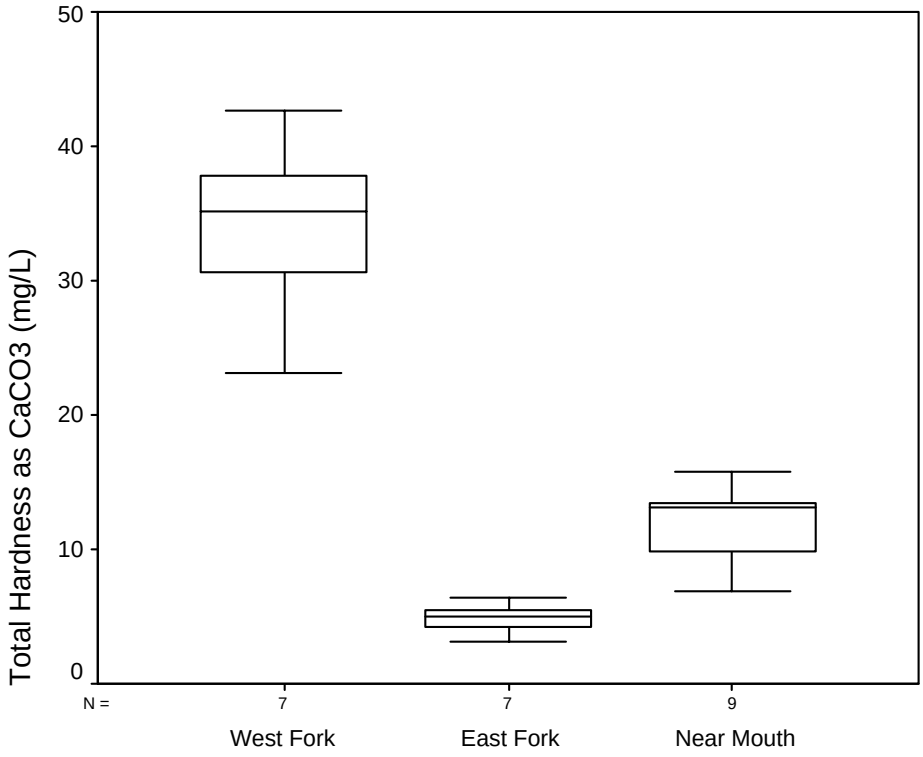
Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.



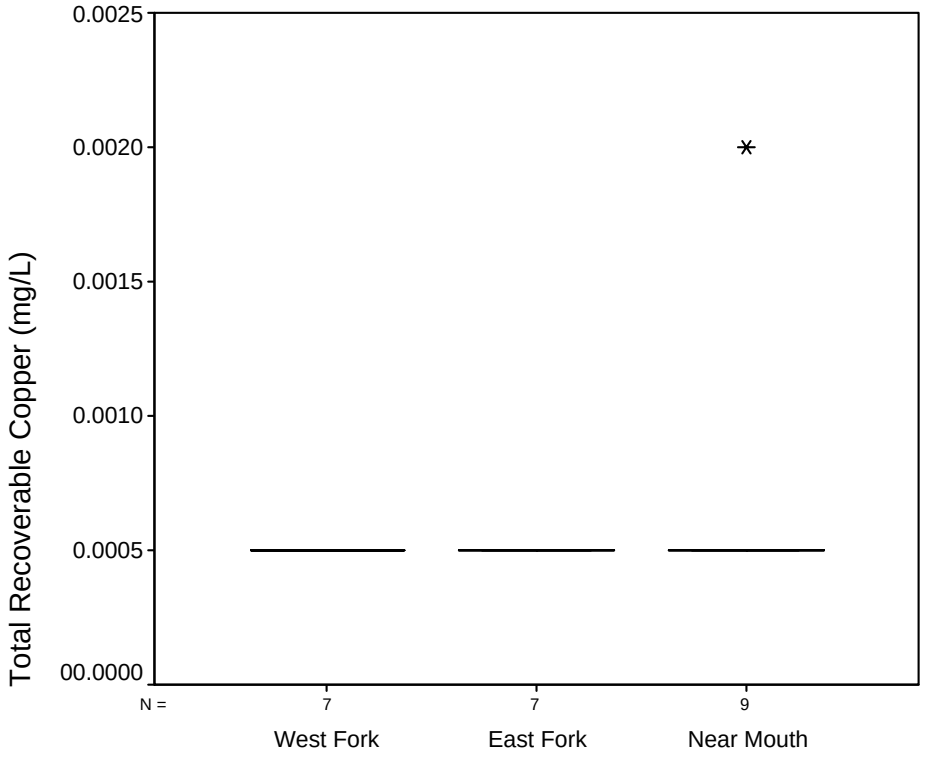


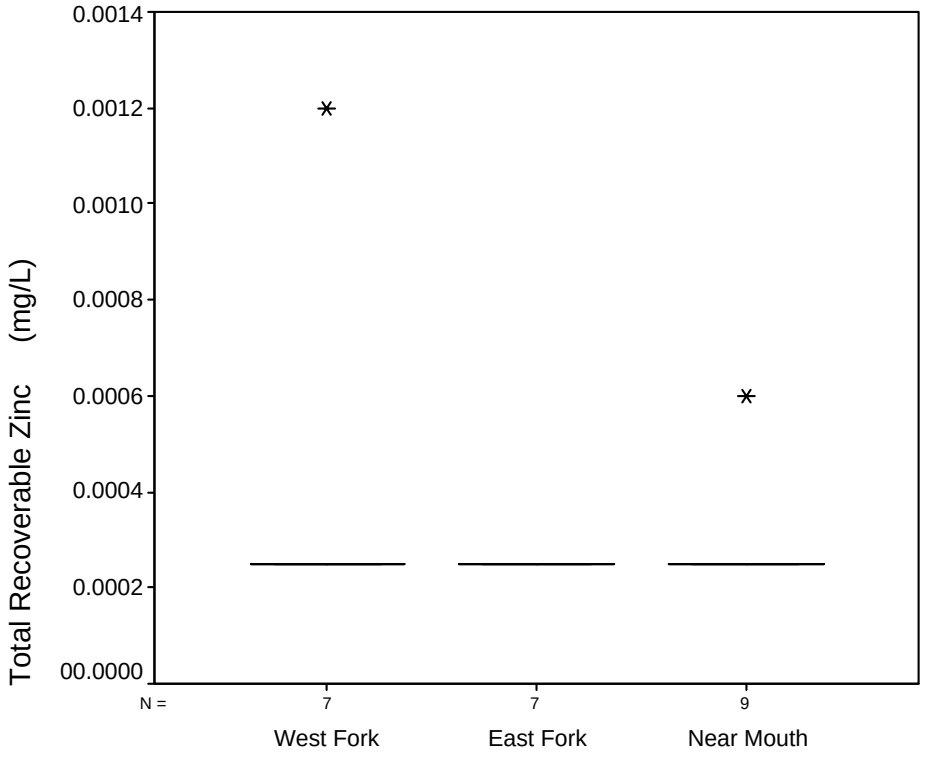
Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.



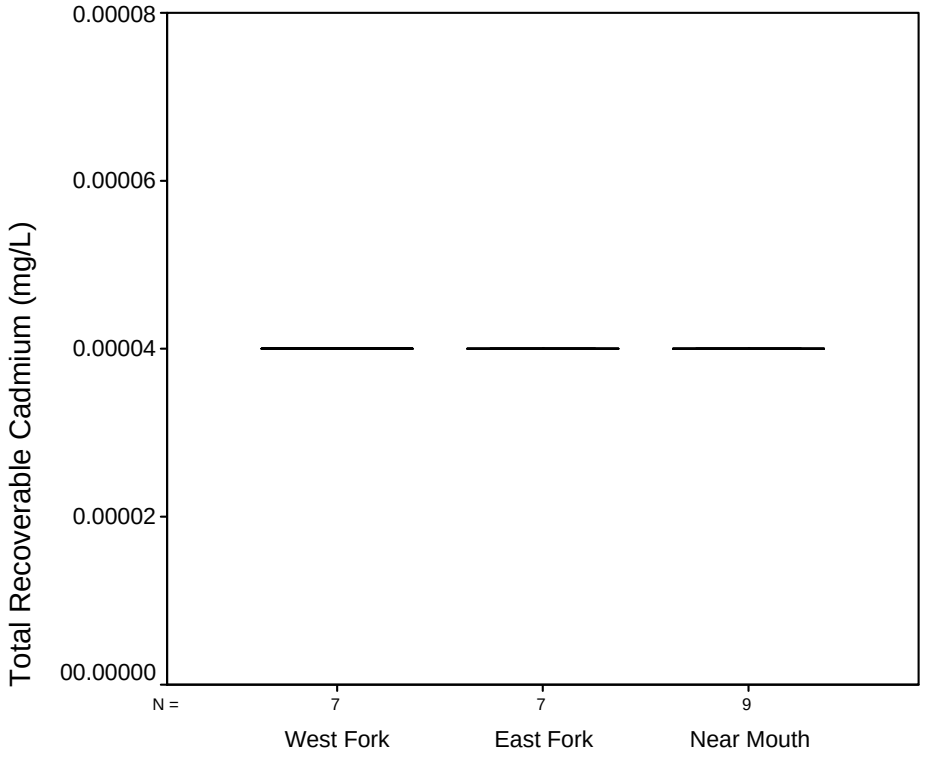


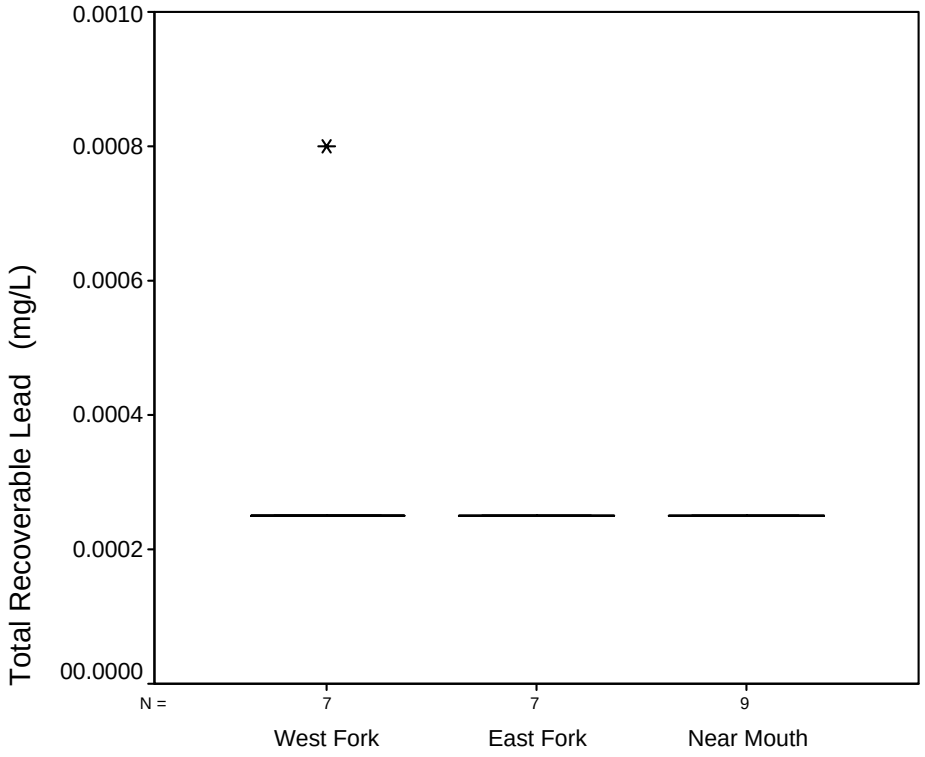
Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.



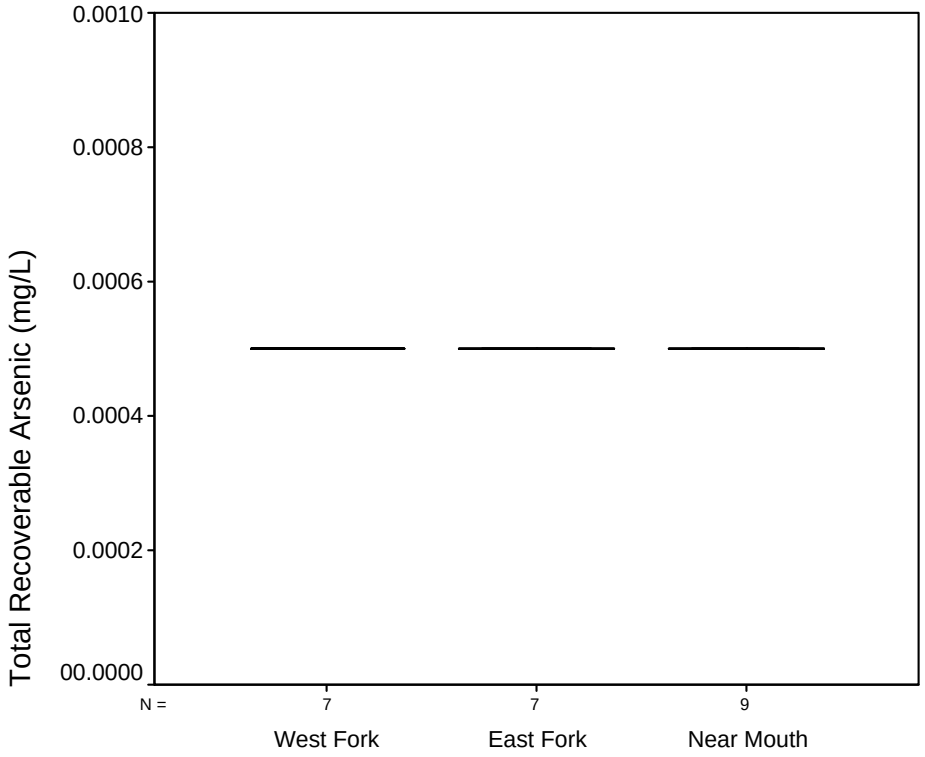


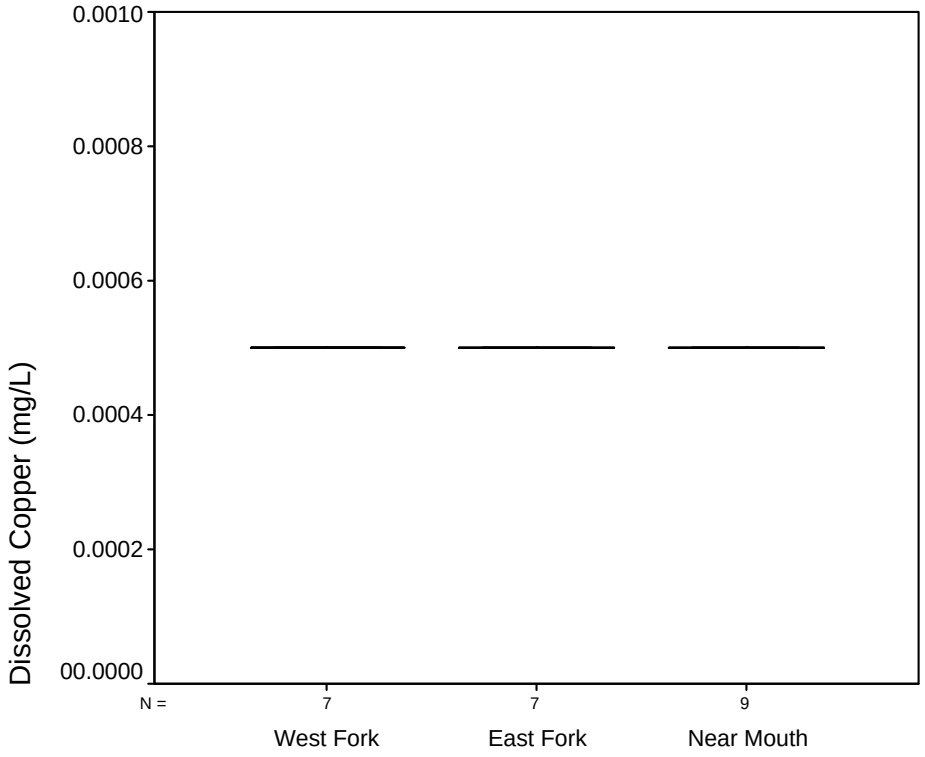
Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.



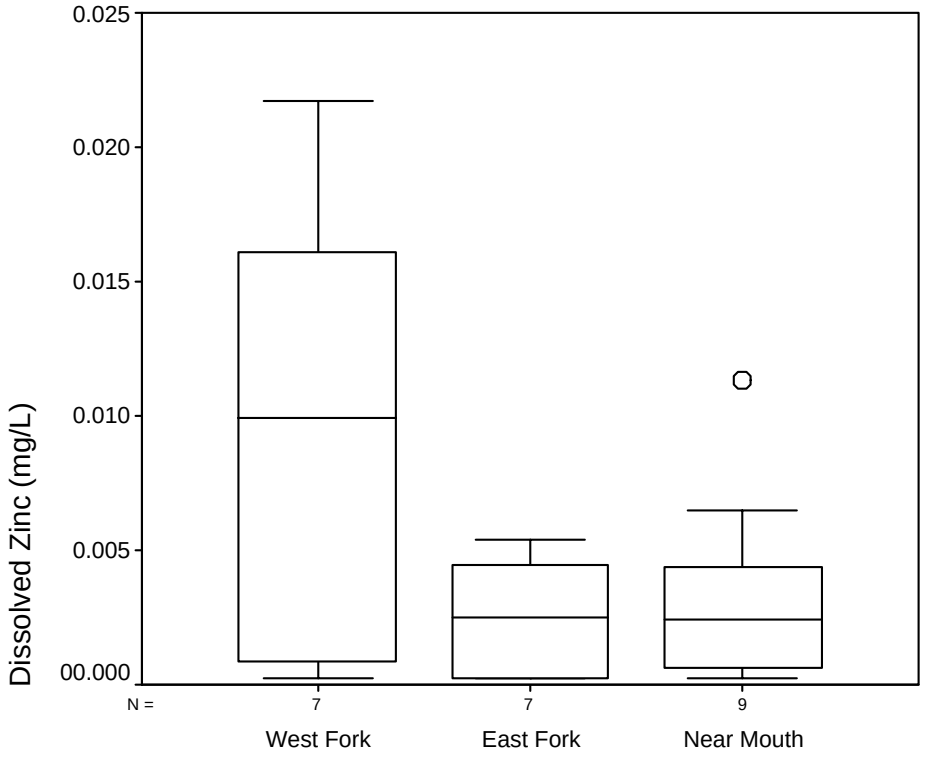


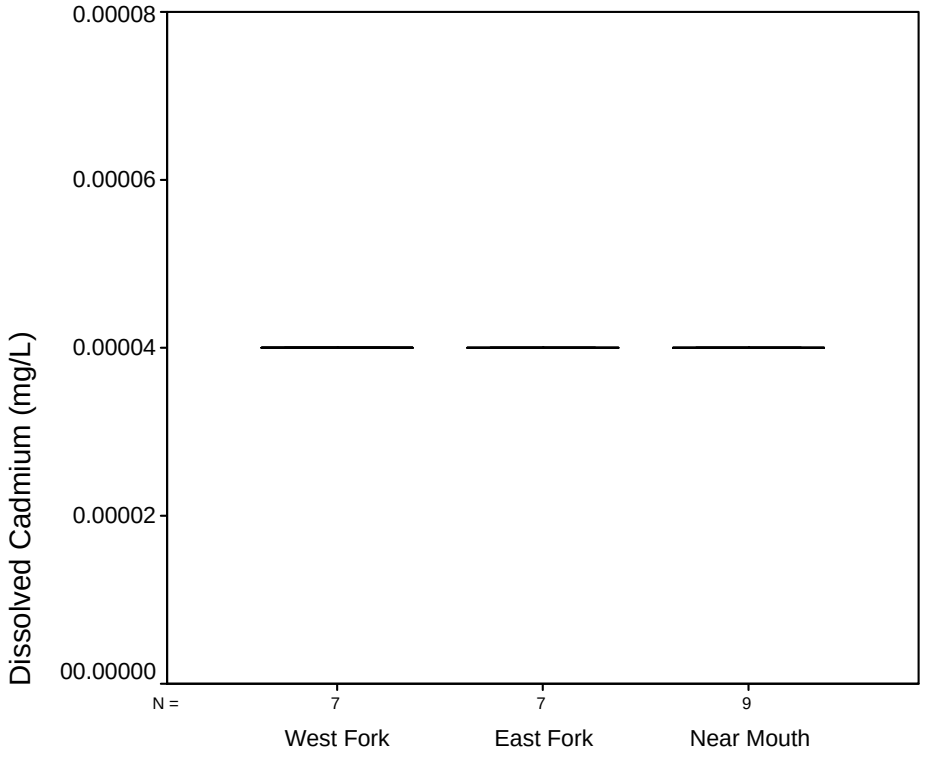
Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.



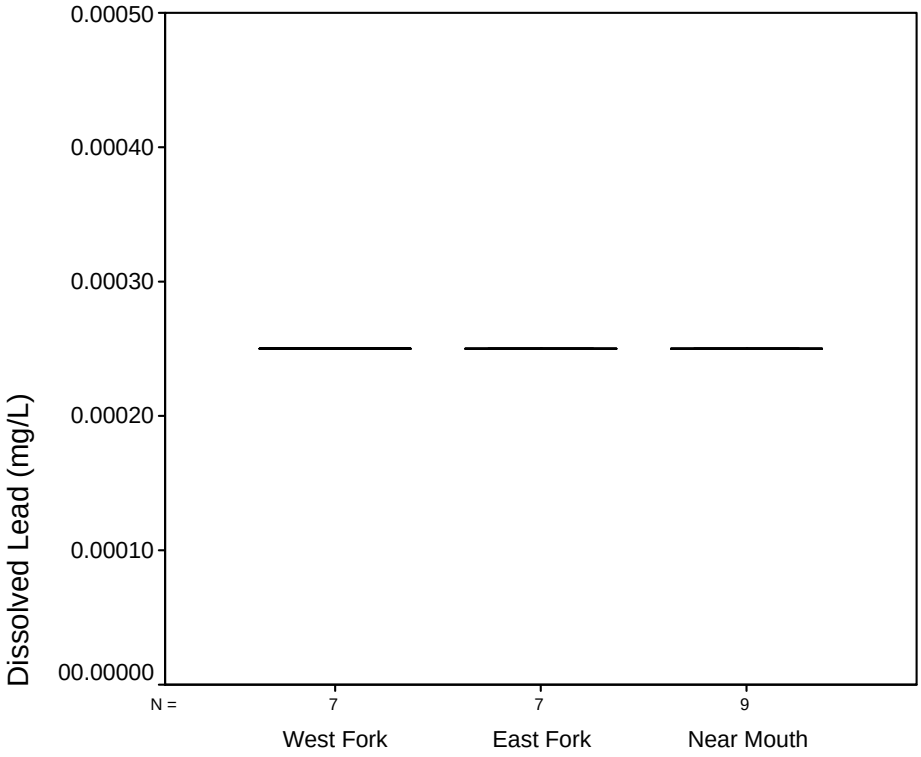


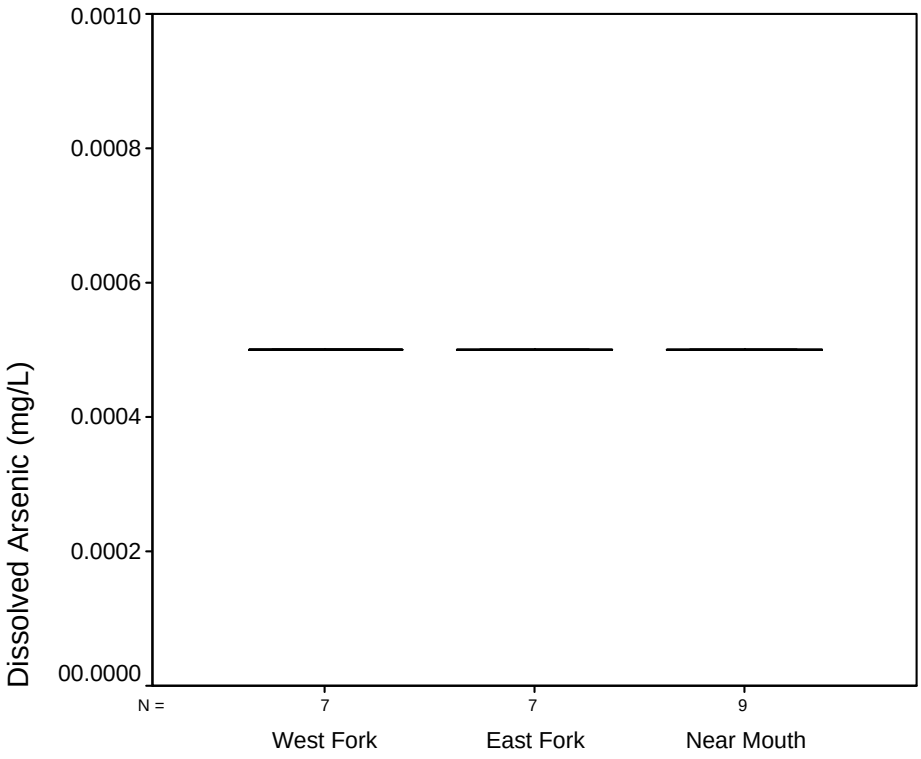
Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.





Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.





Non-detectable concentrations reported as ½ the analytical detection limit.
Some outliers or extreme values may not be shown on boxplot.

Appendix C

2006 ROCK CREEK WATER QUALITY SUMMARY STATISTICS

2006 Report for Supplemental Monitoring of Potential Mine Effects near Noxon, MT

Site 28.1 – West Fork of Rock Creek

Field Constituents[a]

		Temperature (oC)	pH (s.u.)	Specific Conductance (us/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Flow (CFS)
03/14/06		4.0	8.59	76	11.1	.47	1.76
05/16/06		7.3	8.39	60	9.9	10.00	39.80
06/13/06		8.3	8.36	51	10.5	.	12.70
07/13/06		9.7	8.68	68	9.9	1.06	2.46
08/17/06		11.1	8.60	70	9.3	.65	.69
11/16/06		5.3	8.64	60	9.3	.52	low
12/11/06		3.0	9.54	61	8.8	.65	low
Total	Mean	6.944	8.6857	63.71	9.821	2.2250	11.4800
	Median	7.300	8.6000	61.00	9.900	.6500	2.4600
	Minimum	3.0	8.36	51	8.8	.47	low
	Maximum	11.1	9.54	76	11.1	10.00	39.80
	Std. Deviation	3.0080	.39623	8.220	.7917	3.81461	
	N	7	7	7	7	6	5

a. STATION = West Fork

Nitrogen Constituents[a]

		Total Nitrogen (mg/L)	Total Soluble Inorganic Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Ammonia (mg/L)
03/14/06		.	.01	.	.0050	.0050
05/16/06		.14	.03	.1233	.0213	.0050
06/13/06		.06	.01	.0500	.0050	.0050
07/13/06		.06	.01	.0500	.0050	.0050
08/17/06		.06	.01	.0500	.0050	.0050
11/16/06		.06	.01	.0500	.0050	.0050
12/11/06		.07	.02	.0500	.0178	.0050
Total	Mean	.0721	.0142	.062217	.009159	.005000
	Median	.0550	.0100	.050000	.005000	.005000
	Minimum	.06	.01	.0500	.0050	.0050
	Maximum	.14	.03	.1233	.0213	.0050
	Std. Deviation	.03589	.00717	.0299246	.0071731	.0000000
	N	6	7	6	7	7

a. STATION = West Fork

Values below the analytical detection limit are reported as ½ the detection limit.

Site 28.1 – West Fork of Rock Creek

Phosphorus, Sediment and Hardness Constituents[a]

		Total Phosphorus (mg/L)	Soluble Reactive Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Total Hardness as CaCO3 (mg/L)
03/14/06		.0049	.0038	1.0	5.7	2.2	23.1
05/16/06		.0231	.0058	15.4	7.6	3.1	31.7
06/13/06		.0079	.0051	1.0	7.1	2.9	29.6
07/13/06		.0062	.0060	1.0	9.6	4.0	40.5
08/17/06		.0055	.0050	1.0	10.0	4.3	42.7
11/16/06		.0061	.0061	1.0	8.3	3.5	35.1
12/11/06		.0084	.0058	10.3	8.3	3.5	35.1
Total	Mean	.008870	.005357	4.386	8.071	3.356	33.971
	Median	.006190	.005796	1.000	8.300	3.500	35.100
	Minimum	.0049	.0038	1.0	5.7	2.2	23.1
	Maximum	.0231	.0061	15.4	10.0	4.3	42.7
	Std. Deviation	.0063841	.0008089	5.9667	1.4650	.7221	6.6309
	N	7	7	7	7	7	7

a. STATION = West Fork

Total Recoverable Metal Constituents[a]

		Total Recoverable Copper (mg/L)	Total Recoverable Zinc (mg/L)	Total Recoverable Cadmium (mg/L)	Total Recoverable Lead (mg/L)	Total Recoverable Arsenic (mg/L)
03/14/06		.0005	.00025	.00004	.00025	.0005
05/16/06		.0005	.00120	.00004	.00080	.0005
06/13/06		.0005	.00025	.00004	.00025	.0005
07/13/06		.0005	.00025	.00004	.00025	.0005
08/17/06		.0005	.00025	.00004	.00025	.0005
11/16/06		.0005	.00025	.00004	.00025	.0005
12/11/06		.0005	.00025	.00004	.00025	.0005
Total	Mean	.000500	.0003857	.0000400	.0003286	.000500
	Median	.000500	.0002500	.0000400	.0002500	.000500
	Minimum	.0005	.00025	.00004	.00025	.0005
	Maximum	.0005	.00120	.00004	.00080	.0005
	Std. Deviation	.0000000	.00035907	.00000000	.00020788	.0000000
	N	7	7	7	7	7

a. STATION = West Fork

Values below the analytical detection limit are reported as ½ the detection limit.

Site 28.1 – West Fork of Rock Creek

Dissolved Metal Constituents[a]

		Dissolved Copper (mg/L)	Dissolved Zinc (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Lead (mg/L)	Dissolved Arsenic (mg/L)
03/14/06		.0005	.00150	.00004	.00025	.0005
05/16/06		.0005	.00990	.00004	.00025	.0005
06/13/06		.0005	.00025	.00004	.00025	.0005
07/13/06		.0005	.01260	.00004	.00025	.0005
08/17/06		.0005	.00025	.00004	.00025	.0005
11/16/06		.0005	.01960	.00004	.00025	.0005
12/11/06		.0005	.02170	.00004	.00025	.0005
Total	Mean	.000500	.0094000	.0000400	.0002500	.000500
	Median	.000500	.0099000	.0000400	.0002500	.000500
	Minimum	.0005	.00025	.00004	.00025	.0005
	Maximum	.0005	.02170	.00004	.00025	.0005
	Std. Deviation	.0000000	.00908914	.00000000	.00000000	.0000000
	N	7	7	7	7	7

a. STATION = West Fork

Values below the analytical detection limit are reported as ½ the detection limit.

Site 28.2 – East Fork of Rock Creek

Field Constituents[a]

		Temperature (oC)	pH (s.u.)	Specific Conductance (us/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Flow (CFS)
03/14/06		2.9	7.87	19	11.5	.44	7.84
05/16/06		7.8	8.50	10	10.1	2.27	high
06/13/06		10.4	8.01	9	10.2	.	high
07/13/06		13.6	8.39	13	8.7	.63	8.80
08/17/06		14.4	8.25	16	7.9	.71	1.37
11/16/06		4.7	8.27	15	9.1	.55	45.79
12/11/06		2.6	9.52	14	8.7	.49	6.27
Total	Mean	8.047	8.4014	13.71	9.460	.8483	14.0100
	Median	7.800	8.2700	14.00	9.120	.5900	8.8000
	Minimum	2.6	7.87	9	7.9	.44	1.37
	Maximum	14.4	9.52	19	11.5	2.27	high
	Std. Deviation	4.9125	.53803	3.450	1.2206	.70315	
	N	7	7	7	7	6	5

a. STATION = East Fork

Nitrogen Constituents[a]

		Total Nitrogen (mg/L)	Total Soluble Inorganic Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Ammonia (mg/L)
03/14/06		.09	.05	.0500	.0416	.0050
05/16/06		.17	.07	.1056	.0630	.0050
06/13/06		.07	.02	.0500	.0151	.0050
07/13/06		.07	.03	.0500	.0220	.0050
08/17/06		.10	.05	.0500	.0466	.0050
11/16/06		.13	.08	.0500	.0799	.0050
12/11/06		.11	.06	.0500	.0553	.0050
Total	Mean	.1042	.0512	.057943	.046210	.005000
	Median	.0966	.0516	.050000	.046596	.005000
	Minimum	.07	.02	.0500	.0151	.0050
	Maximum	.17	.08	.1056	.0799	.0050
	Std. Deviation	.03557	.02264	.0210148	.0226413	.0000000
	N	7	7	7	7	7

a. STATION = East Fork

Values below the analytical detection limit are reported as ½ the detection limit.

Site 28.2 – East Fork of Rock Creek

Phosphorus, Sediment and Hardness Constituents[a]

		Total Phosphorus (mg/L)	Soluble Reactive Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Total Hardness as CaCO3 (mg/L)
03/14/06		.0020	.0042	1.0	1.7	.3	5.5
05/16/06		.0084	.0020	2.7	1.0	.2	3.4
06/13/06		.0054	.0020	1.0	.9	.2	3.1
07/13/06		.0020	.0020	1.0	1.6	.3	5.5
08/17/06		.0020	.0020	1.0	1.8	.4	6.4
11/16/06		.0051	.0020	1.0	1.5	.3	5.0
12/11/06		.0020	.0020	1.0	1.5	.3	5.0
Total	Mean	.003843	.002319	1.243	1.433	.286	4.837
	Median	.002000	.002000	1.000	1.500	.300	5.000
	Minimum	.0020	.0020	1.0	.9	.2	3.1
	Maximum	.0084	.0042	2.7	1.8	.4	6.4
	Std. Deviation	.0025241	.0008440	.6425	.3477	.0690	1.1954
	N	7	7	7	7	7	7

a. STATION = East Fork

Total Recoverable Metal Constituents[a]

		Total Recoverable Copper (mg/L)	Total Recoverable Zinc (mg/L)	Total Recoverable Cadmium (mg/L)	Total Recoverable Lead (mg/L)	Total Recoverable Arsenic (mg/L)
03/14/06		.0005	.00025	.00004	.00025	.0005
05/16/06		.0005	.00025	.00004	.00025	.0005
06/13/06		.0005	.00025	.00004	.00025	.0005
07/13/06		.0005	.00025	.00004	.00025	.0005
08/17/06		.0005	.00025	.00004	.00025	.0005
11/16/06		.0005	.00025	.00004	.00025	.0005
12/11/06		.0005	.00025	.00004	.00025	.0005
Total	Mean	.000500	.0002500	.0000400	.0002500	.000500
	Median	.000500	.0002500	.0000400	.0002500	.000500
	Minimum	.0005	.00025	.00004	.00025	.0005
	Maximum	.0005	.00025	.00004	.00025	.0005
	Std. Deviation	.0000000	.00000000	.00000000	.00000000	.0000000
	N	7	7	7	7	7

a. STATION = East Fork

Values below the analytical detection limit are reported as ½ the detection limit.

Site 28.2 – East Fork of Rock Creek

Dissolved Metal Constituents[a]

		Dissolved Copper (mg/L)	Dissolved Zinc (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Lead (mg/L)	Dissolved Arsenic (mg/L)
03/14/06		.0005	.00025	.00004	.00025	.0005
05/16/06		.0005	.00390	.00004	.00025	.0005
06/13/06		.0005	.00025	.00004	.00025	.0005
07/13/06		.0005	.00500	.00004	.00025	.0005
08/17/06		.0005	.00025	.00004	.00025	.0005
11/16/06		.0005	.00540	.00004	.00025	.0005
12/11/06		.0005	.00250	.00004	.00025	.0005
Total	Mean	.000500	.0025071	.0000400	.0002500	.000500
	Median	.000500	.0025000	.0000400	.0002500	.000500
	Minimum	.0005	.00025	.00004	.00025	.0005
	Maximum	.0005	.00540	.00004	.00025	.0005
	Std. Deviation	.0000000	.00230243	.00000000	.00000000	.0000000
	N	7	7	7	7	7

a. STATION = East Fork

Values below the analytical detection limit are reported as ½ the detection limit.

Site 28.3 – Rock Creek near mouth

Field Constituents[a]

		Temperature (oC)	pH (s.u.)	Specific Conductance (us/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Flow (CFS)
03/14/06		4.2	7.97	32	11.8	.33	9.33
04/12/06		6.7	8.25	31	10.5	.68	86.90
05/16/06		9.4	8.41	18	9.4	5.33	high
06/13/06		10.3	7.66	12	11.0	.	high
07/13/06		12.3	7.92	25	9.4	.87	11.41
08/17/06		15.3	7.92	27	8.0	.56	3.39
09/13/06		14.2	8.58	29	.	.43	low
11/16/06		7.1	8.54	20	9.6	.82	31.68
12/11/06		3.5	7.27	28	9.0	.57	1.84
Total	Mean	9.210	8.0578	24.67	9.831	1.1988	60.5056
	Median	9.400	7.9700	27.00	9.495	.6250	11.4100
	Minimum	3.5	7.27	12	8.0	.33	low
	Maximum	15.3	8.58	32	11.8	5.33	high
	Std. Deviation	4.2043	.43168	6.671	1.2063	1.67915	
	N	9	9	9	8	8	6

a. STATION = Near Mouth

Nitrogen Constituents[a]

		Total Nitrogen (mg/L)	Total Soluble Inorganic Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Total Ammonia (mg/L)
03/14/06		.06	.02	.0500	.0144	.0050
04/12/06		.07	.03	.0500	.0218	.0050
05/16/06		.17	.06	.1253	.0458	.0148
06/13/06		.06	.02	.0500	.0141	.0050
07/13/06		.06	.01	.0500	.0050	.0050
08/17/06		.06	.01	.0500	.0050	.0050
09/13/06		.	.01	.	.0050	.0050
11/16/06		.12	.08	.0500	.0718	.0050
12/11/06		.06	.02	.0500	.0104	.0050
Total	Mean	.0830	.0276	.059412	.021496	.006091
	Median	.0643	.0191	.050000	.014118	.005000
	Minimum	.06	.01	.0500	.0050	.0050
	Maximum	.17	.08	.1253	.0718	.0148
	Std. Deviation	.04170	.02432	.0266226	.0228239	.0032728
	N	8	9	8	9	9

a. STATION = Near Mouth

Values below the analytical detection limit are reported as ½ the detection limit.

Site 28.3 – Rock Creek near mouth

Phosphorus, Sediment and Hardness Constituents[a]

		Total Phosphorus (mg/L)	Soluble Reactive Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Total Hardness as CaCO3 (mg/L)
03/14/06		.0041	.0020	1.0	4.0	1.1	14.5
04/12/06		.0095	.0033	1.3	4.2	1.3	15.8
05/16/06		.0235	.0020	12.6	2.3	.7	8.6
06/13/06		.0069	.0020	1.7	1.8	.5	6.9
07/13/06		.0046	.0035	1.0	3.6	1.1	13.3
08/17/06		.0051	.0033	1.0	3.6	1.0	13.1
09/13/06		.0069	.0059	1.0	3.6	1.0	13.1
11/16/06		.0056	.0020	1.0	2.6	.8	9.8
12/11/06		.0041	.0035	1.0	3.6	1.1	13.5
Total	Mean	.007811	.003050	2.400	3.249	.956	12.067
	Median	.005570	.003263	1.000	3.580	1.020	13.100
	Minimum	.0041	.0020	1.0	1.8	.5	6.9
	Maximum	.0235	.0059	12.6	4.2	1.3	15.8
	Std. Deviation	.0061248	.0012767	3.8324	.8144	.2447	2.9487
	N	9	9	9	9	9	9

a. STATION = Near Mouth

Total Recoverable Metal Constituents[a]

		Total Recoverable Copper (mg/L)	Total Recoverable Zinc (mg/L)	Total Recoverable Cadmium (mg/L)	Total Recoverable Lead (mg/L)	Total Recoverable Arsenic (mg/L)
03/14/06		.0005	.00025	.00004	.00025	.0005
04/12/06		.0005	.00025	.00004	.00025	.0005
05/16/06		.0020	.00060	.00004	.00025	.0005
06/13/06		.0005	.00025	.00004	.00025	.0005
07/13/06		.0005	.00025	.00004	.00025	.0005
08/17/06		.0005	.00025	.00004	.00025	.0005
09/13/06		.0005	.00025	.00004	.00025	.0005
11/16/06		.0005	.00025	.00004	.00025	.0005
12/11/06		.0005	.00025	.00004	.00025	.0005
Total	Mean	.000667	.0002889	.0000400	.0002500	.000500
	Median	.000500	.0002500	.0000400	.0002500	.000500
	Minimum	.0005	.00025	.00004	.00025	.0005
	Maximum	.0020	.00060	.00004	.00025	.0005
	Std. Deviation	.0005000	.00011667	.00000000	.00000000	.0000000
	N	9	9	9	9	9

a. STATION = Near Mouth

Values below the analytical detection limit are reported as ½ the detection limit.

Site 28.3 – Rock Creek near mouth

Dissolved Metal Constituents[a]

		Dissolved Copper (mg/L)	Dissolved Zinc (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Lead (mg/L)	Dissolved Arsenic (mg/L)
03/14/06		.0005	.00060	.00004	.00025	.0005
04/12/06		.0005	.00440	.00004	.00025	.0005
05/16/06		.0005	.00170	.00004	.00025	.0005
06/13/06		.0005	.00025	.00004	.00025	.0005
07/13/06		.0005	.00240	.00004	.00025	.0005
08/17/06		.0005	.00025	.00004	.00025	.0005
09/13/06		.0005	.00650	.00004	.00025	.0005
11/16/06		.0005	.00390	.00004	.00025	.0005
12/11/06		.0005	.01130	.00004	.00025	.0005
Total	Mean	.000500	.0034778	.0000400	.0002500	.000500
	Median	.000500	.0024000	.0000400	.0002500	.000500
	Minimum	.0005	.00025	.00004	.00025	.0005
	Maximum	.0005	.01130	.00004	.00025	.0005
	Std. Deviation	.0000000	.00361923	.00000000	.00000000	.0000000
	N	9	9	9	9	9

a. STATION = Near Mouth

Values below the analytical detection limit are reported as ½ the detection limit.

Station	Date	Hardness (mg/L)	Total Recoverable Cadmium (ug/L)	Cadmium Acute Standard	Cadmium Chronic Standard	Total Recoverable Copper (ug/L)	Copper Acute Standard	Copper Chronic Standard	Total Recoverable Lead (ug/L)	Lead Acute Standard	Lead Chronic Standard	Total Recoverable Zinc (ug/L)	Zinc Acute Standard	Zinc Chronic Standard
28.1	03/14/06	23.1	0.080	0.48	0.09	1.00	3.52	2.67	0.500	12.64	0.49	0.500	35	35
28.1	05/16/06	31.7	0.080	0.66	0.12	1.00	4.74	3.50	0.800	18.91	0.74	1.200	45	45
28.1	06/13/06	29.6	0.080	0.62	0.11	1.00	4.45	3.30	0.500	17.33	0.68	0.500	43	43
28.1	07/13/06	40.5	0.080	0.85	0.14	1.00	5.97	4.31	0.500	25.84	1.01	0.500	56	56
28.1	08/17/06	42.7	0.080	0.90	0.14	1.00	6.28	4.51	0.500	27.64	1.08	0.500	58	58
28.1	11/16/06	35.1	0.080	0.74	0.12	1.00	5.22	3.81	0.500	21.53	0.84	0.500	49	49
28.1	12/11/06	35.1	0.080	0.74	0.12	1.00	5.22	3.81	0.500	21.53	0.84	0.500	49	49
28.2	03/14/06	5.5	0.080	0.11	0.03	1.00	0.91	0.78	0.500	2.03	0.08	0.500	10	10
28.2	05/16/06	3.4	0.080	0.07	0.02	1.00	0.57	0.51	0.500	1.09	0.04	0.500	7	7
28.2	06/13/06	3.1	0.080	0.06	0.02	1.00	0.53	0.48	0.500	0.98	0.04	0.500	6	6
28.2	07/13/06	5.5	0.080	0.11	0.03	1.00	0.91	0.78	0.500	2.03	0.08	0.500	10	10
28.2	08/17/06	6.4	0.080	0.13	0.04	1.00	1.05	0.89	0.500	2.47	0.10	0.500	12	12
28.2	11/16/06	5.00	0.080	0.10	0.03	1.00	0.83	0.72	0.500	1.80	0.07	0.500	9	9
28.2	12/11/06	5.00	0.080	0.10	0.03	1.00	0.83	0.72	0.500	1.80	0.07	0.500	9	9
28.3	03/14/06	14.5	0.080	0.30	0.06	1.00	2.27	1.79	0.500	6.99	0.27	0.500	23	23
28.3	04/12/06	15.8	0.080	0.33	0.07	1.00	2.46	1.93	0.500	7.80	0.30	0.500	25	25
28.3	05/16/06	8.6	0.080	0.18	0.04	2.00	1.39	1.15	0.500	3.62	0.14	0.600	15	15
28.3	06/13/06	6.9	0.080	0.14	0.04	1.00	1.12	0.95	0.500	2.70	0.11	0.500	12	12
28.3	07/13/06	13.3	0.080	0.27	0.06	1.00	2.09	1.66	0.500	6.26	0.24	0.500	22	22
28.3	08/17/06	13.1	0.080	0.27	0.06	1.00	2.06	1.64	0.500	6.14	0.24	0.500	21	21
28.3	09/13/06	13.1	0.080	0.27	0.06	1.00	2.06	1.64	0.500	6.14	0.24	0.500	21	21
28.3	11/16/06	9.80	0.080	0.20	0.05	1.00	1.57	1.28	0.500	4.24	0.17	0.500	17	17
28.3	12/11/06	13.5	0.080	0.28	0.06	1.00	2.12	1.69	0.500	6.38	0.25	0.500	22	22

Appendix D

2006 CRAYFISH TISSUE RESULTS

2006 Report for Supplemental Monitoring of Potential Mine Effects near Noxon, MT

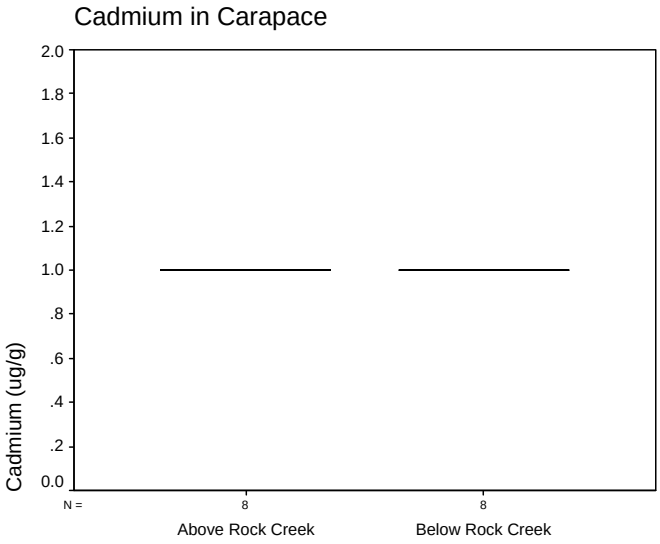
Site	Site Name	Specimen #	Gender	Length (mm)	Carapace			
					Cadmium (ug/g)	Copper (ug/g)	Zinc (ug/g)	Moisture (%)
29.1	Above Rock Creek	1	M	59	<1.00	5.66	19.3	56.6
29.1	Above Rock Creek	2	M	59	<1.00	4.93	18.9	50.4
29.1	Above Rock Creek	3	M	59	<1.00	7.25	24.5	56.7
29.1	Above Rock Creek	4	F	58	<1.00	8.32	20.5	52.7
29.1	Above Rock Creek	5	F	58	<1.00	6.91	21.9	53.0
29.1	Above Rock Creek	6	M	58	<1.00	7.15	25.4	55.1
29.1	Above Rock Creek	7	F	59	<1.00	5.14	24.8	56.4
29.1	Above Rock Creek	8	F	59	<1.00	6.75	19.0	54.3
29.2	Below Rock Creek	14	F	59	<1.00	5.57	20.3	50.5
29.2	Below Rock Creek	15	F	59	<1.00	3.39	16.1	51.1
29.2	Below Rock Creek	16	F	59	<1.00	7.14	19.2	51.2
29.2	Below Rock Creek	17	F	59	<1.00	6.22	17.7	50.9
29.2	Below Rock Creek	18	M	60	<1.00	6.32	16.0	57.1
29.2	Below Rock Creek	19	M	60	<1.00	16.1	27.8	60.1
29.2	Below Rock Creek	22	M	60	<1.00	7.55	18.5	49.2
29.2	Below Rock Creek	23	M	60	<1.00	5.89	16.3	49.6

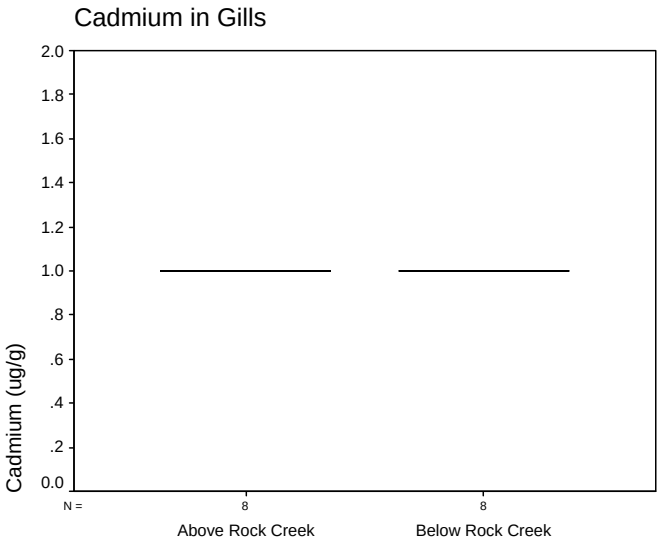
Site	Site Name	Specimen #	Gender	Length (mm)	Gills			
					Cadmium (ug/g)	Copper (ug/g)	Zinc (ug/g)	Moisture (%)
29.1	Above Rock Creek	1	M	59	<1.00	313	51.3	91.7
29.1	Above Rock Creek	2	M	59	<1.00	341	48.1	87.8
29.1	Above Rock Creek	3	M	59	<1.00	362	48.1	89.9
29.1	Above Rock Creek	4	F	58	<1.00	358	55.2	88.1
29.1	Above Rock Creek	5	F	58	<1.00	354	46.8	90.3
29.1	Above Rock Creek	6	M	58	<1.00	304	60.5	89.4
29.1	Above Rock Creek	7	F	59	<1.00	245	49.4	89.8
29.1	Above Rock Creek	8	F	59	<1.00	282	52.6	90.1
29.2	Below Rock Creek	14	F	59	<1.00	325	58.3	89.3
29.2	Below Rock Creek	15	F	59	<1.00	238	59.7	91.2
29.2	Below Rock Creek	16	F	59	<1.00	296	52.6	88.6
29.2	Below Rock Creek	17	F	59	<1.00	324	43.8	88.1
29.2	Below Rock Creek	18	M	60	<1.00	411	48.5	90.3
29.2	Below Rock Creek	19	M	60	<1.00	269	59.4	94.5
29.2	Below Rock Creek	22	M	60	<1.00	332	48.3	89.8
29.2	Below Rock Creek	23	M	60	<1.00	403	53.8	90.0

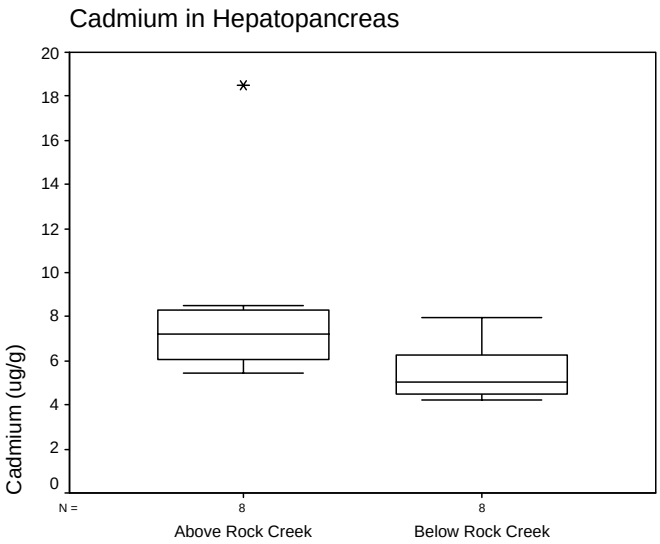
Site	Site Name	Specimen #	Gender	Length (mm)	Hepatopancreas			
					Cadmium (ug/g)	Copper (ug/g)	Zinc (ug/g)	Moisture (%)
29.1	Above Rock Creek	1	M	59	6.65	2050	250	83.1
29.1	Above Rock Creek	2	M	59	6.36	1390	142	75.1
29.1	Above Rock Creek	3	M	59	5.47	2130	118	72.7
29.1	Above Rock Creek	4	F	58	5.73	1710	229	69.5
29.1	Above Rock Creek	5	F	58	8.52	2780	268	81.8
29.1	Above Rock Creek	6	M	58	7.74	2900	359	81.8
29.1	Above Rock Creek	7	F	59	18.5	2680	737	81.2
29.1	Above Rock Creek	8	F	59	8.08	2230	359	78.9
29.2	Below Rock Creek	14	F	59	4.41	1520	345	67.9
29.2	Below Rock Creek	15	F	59	7.97	3030	348	80.0
29.2	Below Rock Creek	16	F	59	4.68	1590	329	73.9
29.2	Below Rock Creek	17	F	59	4.55	2490	164	74.7
29.2	Below Rock Creek	18	M	60	5.45	3100	337	75.8
29.2	Below Rock Creek	19	M	60	5.88	3310	248	82.7
29.2	Below Rock Creek	22	M	60	6.59	3290	392	79.9
29.2	Below Rock Creek	23	M	60	4.19	2100	346	80.7

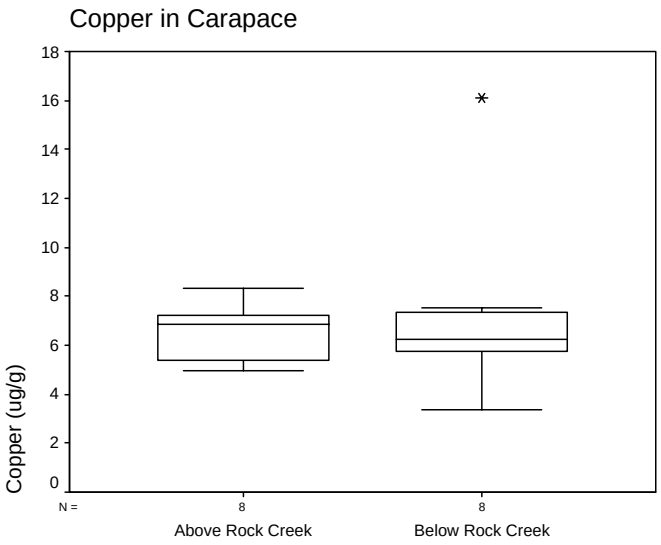
Case Summaries

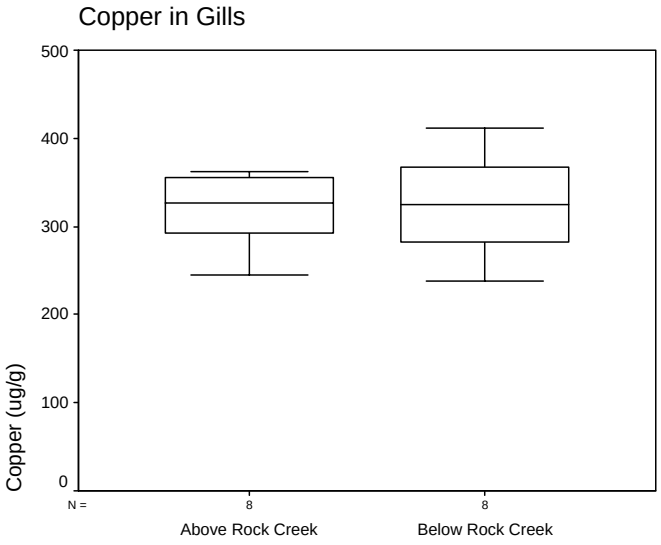
TISSUE	SITE		Cadmium (ug/g)	Copper (ug/g)	Zinc (ug/g)	Moisture (%)
Carapace	Above Rock Creek	Mean	1.0000	6.5138	21.7875	54.400
		Median	1.0000	6.8300	21.2000	54.700
		Minimum	1.00	4.93	18.90	50.4
		Maximum	1.00	8.32	25.40	56.7
		Std. Deviation	.00000	1.16782	2.76325	2.2513
		N	8	8	8	8
	Below Rock Creek	Mean	1.0000	7.2725	18.9875	52.463
		Median	1.0000	6.2700	18.1000	51.000
		Minimum	1.00	3.39	16.00	49.2
		Maximum	1.00	16.10	27.80	60.1
		Std. Deviation	.00000	3.77809	3.88787	3.9355
		N	8	8	8	8
	Total	Mean	1.0000	6.8931	20.3875	53.431
		Median	1.0000	6.5350	19.2500	52.850
		Minimum	1.00	3.39	16.00	49.2
		Maximum	1.00	16.10	27.80	60.1
		Std. Deviation	.00000	2.72968	3.56480	3.2549
		N	16	16	16	16
Gills	Above Rock Creek	Mean	1.0000	319.8750	51.5000	89.638
		Median	1.0000	327.0000	50.3500	89.850
		Minimum	1.00	245.00	46.80	87.8
		Maximum	1.00	362.00	60.50	91.7
		Std. Deviation	.00000	41.71138	4.56008	1.2420
		N	8	8	8	8
	Below Rock Creek	Mean	1.0000	324.7500	53.0500	90.225
		Median	1.0000	324.5000	53.2000	89.900
		Minimum	1.00	238.00	43.80	88.1
		Maximum	1.00	411.00	59.70	94.5
		Std. Deviation	.00000	59.85160	5.87610	1.9812
		N	8	8	8	8
	Total	Mean	1.0000	322.3125	52.2750	89.931
		Median	1.0000	324.5000	51.9500	89.850
		Minimum	1.00	238.00	43.80	87.8
		Maximum	1.00	411.00	60.50	94.5
		Std. Deviation	.00000	49.89952	5.14373	1.6259
		N	16	16	16	16
Heptaopancreas	Above Rock Creek	Mean	8.3813	2233.7500	307.7500	78.013
		Median	7.1950	2180.0000	259.0000	80.050
		Minimum	5.47	1390.00	118.00	69.5
		Maximum	18.50	2900.00	737.00	83.1
		Std. Deviation	4.23417	530.79287	194.23973	4.9956
		N	8	8	8	8
	Below Rock Creek	Mean	5.4650	2553.7500	313.6250	76.950
		Median	5.0650	2760.0000	341.0000	77.850
		Minimum	4.19	1520.00	164.00	67.9
		Maximum	7.97	3310.00	392.00	82.7
		Std. Deviation	1.30413	741.29110	72.53952	4.8214
		N	8	8	8	8
	Total	Mean	6.9231	2393.7500	310.6875	77.481
		Median	6.1200	2360.0000	333.0000	79.400
		Minimum	4.19	1390.00	118.00	67.9
		Maximum	18.50	3310.00	737.00	83.1
		Std. Deviation	3.38054	644.37955	141.67461	4.7744
		N	16	16	16	16

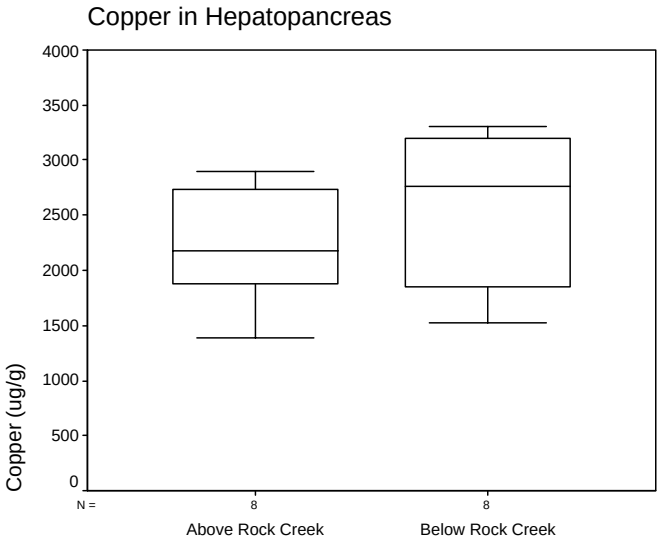

Cadmium in Carapace
Cadmium (ug/g)
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0.0
N =
8
8
Above Rock Creek
Below Rock Creek


Cadmium in Gills
Cadmium (ug/g)
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0.0
N =
8
8
Above Rock Creek
Below Rock Creek

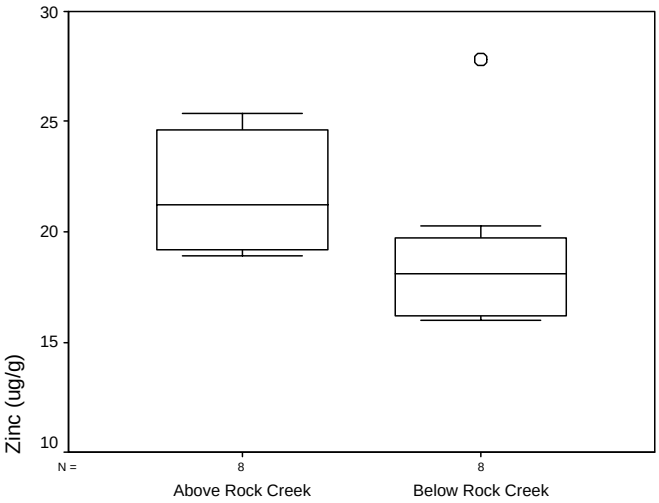

Cadmium in Hepatopancreas
Cadmium (ug/g)
20
18
16
14
12
10
8
6
4
2
0
N =
8
8
Above Rock Creek
Below Rock Creek


Copper in Carapace
Copper (ug/g)
18
16
14
12
10
8
6
4
2
0
N =
8
8
Above Rock Creek
Below Rock Creek

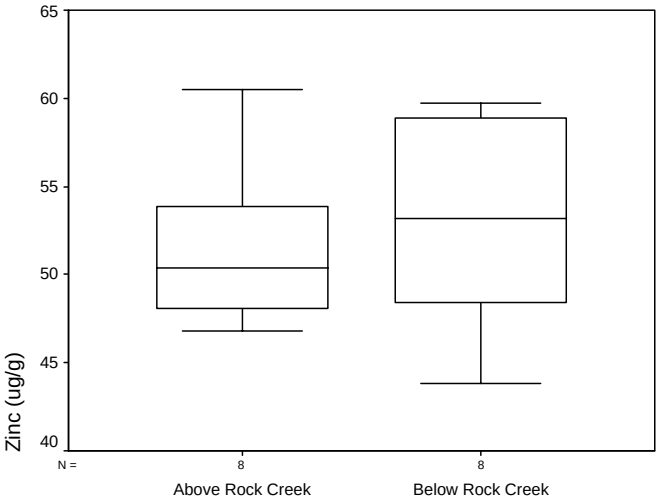

Copper in Gills
Copper (ug/g)
500
400
300
200
100
0
N =
8
8
Above Rock Creek
Below Rock Creek


Copper in Hepatopancreas
Copper (ug/g)
4000
3500
3000
2500
2000
1500
1000
500
0
N =
8
8
Above Rock Creek
Below Rock Creek

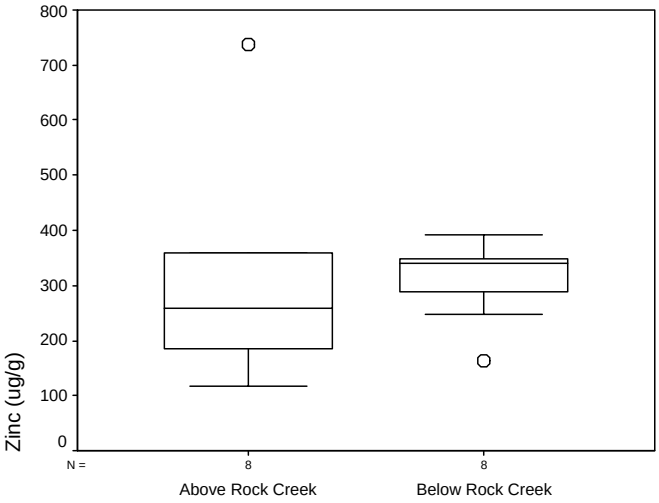
Zinc in Carapace



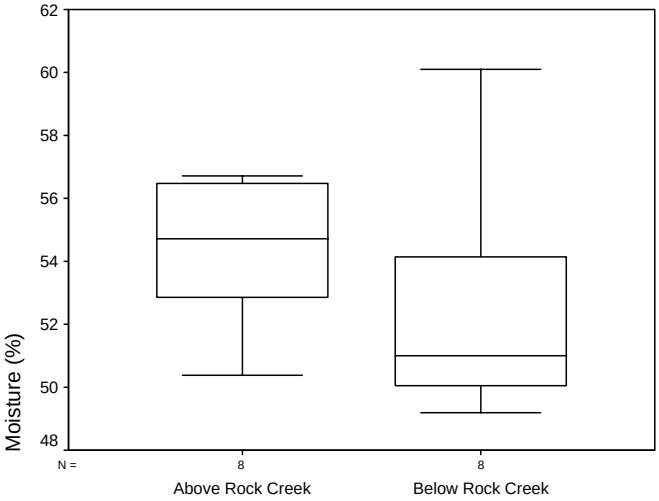
Zinc in Gills



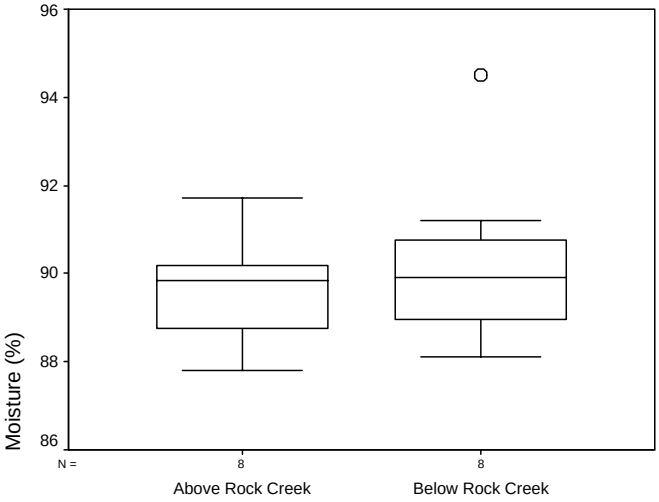
Zinc in Hepatopancreas



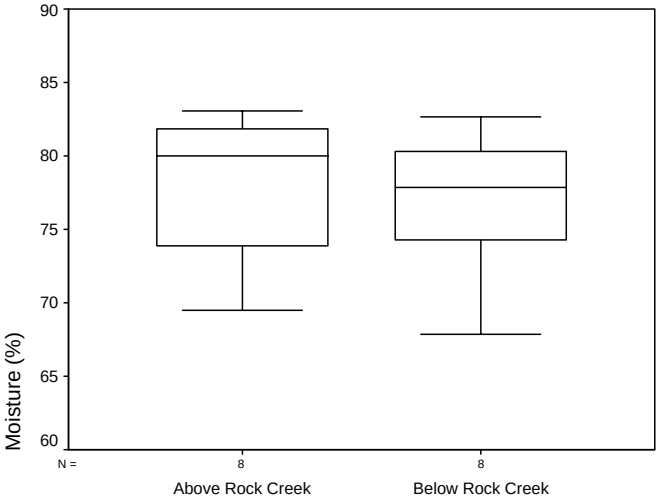
Moisture in Carapace



Moisture in Gills



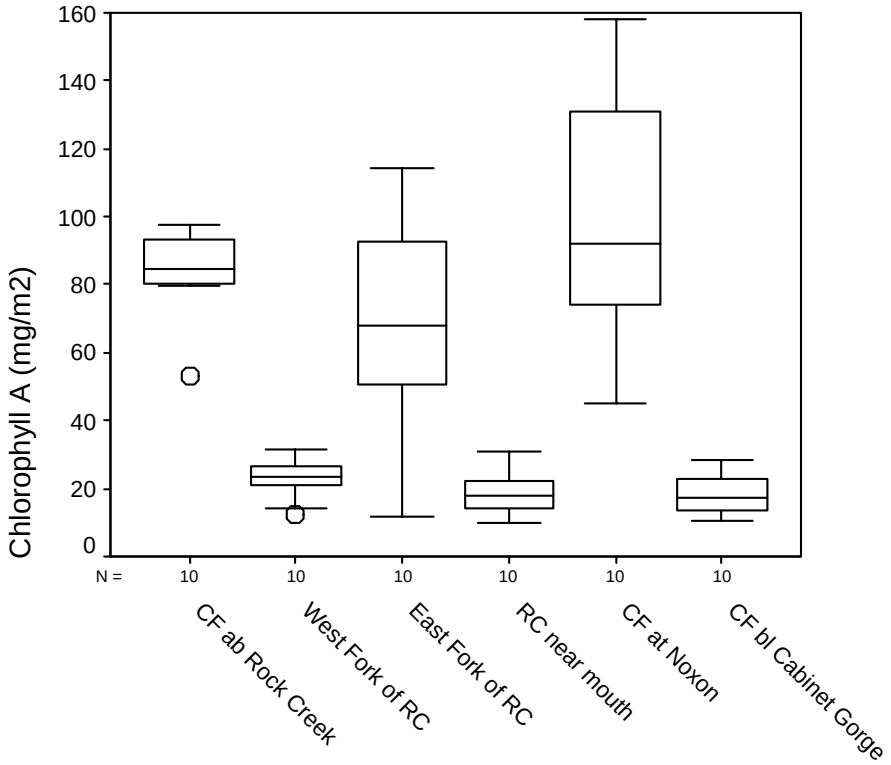
Moisture in Hepatopancreas

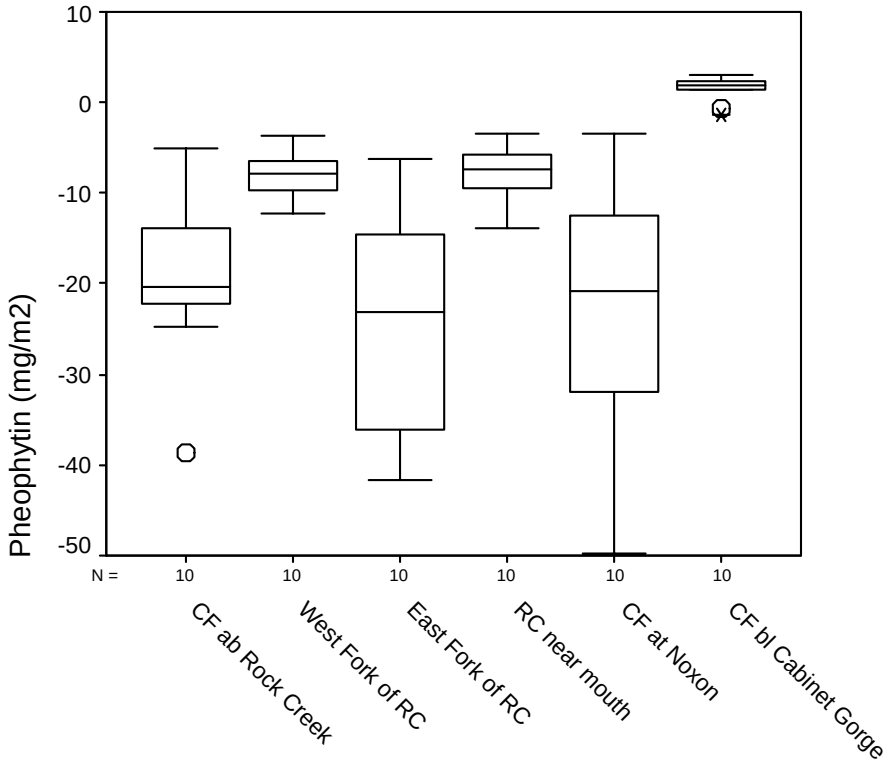


Appendix E

2006 PERIPHYTON RESULTS

2006 Report for Supplemental Monitoring of Potential Mine Effects near Noxon, MT


Chlorophyll A (mg/m2)
160
140
120
100
80
60
40
20
0
N =
10
10
10
10
10
10
CF ab Rock Creek
West Fork of RC
East Fork of RC
RC near mouth
CF at Noxon
CF bl Cabinet Gorge


Pheophytin (mg/m2)
10
0
-10
-20
-30
-40
-50
N =
10
10
10
10
10
10
CF ab Rock Creek
West Fork of RC
East Fork of RC
RC near mouth
CF at Noxon
CF bl Cabinet Gorge

Summary Statistics[a]

		Chlorophyll A (mg/m2)
1		53.30
2		97.50
3		85.80
4		93.20
5		90.20
6		93.10
7		79.80
8		80.50
9		83.60
10		80.60
Total	Mean	83.7600
	Median	84.7000
	Minimum	53.30
	Maximum	97.50
	Std. Deviation	12.35990
	N	10

a. STATION = CF ab Rock Creek

Summary Statistics[a]

		Chlorophyll A (mg/m2)
1		22.60
2		12.50
3		21.10
4		22.40
5		31.20
6		24.20
7		26.30
8		14.40
9		29.30
10		26.50
Total	Mean	23.0500
	Median	23.4000
	Minimum	12.50
	Maximum	31.20
	Std. Deviation	5.96122
	N	10

a. STATION = West Fork of RC

Summary Statistics[a]

		Chlorophyll A (mg/m2)
1		58.00
2		11.60
3		72.30
4		81.20
5		50.50
6		98.20
7		92.60
8		40.50
9		114.00
10		63.20
Total	Mean	68.2100
	Median	67.7500
	Minimum	11.60
	Maximum	114.00
	Std. Deviation	30.16987
	N	10

a. STATION = East Fork of RC

Summary Statistics[a]

		Chlorophyll A (mg/m2)
1		11.80
2		22.40
3		31.10
4		9.69
5		19.00
6		13.90
7		25.50
8		14.20
9		16.40
10		21.00
Total	Mean	18.4990
	Median	17.7000
	Minimum	9.69
	Maximum	31.10
	Std. Deviation	6.63355
	N	10

a. STATION = RC near mouth

Summary Statistics[a]

		Chlorophyll A (mg/m2)
1		91.70
2		158.00
3		88.30
4		92.50
5		116.00
6		156.00
7		131.00
8		49.00
9		44.80
10		74.00
Total	Mean	100.1300
	Median	92.1000
	Minimum	44.80
	Maximum	158.00
	Std. Deviation	39.86491
	N	10

a. STATION = CF at Noxon

Summary Statistics[a]

		Chlorophyll A (mg/m2)
1		16.20
2		22.80
3		13.80
4		10.30
5		10.80
6		28.20
7		18.00
8		24.10
9		14.60
10		18.30
Total	Mean	17.7100
	Median	17.1000
	Minimum	10.30
	Maximum	28.20
	Std. Deviation	5.84151
	N	10

a. STATION = CF bl Cabinet Gorge

Aquatic Plant Field Sheet – Clark Fork Sites

Site	Name	Type	Cover (%)	Amount	Color	Conditon
29.1	Clark Fork above Rock Creek	Microalgae	90	moderate	golden brown	mature
		Macroalgae	5	moderate	dark green	mature
		Mosses	0	NA	NA	NA
		Macrophyte	0	NA	NA	NA
		Bare Substrate	5	Rank of Bare Substrates		
				Rock	Wood	Sediment
				1	3	2
29.2	Clark Fork below Rock Creek	Microalgae	75	moderate	golden brown	mature/decaying
		Macroalgae	10	light	light green	mature/decaying
		Mosses	0	NA	NA	NA
		Macrophyte	10	moderate	dark green	mature
		Bare Substrate	5	Rank of Bare Substrates		
				Rock	Wood	Sediment
				1	2	3
30	Clark Fork below Cabinet Gorge	Microalgae	90	moderate	golden brown	mature
		Macroalgae	5	light	light green	mature
		Mosses	0	NA	NA	NA
		Macrophyte	0	NA	NA	NA
		Bare Substrate	5	Rank of Bare Substrates		
				Rock	Wood	Sediment
				1	3	2

Aquatic Plant Field Sheet – Rock Creek Sites

Site	Name	Type	Cover (%)	Amount	Color	Conditon
28.1	West Fork of Rock Creek	Microalgae	75	light film	light green	mature
		Macroalgae	0	NA	NA	NA
		Mosses	5	light	light green	mature
		Macrophyte	0	NA	NA	NA
		Bare Substrate	20	Rank of Bare Substrates		
				Rock	Wood	Sediment
				1	3	2
28.2	East Fork of Rock Creek	Microalgae	75	light film	golden brown	mature
		Macroalgae	5	light	bright green	mature
		Mosses	0	NA	NA	NA
		Macrophyte	0	NA	NA	NA
		Bare Substrate	20	Rank of Bare Substrates		
				Rock	Wood	Sediment
				1	2	3
28.3	Rock Creek near mouth	Microalgae	70	light film	golden brown	mature
		Macroalgae	5	light	light green	mature
		Mosses	0	NA	NA	NA
		Macrophyte	0	NA	NA	NA
		Bare Substrate	25	Rank of Bare Substrates		
				Rock	Wood	Sediment
				1	3	2

Appendix F

2006 MACROINVERTEBRATE RESULTS

2006 Report for Supplemental Monitoring of Potential Mine Effects near Noxon, MT

Rhithron Associates, Inc.

29 Fort Missoula Road
Missoula, Montana 59804
406.721.1977

Gary Ingman
PBS&J-Land and Water
801 Last Chance Gulch
Helena, Montana 59624

September 15, 2006

Dear Gary,

The pages accompanying this letter are the taxa lists and metric summary pages for the aquatic invertebrate sample collected on 8/16/2006 from the Clark Fork River below Cabinet Gorge Dam. The following table summarizes the scores and impairment classifications from 3 bioassessment methods: the Montana MMI (TetraTech 2006), the Montana O/E model (Hawkins 2005), and the MVFP index (Bollman 1998). It is essential to note that it is unclear whether any of these assessment methods is entirely appropriate for the evaluation of large river assemblages. The Montana MMI and the Montana O/E model are the current operative standard methods of Montana DEQ (Montana DEQ 2006). The MVFP index was replaced by these new methods in 2006. As usual, my narrative interpretation of the invertebrate assemblage is based on: the taxonomic and functional composition of the sampled invertebrate assemblages; the sensitivities, tolerances, physiology, and habitus information for individual taxa gleaned from the writer's research; the published literature, and other expert sources; and on the performance of bioassessment metrics which have been demonstrated to be useful tools for interpreting potential implications of benthic invertebrate assemblage composition.

Method	Score	Impairment classification
Montana MMI	68.0	Unimpaired
O/E model	0.89	Unimpaired
MVFP index	33%	Moderate impairment

The invertebrate assemblage collected at this site is consistent with expectations for a site downstream of a reservoir outflow in the sense that it is dominated by filter-feeders. The assemblage was dominated by net-spinning caddisflies (*Cheumatopsyche* sp. and *Hydropsyche* sp.) and midges (16 unique taxa), with a strong contingent of blackfly larvae (*Simulium* sp.). The taxa collected here indicate cool-to-warm water temperatures; it appears that lentic conditions (indicated by the presence of cladocerans and copepods) were sampled as well as flowing water environs (many rheophilic taxa). Mayfly taxa richness (2) was lower than expected, and the biotic index value (5.53) was higher than expected. The biotic index may be influenced by warm water temperatures, but these 2 metric indicators of water quality seem to suggest that water quality was impaired. Nutrient enrichment is suggested by the abundance of *Cricotopus* spp. and *Orthocladius* sp. among the midges; these taxa are often associated with filamentous algae. Although metals contamination cannot be ruled out, there is no specific evidence that metal pollution limited this biotic assemblage. The metals tolerance index was not elevated relative to the biotic index. On the other hand, not a single heptageniid mayfly was collected. Twelve "clinger" taxa and 6 caddisfly taxa were counted. If sediment deposition was present, the effects on colonization were slight.

Please see the enclosed technical summary for a description of sample processing methods and quality control results.

Gary, as always, if you have questions or concerns about this data, please contact me. Thank you for this interesting work.

Sincerely,

Wease Bollman
Aquatic Biologist

REFERENCES

Bollman, W. 1998. Improving Stream Bioassessment Methods for the Montana Valleys and Foothill Prairies Ecoregion. Master's Thesis (MS). University of Montana. Missoula, Montana.

Montana DEQ. 2006. Sample Collection, Sorting, and Taxonomic Identification of Benthic Macroinvertebrates. Water Quality Planning Bureau. Standard Operating Procedure. WQPBWQM-009. Helena, Montana.

Hawkins, C.P. 2005. Development of a RIVPACS (O/E) model for assessing the biological integrity of Montana Streams (Draft). The Western Center for Monitoring and Assessment of Freshwater Ecosystems. Utah State University, Logan, Utah.

TetraTech. 2006. EDAS v 3.3.2k for Montana. Microsoft Access Application.

Analysis of biological samples from Rhithron Associates Project PBSJ06CGD:
TECHNICAL SUMMARY
Prepared for PBS&J-Land and Water Consulting

Prepared by:
Rhithron Associates, Inc. Missoula, Montana
September 19, 2006

METHODS

Sample processing

A single macroinvertebrate sample was delivered to Rhithron's laboratory facility in Missoula, Montana. The sample arrived in good condition, ethanol was the apparent preservative. No adjustment of preservative was required. The sample was described as a composite of multiple 20 second kicks per EPA EMAP large river protocols (Gary Ingman, pers.comm.)

A subsample of 500 (minimum) organisms was obtained using methods consistent with Idaho DEQ standard operating procedure: a Caton sub-sampling device, divided into 30 grids, each approximately 5 cm by 6 cm, was used. Contents of the sample jar were thoroughly mixed, poured out into the Caton tray, and individual grids were randomly selected. Grid contents were examined under stereoscopic microscopes using 10x-30x magnification. All aquatic invertebrates from each selected grid were sorted from the substrate, and placed in alcohol for subsequent identification. Grid selection, examination, and sorting continued until 538 organisms were sorted; 3 grids were completely picked. All remaining Caton grids were examined for taxa not found in the sorting procedure. All sample remnants, including sorted substrate and unsorted remainders, were retained and stored.

All organisms were examined under 10x-80x stereoscopic microscopes (Leica S8E and S6E) and identified to the lowest practical level consistent with Idaho Department of Environmental Quality (DEQ) data requirements using appropriate published taxonomic references. Midges (Diptera: Chironomidae) and oligochaetes were slide-mounted using CMC-10 mounting media and identified using 400x-1000x magnification under compound microscopes (Olympus BX51). A reference collection of specimens of each identified taxon was constructed. All remaining organisms were collected into vials labeled by taxon; all vials were filled with 95% ethanol for preservative.

Quality control procedures

Quality control procedures for initial sample processing and subsampling involved checking sorting efficiency. This check was conducted by an independent observer who microscopically re-examined the sorted substrate from the sample. All organisms that were missed were counted and this number was added to the total number obtained in the original sort. Sorting efficiency was evaluated by applying the following calculation:

$$SE = \frac{n_1}{n_2} \times 100$$

where SE is the sorting efficiency expressed as a percentage, n_1 is the total number of specimens in the first sort, and n_2 is the total number of specimens in the first and second sorts combined.

Quality control procedures for taxonomy involved checking taxonomic accuracy and precision, and enumeration accuracy. All organisms were re-identified by an independent taxonomist. A Bray-Curtis similarity (BCS) statistic was generated to compare results.

Data analysis

A taxa list with counts was constructed. Standard metric calculations for aquatic invertebrate assemblages were made using Rhithron's customized database software, and a multimetric index developed for montane ecoregions of Montana (MVFP index) (Bollman 1998) was calculated and scored. Montana's Ecological Data Application System (EDAS) was used to calculate the Montana Multi-Metric Index (MMI) (TetraTech 2006). After translation to appropriate Operational Taxonomic Units (OTUs), data was uploaded to an Observed/Expected (O/E) model (Hawkins 2005), and an O/E score was generated.

RESULTS

Quality Control Procedures

The SE for this sample was 99.1%. The BCS for this sample was 100%.

Data analysis

The taxa list and counts, and values and scores for various standard bioassessment metrics and indices calculated by Rhithron software are given in accompanying materials.

Results of the MVFP index, the Montana MMI and the O/E model comparison for each sample are given in Table 1. Impairment categories for the MVFP index are taken from Bollman (1998); impairment categories for the Montana MMI and O/E model are described in Montana DEQ (2006).

Table 1. *Bioassessment results for the aquatic invertebrate sample.*

Method	Score	Impairment classification
Montana MMI	68.0	Unimpaired
O/E model	0.89	Unimpaired
MVFP index	33%	Moderate impairment

REFERENCES

Bollman, W. 1998. Improving Stream Bioassessment Methods for the Montana Valleys and Foothill Prairies Ecoregion. Master's Thesis (MS). University of Montana. Missoula, Montana.

Montana DEQ. 2006. Sample Collection, Sorting, and Taxonomic Identification of Benthic Macroinvertebrates. Water Quality Planning Bureau. Standard Operating Procedure. WQPBWQM-009. Helena, Montana.

TetraTech. 2006. EDAS v 3.3.2k for Montana. Microsoft Access Application.

Hawkins, C.P. 2005. Development of a RIVPACS (O/E) model for assessing the biological integrity of Montana Streams (Draft). The Western Center for Monitoring and Assessment of Freshwater Ecosystems. Utah State University, Logan, Utah.

Metrics Report

Project ID: PBSJ06CGD
RAI No.: PBSJ06CGD001
Sta. Name: Clark Fork below Cabinet Gorge Dam
Client ID: Site 30
STORET ID:
Coll. Date: 8/16/2006

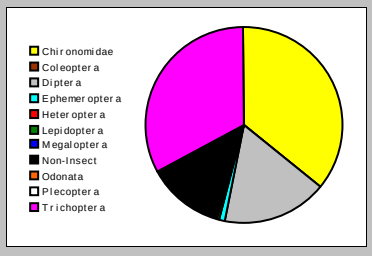
Abundance Measures

Sample Count: 537
Sample Abundance: 5,370.00 10.00% of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Non-Insect	6	68	12.66%
Odonata			
Ephemeroptera	2	6	1.12%
Plecoptera			
Heteroptera			
Megaloptera			
Trichoptera	6	178	33.15%
Lepidoptera	1	2	0.37%
Coleoptera			
Diptera	1	90	16.76%
Chironomidae	16	193	35.94%

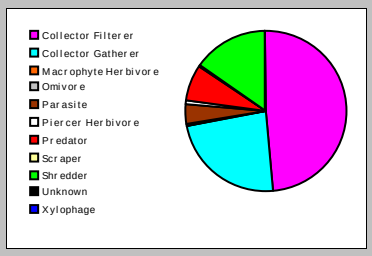


Dominant Taxa

Category	A	PRA
Cheumatopsyche	114	21.23%
Simulium	84	15.64%
Cricotopus (Cricotopus)	71	13.22%
Acari	36	6.70%
Ceraclea	34	6.33%
Hydropsyche	23	4.28%
Nematoda	20	3.72%
Orthocladiinae	18	3.35%
Synorthocladius	17	3.17%
Orthocladius	14	2.61%
Chironomidae	14	2.61%
Microtendipes	13	2.42%
Cricotopus bicinctus	9	1.68%
Cladocera	8	1.49%
Eukiefferiella Pseudomontana Gr.	6	1.12%

Functional Composition

Category	R	A	PRA
Predator	2	40	7.45%
Parasite	1	20	3.72%
Collector Gatherer	14	127	23.65%
Collector Filterer	7	260	48.42%
Macrophyte Herbivore			
Piercer Herbivore	2	5	0.93%
Xylophage			
Scraper	1	2	0.37%
Shredder	4	82	15.27%
Omivore	1	1	0.19%
Unknown			



Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	32	3	3		3
Non-Insect Percent	12.66%				
E Richness	2	1		1	
P Richness	0	1		0	
T Richness	6	3		3	
EPT Richness	8		2		0
EPT Percent	34.26%		2		0
Oligochaeta+Hirudinea Percent	0.19%				
Baetidae/Ephemeroptera	0.000				
Hydropsychidae/Trichoptera	0.775				
Dominance					
Dominant Taxon Percent	21.23%		3		3
Dominant Taxa (2) Percent	36.87%				
Dominant Taxa (3) Percent	50.09%	3			
Dominant Taxa (10) Percent	80.26%				
Diversity					
Shannon H (loge)	2.536				
Shannon H (log2)	3.659		3		
Margalef D	5.000				
Simpson D	0.119				
Evenness	0.065				
Function					
Predator Richness	2		0		
Predator Percent	7.45%	1			
Filterer Richness	7				
Filterer Percent	48.42%			0	
Collector Percent	72.07%		2		1
Scraper+Shredder Percent	15.64%		2		0
Scraper/Filterer	0.008				
Scraper/Scraper+Filterer	0.008				
Habit					
Burrower Richness	0				
Burrower Percent	0.00%				
Swimmer Richness	1				
Swimmer Percent	0.74%				
Clinger Richness	12	3			
Clinger Percent	62.20%				
Characteristics					
Cold Stenotherm Richness	0				
Cold Stenotherm Percent	0.00%				
Hemoglobin Bearer Richness	2				
Hemoglobin Bearer Percent	2.61%				
Air Breather Richness	0				
Air Breather Percent	0.00%				
Voltinism					
Univoltine Richness	8				
Semivoltine Richness	0	1			
Multivoltine Percent	49.16%		2		
Tolerance					
Sediment Tolerant Richness	1				
Sediment Tolerant Percent	0.37%				
Sediment Sensitive Richness	0				
Sediment Sensitive Percent	0.00%				
Metals Tolerance Index	4.320				
Pollution Sensitive Richness	1	1		1	
Pollution Tolerant Percent	22.72%	3		1	
Hilsenhoff Biotic Index	5.527		2		0
Intolerant Percent	4.84%				
Supertolerant Percent	5.59%				
CTQa	100.091				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	20	40.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	21	70.00%	Slight
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	6	33.33%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	7	33.33%	Moderate