Missouri Department of Natural Resources

Biological Assessment and Fine Sediment Study Report

Tributaries of Mill Creek and Mineral Fork
Washington County, Missouri

Fall 2008 – Spring 2009 – Fall 2009

Prepared for:
Missouri Department of Natural Resources
Division of Environmental Quality
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Water Pollution Control Branch

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1.0 Introduction

Fountain Farm Branch, Pond Creek, Shibboleth Branch, Salt Pines Creek, and Tributary of Old Mines Creek (Trib. Old Mines Creek) in Washington County are the focus of this study. The streams are located in southeastern Missouri within the Ozark/Meramec Ecological Drainage Unit (**EDU**; Figure 1). The streams are tributaries of Mill Creek and Mineral Fork, which ultimately drain into Big River approximately 60 miles southwest of St. Louis, Missouri (Table 1; Figure 1). The tributaries are located in Washington County, while the similar-size control streams are located in Crawford, Dent, and Iron counties, Missouri (Table 1; Figure 2; Figure 3).

Most of the tributaries included in this study are class "C" or "P" listed in Chapter 7 of Missouri's Water Quality Standards (MDNR 2009c). Class "**C**" streams may cease flow in dry periods, but maintain permanent pools which support aquatic life. Class "**P**" streams maintain permanent flow even during drought periods. Because the streams included in this study are generally very small, one control segment on upper Courtois Creek was unclassified (shown as **U**).

Most of the streams have beneficial use designations for livestock and wildlife watering (**LWW**); protection of warm water aquatic life and human health-fish consumption (**AQL**); and whole body contact (**WBC**), category B, while one, Fountain Farm Branch, has a beneficial use for secondary contact recreation (**SCR**) (MDNR 2009c). The WBC "Category B" applies to waters designated for whole body contact recreation not contained within category A. Category A is defined as:

> those water segments that have been established by the property owner as public swimming areas allowing full and free access by the public for swimming purposes and waters with existing whole body contact recreational use(s). Examples of this category include, but are not limited to, public swimming beaches and property where whole-body contact recreational activity is open to and accessible by the public through law or written permission of the landowner (MDNR 2009c).

An example of category B would be a stream that includes areas not designated as swimming property.

1.1 Justification

The watersheds of Mill Creek and Mineral Fork in Washington County have been extensively mined for barium. In the fall of 2005 and spring of 2006, the Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) conducted biological assessments on Mill Creek and Mineral Fork, Washington County (MDNR 2007a; MDNR 2007b). Mill Creek contained high dissolved barium concentrations, apparently either from runoff within the watershed or from in stream natural background occurrences. Mineral Fork had a relatively high level of dissolved barium concentrations with a continuous low level of chloride, which are indicators of

mining activity and/or wastewater influence. The tributaries to these streams were recommended for study as potential contributors of mine-related material.

Mine waste sedimentation has historically been responsible for covering aquatic habitats within these and other streams, making them uninhabitable for some invertebrates (Ryck 1974; MDC 1997, 2006). Damage to some aquatic habitats and the potential for serious damage to several streams existed due to past lead and barite mining activity (MDC 1997; 2006). In 1975, the collapse of a barite tailings pond released a significant amount of metals-laden fine sediment into Shibboleth Creek, a tributary to Mill Creek (Duchrow 1978). Heavy metals were found in fish of Mill Creek in a later study (Czarnezki and Trial 1997). Shibboleth Branch (WBID 2120), a tributary to Mill Creek, was placed on the 2004/2006 303(d) list of impaired waters in Missouri for inorganic sediment potentially from barite tailings pond sources (MDNR 2009a). Fountain Farm Branch (WBID 3657) may contribute barite mining sediment to Mill Creek as well (MDNR 1994). Pond Creek (WBID 2128), another tributary to Mill Creek, is on the 303(d) list for inorganic sediment potentially from barite tailings pond sources (MDNR 2009a).

A study proposal was written to include a biological assessment, stream habitat assessment, and fine sediment study of the tributaries of Mill Creek and Mineral Fork, Washington County, dated August 12, 2008 (Appendix A). This study was requested by the Missouri Department of Natural Resources (**MDNR**), Water Protection Program (**WPP**), Water Pollution Control Branch (**WPCB**). The 2008-2009 biological assessment, stream habitat assessment, and fine sediment study were conducted by the Division of Environmental Quality (**DEQ**), Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**), and Chemical Analysis Section (**CAS**).

This is a final report to follow up on a preliminary report: <u>A Preliminary Report Biological Assessment and Fine Sediment Study, Pond Creek and Shibboleth Branch, Washington County, Missouri, Fall 2008-Spring 2009</u>. This report includes examination of all tributaries that were requested by WPP. It also includes comparisons using similar-sized control stream criteria and dominant macroinvertebrate families not included in the preliminary report. Water quality and fine sediment coverage and character are included in the tables and are further discussed.

1.2 Objectives

- Assess the quality of stream habitat.
- Assess aquatic life protection designated use status of the macroinvertebrate community.
- Document nutrient and dissolved metals levels in the tributaries and assess water quality.
- Identify the relative coverage of fine sediment per area and identify the metals character of sediment.

1.3 Null Hypotheses

1. Stream habitat quality will be similar between test and control tributaries.

2. Biological metrics and Macroinvertebrate Stream Condition Index (**MSCI**) scores will be similar between test and control streams as well as wadeable/perennial stream biological criteria.

3. Physicochemical water quality will be similar at all stations and parameters will meet the Water Quality Standards (**WQS**) of Missouri (MDNR 2009c).

4. The relative coverage and metals character of fine sediment in test streams will be similar to that of control streams and metals concentrations will be below Probable Effects Concentrations (**PEC**) (MacDonald et al. 2000).

2.0 Methods

Kenneth B. Lister, Mike Irwin, and others of the ESP, WQMS staff conducted this study. Methods are outlined in this section. The study timing is outlined. The study area and station descriptions, Ecological Drainage Units (**EDUs**), and land uses are identified. Stream habitat assessment procedures are discussed. Biological assessment procedures, which include macroinvertebrate community and physicochemical water collection with analyses, are discussed.

2.1 Study Timing

Sampling was conducted in the fall of 2008, spring of 2009, and Shibboleth Branch #3 and #2 were sampled again in the fall of 2009. Fall macroinvertebrates, water quality samples, and stream habitat assessments were conducted between September 23 and October 1, 2009. A habitat assessment was conducted on Shibboleth Branch #3 on September 3, 2009. Fine sediment sampling was conducted between October 15 and October 22, 2009. Non-filterable residue was sampled at Shibboleth Branch #3 on January 22, 2009. Spring macroinvertebrates and water quality samples were collected between March 23 and April 8, 2009. Biological assessments were again conducted at Shibboleth Branch #3 and #2 on September 15, 2009.

2.2 Study Area and Station Descriptions

The study area includes 13 stations located on 10 streams in the Ozark/Meramec Ecological Drainage Unit (**EDU**; Table 1; Figure 1). Eight streams are considered test streams/stations and five are control/candidate reference streams. The test streams will hereafter be referred to as **tributaries**. The tributaries are located in Washington County, and the control streams are found in Washington, Iron, Dent, and Crawford counties (Figures 2 and 3). Control streams were chosen using Valley Segment Type (VST; MoRAP) similarity, absence of known point sources, and known past mining. The tributaries are grouped by the streams to which they drain, either Mill Creek or Mineral Fork. Mill Creek tributaries and number of stations are Fountain Farm Branch (1); Pond Creek (2); and Shibboleth Branch (3). Mineral Fork tributaries include Salt Pines Creek (1) and a tributary of Old Mines Creek referred to as Trib. Old Mines Creek (1).

Table 1
Location and Descriptive Information for Tributaries and Control Streams

Station	County	Location	Description; WBID	Purpose; Class
Fountain Farm Branch #1	Washington	NE sec. 33, T. 38 N., R. 3 E. E702139 N4205858	Upstream confluence with Mill Creek; 3657	Test; C
Pond Creek #2	Washington	NE sec.3, T. 37 N., R. 3 E. E703719 N4203308	Downstream Pond Creek Road; 2128	Test; C
Pond Creek #1	Washington	NW sec. 35, T. 38 N., R. 3 E. E704868 N4205941	Upstream confluence with Mill Creek; 2127	Test; P
Shibboleth Branch #3	Washington	NE sec. 21/NW sec. 22, T. 38 N., R. 3 E. E702030 N4209388	Apx 0.25 miles east of Hwy E, Powder Lake Spg. Rd; 2120	Test; C
Shibboleth Branch #2	Washington	NW sec. 14, T. 38 N., R. 3 E. E704807 N4210506	End Johnson Road; 2120	Test; C
Shibboleth Branch #1	Washington	NW sec. 13, T. 38 N., R. 3 E. E705671 N4210490	Downstream bridge Johnson Road; 2119	Test; P
Salt Pines Creek	Washington	NE sec. 31, T. 39 N., R. 3 E E697830 N4215928	North/Downstream of MO Hwy 21; 2113	Test; C
Trib. Old Mines Creek	Washington	NW sec. 30, T. 39 N., R. 3 E. E698562 N4216811	North/Downstream of MO Hwy 21; 2114	Test; C
Brazil Creek	Washington	NE sec. 28, T. 38 N., R. 1 W. E672696 N4206120	Downstream USFS Brazil Creek Campground	Control/ Candidate Reference; P
Courtois Creek	Iron	SW sec. 28, T. 35 N., R. 1 W. E672115 N4175783	Downstream CR80A @ Goodwater, MO	Control/ Candidate Reference; U
East Fork Huzzah Creek	Dent	SW sec. 20, T. 34 N., R. 2 W. E659956 N4164882	Downstream LWB apx. 2 miles S on AC at Boss, MO	Control/ Candidate Reference; C
West Fork Huzzah Creek	Dent	SW sec. 15, T. 34 N., R. 3 W. E653573 N4166719	Downstream MO Hwy 32 at Howes Mill, MO; USFS	Control/ Candidate Reference; C
Shoal Creek	Crawford	NW sec. 22, T. 36 N., R. 2 W. E663955 N4187505	USFS-Big Shoal Creek Road apx. 3 miles NE Davisville	Control/ Candidate Reference; P

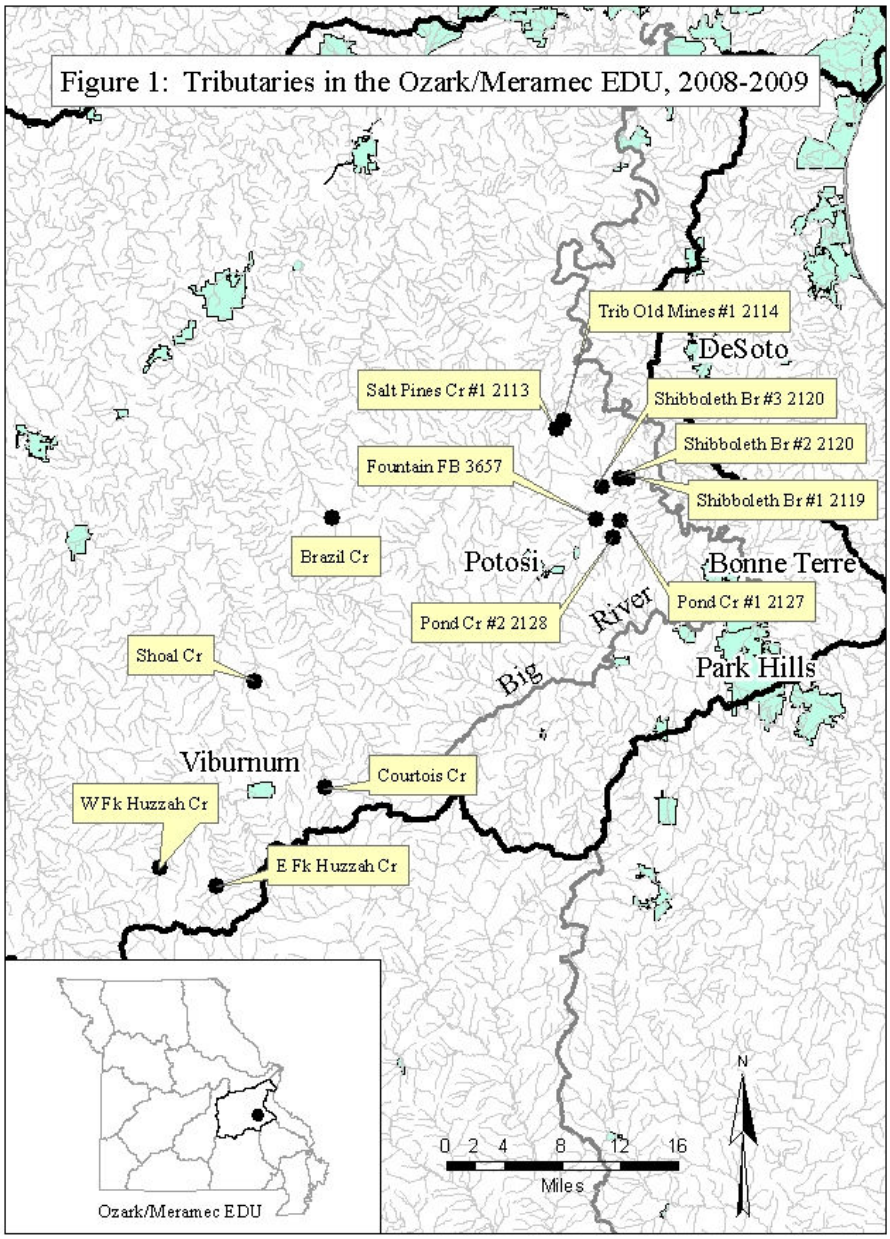


Figure 1: Tributaries in the Ozark/Meramec EDU, 2008-2009

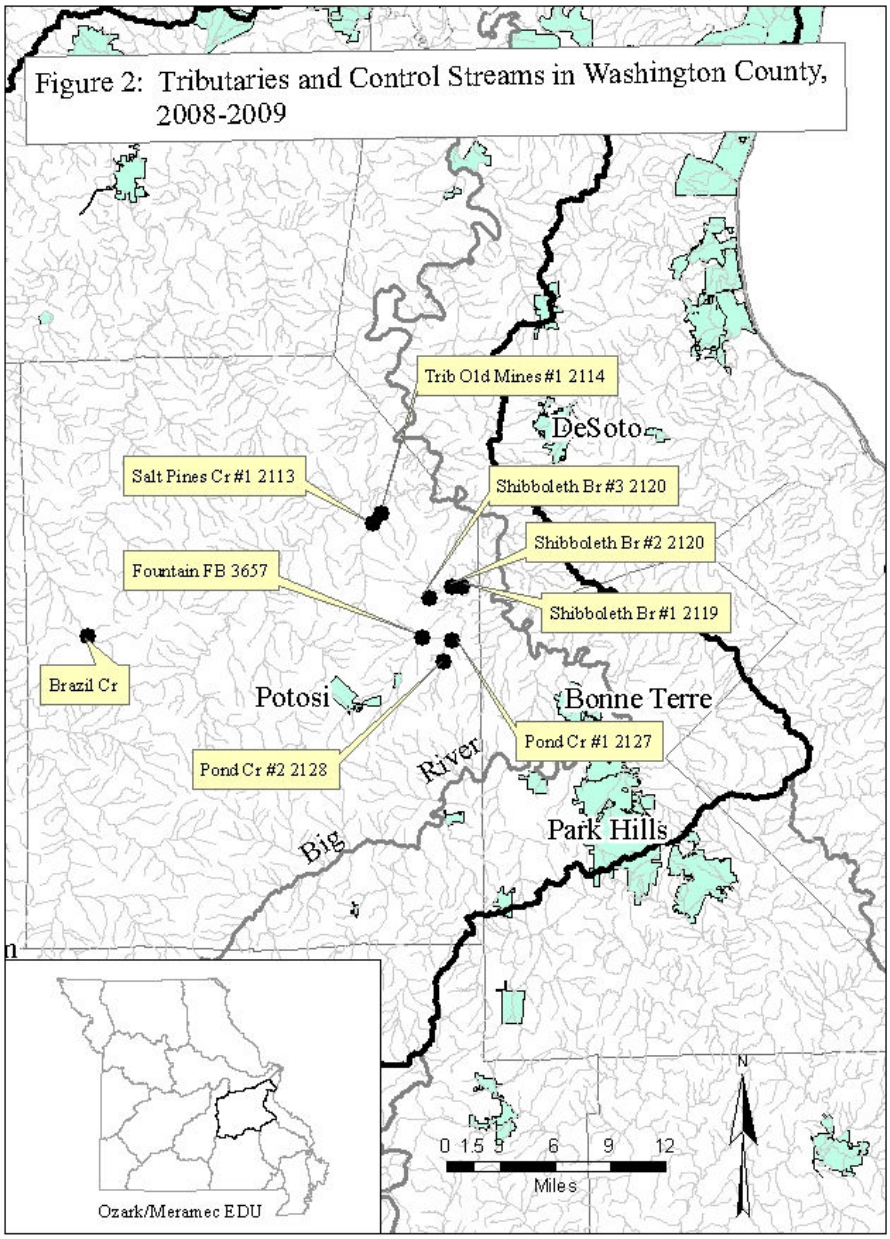


Figure 2: Tributaries and Control Streams in Washington County, 2008-2009
Trib Old Mines #1 2114
DeSoto
Salt Pines Cr #1 2113
Shibboleth Br #3 2120
Shibboleth Br #2 2120
Fountain FB 3657
Shibboleth Br #1 2119
Brazil Cr
Potosi
Bonne Terre
Pond Cr #1 2127
Pond Cr #2 2128
River
Big
Park Hills
Ozark/Meramec EDU
0 1.5 3 6 9 12
Miles
N

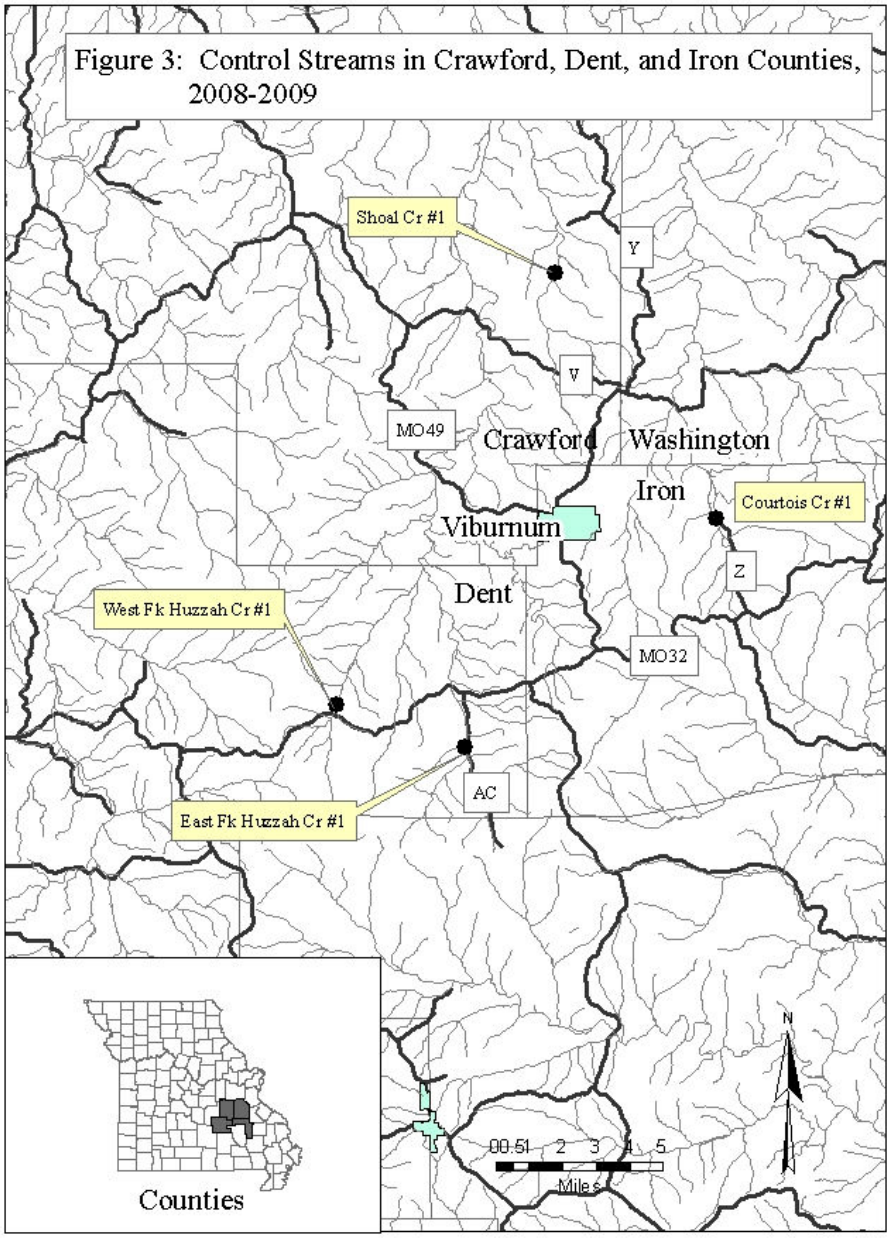


Figure 3: Control Streams in Crawford, Dent, and Iron Counties, 2008-2009

2.2.1 Ecological Drainage Unit

The tributaries and controls are located within the Ozark/Meramec Ecological Drainage Unit (**EDU**; Figure 1). Ecological Drainage Units are drainage units that are delineated and described by the natural terrestrial physiographic and major riverine components.

Similar size streams within an EDU are expected to contain similar aquatic communities and stream habitat conditions. Comparisons of biological and physicochemical results between test streams and similar size control streams within the same EDU should then be appropriate.

2.2.2 Land Use Description

Land cover (use) was compared among test stations, candidate references (controls), and the Ozark/Meramec EDU using a 14-digit Hydrological Unit scale (**HUC-14**; Table 2). Percent land cover data were derived from Thematic Mapper satellite data collected between 2000 and 2004 and interpreted by the Missouri Resource Assessment Partnership (**MoRAP**). Land cover was relatively similar between the tributaries and the control stations as well as with the general land cover of the Ozark/Meramec EDU. All streams had a relatively high percentage of forest followed by grassland. Therefore, general land use should not interfere with comparisons among stations or streams.

Table 2
Percent Land Cover in the Tributaries, Control (Candidate Reference) Stations, and the Ozark/Meramec EDU

Stations	HUC-14	Urban	Crops	Grass	Forest	Wetland	Open-water
Fountain Farm Branch #1	07140104080002	6	0	15	73	1	1
Pond Creek #2, #1	07140104080002	6	0	15	73	1	1
Shibboleth Branch #3, #2, #1	07140104080002	6	0	15	73	1	1
Salt Pines Creek #1	07140104040003	1	0	10	83	2	1
Trib. Old Mines Cr #1	07140104040003	1	0	10	83	2	1
Brazil Creek #1	07140102050005	0	0	15	83	0	0
Courtois Creek #1	07140102040001	1	0	8	86	0	0
East Fork Huzzah Creek #1	07140102030001	0	0	17	80	0	0
West Fork Huzzah Creek #1	07140102030001	0	0	17	80	0	0
Shoal Creek #1	07140102030004	0	0	17	80	0	0
Ozark/Meramec EDU	--	4	1	27	62	0	0

2.3 Stream Habitat Assessment Project Procedure

The standardized Stream Habitat Assessment Project Procedure (**SHAPP**) was followed as described for Riffle/Pool prevalent streams (MDNR 2003d). According to the SHAPP, the quality of an aquatic community is based on the ability of the stream to support the aquatic community. If SHAPP scores at test stations are ≥75% of the mean control scores, the stream habitat at the test station is considered to be comparable to the control streams. Brazil, Courtois, East Fork Huzzah, West Fork Huzzah, and Shoal Creeks were used as SHAPP controls (Table 1; Figures 1, 2, 3). Stream habitat assessment scores of the tributaries were compared as a percentage of the mean of SHAPP control scores. Scoring factors may be included to explain differences if needed.

2.4 Biological Assessment

Sampling was conducted as described in the MDNR Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP,** MDNR 2003c). Biological assessments consist of macroinvertebrate community and physicochemical water collection and analyses.

2.4.1 Macroinvertebrate Sampling and Analyses

Macroinvertebrates were sampled from multiple habitats as described in the SMSBPP (MDNR 2003c). The tributaries and controls are considered riffle/pool dominant streams. As such, coarse substrate (**CS**; riffle), non-flowing water over depositional substrate (**NF**), and rootmat (**RM**) habitats were sampled. Macroinvertebrates were subsampled in the WQMS lab according to the SMSBPP and identified to specific taxonomic levels in order to standardize calculation of the metrics (MDNR 2003c; MDNR 2005a).

Macroinvertebrate community data were analyzed using three strategies. Macroinvertebrate Stream Condition Index (**MSCI**) scores, individual biological criteria metrics, and dominant macroinvertebrate families (**DMF**) were examined.

A Macroinvertebrate Stream Condition Index (MSCI) is a qualitative rank measurement of a stream's aquatic biological integrity (Rabeni et al. 1997). The MSCI was further refined for reference streams within each EDU in Biological Criteria for Perennial/Wadeable Streams (**BIOREF;** MDNR 2002), where comparisons are made between test streams and a BIOREF scoring range generated from data collected from wadeable/perennial reference streams. A station's MSCI score ultimately identifies the ability of the stream to support the beneficial use for the protection of warm water aquatic life and human health-fish consumption (**AQL**).

The MSCI score is a compilation of rank scores that were assigned to individual biological criteria metrics as a measure of biological integrity. Four primary biological criteria metrics were compared to respective BIOREF scoring ranges and were used to calculate the MSCI per station: 1) Taxa Richness (**TR**); 2) Ephemeroptera/Plecoptera/ Trichoptera Taxa (**EPTT**); 3) Biotic Index (**BI**); and 4) Shannon Diversity Index (**SDI**). Metric scores are compared to the BIOREF scoring range (BIOREF Scoring Table) and rank scores (5, 3, 1) are assigned to each metric. Rank scores are compiled and the MSCI

was completed for each station. The MSCI scores are interpreted as follows: 20-16 = full support of AQL; 14-10 = partial support of AQL; and 8-4 = non-support of AQL. MSCI scores were compared among stations and grouped by season (Tables 4, 6, and 8).

Further metric evaluation was conducted to illustrate if stream size potentially affected the previous BIOREF MSCI score, and ultimately the categorization of the tributaries. A "Control Criteria" scoring range was generated for each season using the similar size control streams (Tables 5, 7, and 9). The control criteria were generated using the same methodology outlined in the SMSBPP for the larger BIOREF stream scoring range. Comparisons are made between the BIOREF and control criteria MSCI scores (**Δ MSCI**), individual metrics, and within the biological support category (**Δ Support**). These comparisons are found in Tables 5, 7, and 9.

Secondly, the individual biological criteria metrics for each station were compared to the BIOREF scoring range to identify the level of integrity for each individual metric. Variations in the metrics may help identify how a community is affected and identify a potential source of impairment.

The third biological analysis included an evaluation of the dominant macroinvertebrate families (DMF) per station. The seven most abundant DMF for each station are listed as a percentage of the total number of individuals in the sample. Dominance by certain families may help identify the type and source of impairment.

A more detailed taxa list is shown in Appendix A, which is reported by season and station. The presence or absence of certain species may help identify a type and source of impairment.

2.4.2 Physicochemical Water Sampling and Analyses

Physicochemical water samples were handled according to the appropriate MDNR, ESP Standard Operating Procedures (**SOP**) and/or Project Procedures (**PP**) for sampling and analyzing physicochemical water samples. Results for physicochemical water variables were examined by season and station.

Physicochemical water parameters consisted of field measurements and grab samples that were returned to the ESP environmental laboratory. Water was sampled according to the SOP MDNR-ESP-001 Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2009b). All samples that were transported to ESP were kept on ice. Temperature (°C), pH, conductivity (µS/cm), dissolved oxygen (mg/L), and discharge (cubic feet per second-**cfs**) were measured *in situ*. The ESP Chemical Analysis Section (CAS) in Jefferson City, Missouri conducted analyses for ammonia as nitrogen (**NH_3-N;** mg/L), nitrate+nitrite as nitrogen (**NO_3+NO_2-N;** mg/L), total nitrogen (**TN**; mg/L), chloride (**Cl;** mg/L), total phosphorus (**TP;** mg/L), and non-filterable residue (**NFR;** mg/L). Turbidity (**NTU**) was measured and recorded in the WQMS biology laboratory. Water samples were filtered in the field for dissolved metals such as barium, cadmium, calcium, cobalt, copper, lead, magnesium, nickel, and

zinc and analyzed by the CAS. Hardness as $CaCO_3$ values were calculated to identify the acceptable limits of the metals concentrations.

Physicochemical water parameters were compared between streams and controls, upstream to downstream (if applicable), as well as with Missouri's Water Quality Standards (WQS; MDNR 2009c). Interpretation of acceptable limits within the WQS may be dependent on a stream's classification and its beneficial-use designation (MDNR 2009c). The tributaries are class C and P, as well as U. Designated beneficial uses for the classified streams were LWW, AQL, and WBC category B, with the exception of Fountain Farm Branch, which was designated Secondary Contact Recreation (SCR) instead of WBC category B. Furthermore, acceptable limits for some parameters may be dependent on the rate of exposure. These exposure or toxicity limits are based on the lethality of a toxicant given long-term (chronic toxicity) or short-term exposure (acute toxicity).

2.4.3 Discharge

Stream discharge was measured using a Marsh-McBirney Flowmate™ flow meter at each station. Velocity and depth measurements were recorded at each station according to SOP MDNR-ESP-113 Flow Measurement in Open Channels (MDNR 2003b).

2.5 Fine Sediment

In-stream deposits of fine sediment (i.e. particle size ca. <2 mm) were estimated for percent coverage per area and characterized for composition of total recoverable metals (**TR;** µg/kg). The CAS of ESP conducted metals character analyses.

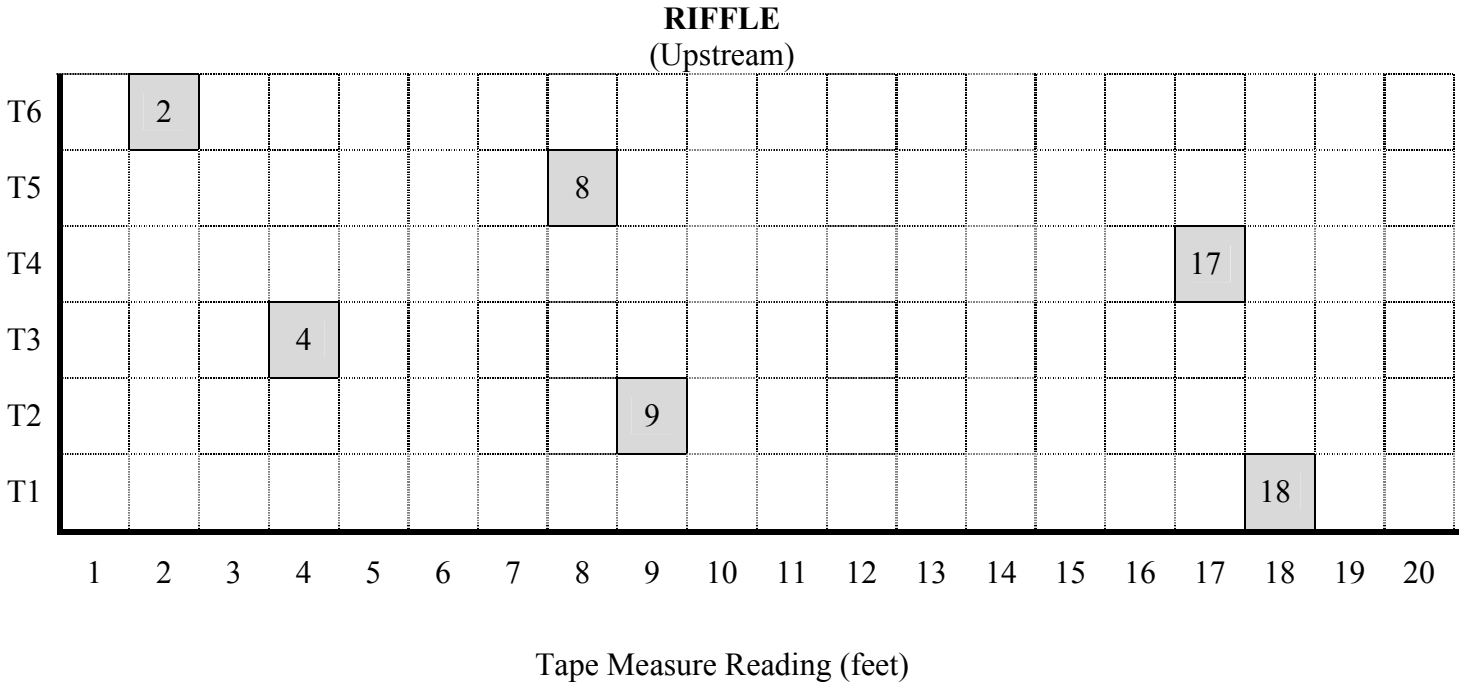
2.5.1 Fine Sediment Coverage Estimation

The relative percentage of fine sediment (<2.0 mm) coverage was visually estimated for each station. The visual estimates were conducted within a metal square (**quadrat**) that was randomly located in sample areas called grids (Figure 3). Each station contained three grids. This method allowed for estimation and comparison of benthic fine sediment among stations.

In order to ensure sampling method uniformity, grids were located at lower margins of riffles or runs and the upper margin of pool habitats in areas of relatively laminar flow. This arrangement or placement of grids was similar to previous fine sediment assessment projects done by the MDNR, WQMS, including Flat River (MDNR 2001) and Upper Big River (MDNR 2003a). Water velocity was no greater than 0.5 feet per second, which allows fine sediment-sized particles (<2.0mm) to settle from transport after high flow events, according to the Hjulstrom Diagram (1939) for threshold transport and settling velocities. A Marsh-McBirney flow meter was used to determine maximum velocity within the proposed grid. Depths did not exceed three feet. Grids did not include eddies, bends, areas downstream of vegetation, or large obstructions that may cause turbulent flow.

Once a suitable area was identified, a virtual grid was constructed (Figure 3). A 100' tape measure anchored across the stream became the downstream transverse edge of a virtual grid of six contiguous transects. Each transect was 12" deep, as wide as the useable grid, and was measured by holding a retractable tape measure perpendicular to the 100' tape. Random numbers, equating to one foot increments, were drawn to determine where the quadrat was placed along each transect. The quadrat was placed within the transect, with the downstream edge contacting the downstream transect edge. Two observers estimated and recorded the percent of fine sediment within the quadrat. The estimates were accepted and recorded if the two observations were within a ten percent margin of error or rejected and repeated until the margin of error was reached. Another random number was drawn and the quadrat was randomly placed in the next transect upstream where the next observation was made. This process continued until fine sediment was estimated in each of the six quadrats (one per transect).

Figure 4: Virtual grid of transects (T) and quadrats (boxes in gray, numbered) for estimating percent fine sediment. Example: stream 20' wide; quadrat placement based on random numbers (e.g. 18, 9, 4, 17, 8, 2)



The coverage data were examined using Analysis of Variance on Ranks, with multiple comparison procedures if differences are detected between tributaries and controls (SigmaStat version 3.5 2006).

2.5.2 Fine Sediment Character

Fine sediment was sampled and analyzed to identify the metals character within each station. A total of three 2-ounce grab samples were composited for each grid. A station is represented by three composite samples. The fine sediment was subsampled and analyzed for total cadmium, lead, and zinc by CAS. The consensus-based Probable Effects Concentration (PEC) for cadmium, lead, and zinc (MacDonald et al. 2000) was compared to levels found in the fine sediment material. A PEC is the level of a contaminant above which harmful effects are likely to be observed. The PEC for lead is 128 mg/kg dry weight; the PEC for cadmium is 4.98 mg/kg; and the PEC for zinc is 459 mg/kg.

2.6 Quality Control

Quality control was conducted in accordance with appropriate MDNR Standard Operating Procedures. Macroinvertebrate community and water physicochemical variables were duplicated at Courtois Creek in fall 2008 and Brazil Creek in spring 2009 (e.g. 1a and 1b). The results were similar between duplicates illustrating little difference between collectors, collection methods, containers, and analytical methods or processes.

3.0 Results

Results are grouped by 1) stream habitat assessment, 2) biological assessment, which includes macroinvertebrate community, water quality, and dissolved metals sections, and 3) fine sediment coverage estimations and characterization. Trends and exceptional results are highlighted.

3.1 Stream Habitat Assessment

All test station stream habitat assessment scores were comparable to the average SHAPP score for control streams (Table 3). Scores were well above the >75 percent similarity between test stations to control stations (MDNR 2003d). In the Mill Creek drainage, Shibboleth Branch #1 was lowest at 81 percent while Pond Creek #1 had 100 percent similarity. In the Mineral Fork drainage, Salt Pines Creek scored 82 percent, while Tributary Old Mines Creek scored 93 percent of the mean. All scores were within the acceptable range, which suggested that differences in habitat quality would not interfere with comparisons between controls and test streams.

3.2 Biological Assessment

Biological assessment consisted of macroinvertebrate community analyses and physicochemical water quality analyses. Results are compared among stations from upstream to downstream.

3.2.1 Macroinvertebrate Community Analyses

The macroinvertebrate community is examined in this section. The Macroinvertebrate Stream Condition Index (MSCI) scores and individual metric scores are examined for each test station for the fall and spring seasons. An MSCI score was also generated using similar size control streams (Control Criteria) to determine if stream size influenced prior results. Dominant macroinvertebrate families were also examined. Results are grouped

by season, watershed, and station. A detailed taxa list grouped by season and station can be found in Appendix B.

Table 3
Stream Habitat Assessment Project Procedure (SHAPP) Scores
and Comparisons with Control Streams

Station	SHAPP Score	Percent of control average
Fountain Farm Branch #1	141	90
Pond Creek #2	139	89
Pond Creek #1	162	100
Shibboleth Branch #3	134	86
Shibboleth Branch #2	132	85
Shibboleth Branch #1	126	81
Salt Pines Creek #1	128	82
Tributary Old Mines #1	146	93
Brazil Creek #1 (control)	161	156 control average
Courtois Creek #1 (control)	146	
West Fork Huzzah Creek #1 (control)	169	
East Fork Huzzah Creek #1 (control)	152	
Shoal Creek #1 (control)	151	

3.2.1.1 MSCI Scores – Fall 2008

One of the five stations in the Mill Creek watershed was partially supporting of the AQL designated-use category in the fall of 2008 (Table 4). Pond Creek #2 had an MSCI score of 12 and was assigned to the partial support category. Individual metrics that contributed to the low score were the TR, EPTT, BI, and SDI.

Both of the tributaries in the Mineral Fork watershed were partially supporting in the fall of 2008 (Table 4). Salt Pines Creek had an MSCI score of 12. Trib. Old Mines also scored 12. Individual metrics that contributed to the MSCI scores were TR, EPTT, BI, and SDI.

Two of the six controls exhibited differences from the BIOREF criteria, while four were within the full support category in the fall of 2008 (Table 4). Brazil Creek and Courtois Creek #1a were partially supporting the designated use. Brazil was well below the optimum individual metrics, except the BI. Courtois Creek #1a contained one fewer taxon in the EPTT metric, which lowered the metric score, which made the overall score lower than its duplicate sample (Courtois Creek 1b). The BIs were low at all controls except Shoal Creek, which was slightly higher than the optimum. This suggested that organic input was probably not an influence on the controls in the fall.

Table 4
Biological Criteria (BIOREF) Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (MSCI) Scores for Tributaries and Control Streams (light gray), Fall 2008

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Fountain Farm Branch #1	0804106	87	22	**6.2**	3.18	18	F
Pond Creek #2	0804107	**78**	**18**	**6.7**	**2.89**	**12**	**P**
Pond Creek #1	0804105	104	31	5.3	3.75	20	F
Shibboleth Branch #2	0804109	91	25	**5.9**	3.33	18	F
Shibboleth Branch #1	0804108	90	24	**6.5**	**3.08**	16	F
Salt Pines Creek	0804103	**69**	**20**	**6.9**	**2.37**	**12**	**P**
Trib. Old Mines #1	0804102	**65**	**17**	**6.3**	**2.87**	**12**	**P**
Brazil Creek #1	0804104	**64**	**17**	4.1	**2.62**	**14**	**P**
Courtois Creek #1a	0804111	**77**	**21**	3.9	**2.97**	**14**	**P**
Courtois Creek #1b	0804112	**75**	22	4.0	**2.98**	16	F
East Fork Huzzah Creek #1	0804113	84	25	5.0	3.47	20	F
West Fork Huzzah Creek #1	0804116	82	24	5.1	3.56	20	F
Shoal Creek #1	0804110	82	22	**5.9**	3.11	18	F
BIOREF Score=5	--	>79	>21	<5.8	>3.09	20-16	**F**ull
BIOREF Score=3	--	79-39	21-11	5.8-7.9	3.09-1.55	14-10	**P**artial
BIOREF Score=1	--	<39	<11	>7.9	<1.55	8-4	**N**on

MSCI Scoring Table (bottom) developed from BIOREF streams (n=7); TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index
Bold=less than optimum BIOREF score; 1a and 1b=QC duplicates

Mill Creek and Mineral Fork tributaries were compared to the control criteria scoring range to determine if stream size affected the MSCI (Table 5). Several changes suggested that stream size influenced the lower MSCI and metric scores at Mill Creek in

the fall of 2008 (Table 5). The scores changed in three Mill Creek tributaries. MSCI scores increased at Pond Creek #2 and Shibboleth Branch #1, but not enough to change the support category. Pond Creek #1 decreased slightly due to the lower tolerance range (BI) of the control scoring range. Mineral Fork scores did not change in the fall.

The changes in control criteria scoring range suggest that smaller streams have fewer taxa, lower tolerance, and are less diverse than the larger BIOREF streams in the fall (Table 5). The scoring range (light gray) was lower than BIOREF criteria for TR and SDI and higher for BI. EPT taxa were not different in the fall between the small control streams and the BIOREF streams. It appears that the size of stream may have contributed to lower BIOREF scores at the small streams in the Mill Creek drainage.

Table 5
Control Criteria Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (Δ MSCI) Scores, Highlighting Changes (**in Bold**) in Scores Using Similar Size Stream Criteria, Fall 2008

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	Δ MSCI	Δ Support
Fountain Farm Branch #1	0804106	87	22	6.2	3.18	18	F
Pond Creek #2	0804107	**78**	18	6.7	2.89	**12** to **14**	P
Pond Creek #1	0804105	104	31	**5.3**	3.75	**20 to 18**	F
Shibboleth Branch #2	0804109	91	25	5.9	3.33	18	F
Shibboleth Branch #1	0804108	90	24	6.5	**3.08**	**16** to **18**	F
Salt Pines Creek	0804103	69	20	6.9	2.37	12	P
Trib. Old Mines #1	0804102	65	17	6.3	2.87	12	P
Control Criteria Score=5	--	>75	>21	<5.1	>2.97	20-16	**F**ull
Control Criteria Score=3	--	75-37	21-11	5.1-7.5	2.97-1.49	14-10	**P**artial
Control Criteria Score=1	--	<37	<11	>7.9	<1.49	8-4	**N**on

Control Criteria MSCI Scoring Table (in light gray) developed from Control streams (n=6); TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

3.2.1.2 MSCI Scores – Spring 2009

Two streams in the Mill Creek watershed were partially supporting of the AQL designated use in the spring of 2009 (Table 6). Pond Creek #2 had an MSCI score of 12. The TR, EPTT, BI, and SDI contributed to the lower score of this small stream. Shibboleth Branch #3 had a score of 14. Individual metrics that contributed to that score included TR, EPTT, and SDI, with a low BI.

Both stations in the Mineral Fork drainage were partially supporting in the spring (Table 6). Salt Pines Creek and Trib. Old Mines Creek had MSCI scores of 12 and 14, respectively. All individual metrics contributed to the lower score at Salt Pines Creek. The BI was the only optimum score at Trib. Old Mines Creek in the spring.

The control streams exhibited differences compared to the BIOREF streams in the spring (Table 6). Four of the six streams had MSCI scores of 14 and were considered partially supporting of the AQL. Most of the streams had lower TR, fewer EPTT, more intolerant taxa, and less diversity and evenness in the community than the BIOREF streams. The BI was low at all control streams, suggesting that organic input was not an influence on the macroinvertebrate community composition in the spring of 2009.

When the similar size control criteria were applied to the tributaries, several changes were evident in the support categories in the spring 2009 MSCI (Table 7). Three streams in the Mill Creek and Mineral Fork watersheds moved from partial (P) to full (F) support when the similar size control stream scoring range was compared to metrics.

Two Mill Creek tributaries were affected by the stream size in the spring of 2009 (Table 7). Pond Creek #2 and Shibboleth Branch #3 changed from the partial support to full support category when the similar size control streams were used to generate the control criteria. Two tributaries dropped slightly because of the lower tolerance range (BI). All stations in the Mill Creek drainage would be considered fully supporting of the AQL designated use and are comparable to the similar size control streams.

Mineral Fork tributaries were apparently influenced by stream size in the spring of 2009 (Table 7). Salt Pines Creek MSCI score increased from 12 to 14 but remained in the partial support category. Trib. Old Mines Creek changed from the partial (P) to full (F) support category when similar size control criteria were compared in the spring 2009. It appears that stream size may have influenced the categorization as impaired.

The changes in the scoring range for individual metrics suggest that these smaller streams have fewer taxa, fewer EPTT, lower tolerance, and lower diversity and evenness than the larger BIOREF streams in the spring (Table 7). The TR, EPTT, BI, and SDI contributed to the change in scores at Mill Creek and Mineral Fork tributaries.

Table 6
Biological Criteria (BIOREF) Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (MSCI) Scores for Tributaries and Control Streams (light gray), Spring 2009

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Fountain Farm Branch #1	0930001	100	31	5.4	3.50	20	F
Pond Creek #2	0930003	**90**	**24**	**6.1**	**3.16**	**12**	**P**
Pond Creek #1	0930002	**90**	**26**	5.5	3.69	16	F
Shibboleth Branch #3	0930012	**69**	**18**	4.3	**3.23**	**14**	**P**
Shibboleth Branch #2	0930006	97	30	5.6	3.47	20	F
Shibboleth Branch #1	0930005	112	33	**5.8**	3.78	18	F
Salt Pines Creek #1	0930004	**71**	**21**	**6.3**	**3.22**	**12**	**P**
Trib. Old Mines #1	0930007	**90**	**23**	5.4	**3.22**	**14**	**P**
Brazil Creek #1a	0930009	**82**	**27**	3.9	**3.00**	**14**	P
Brazil Creek #1b	0930010	**81**	**26**	3.4	**2.83**	**14**	P
Courtois Creek #1	0930011	**83**	**26**	3.7	**3.01**	**14**	P
East Fork Huzzah Creek #1	0930015	**81**	**28**	4.6	**3.26**	**14**	P
West Fork Huzzah Creek #1	0930016	96	**29**	4.3	3.36	18	F
Shoal Creek #1	0930008	99	**23**	5.6	3.77	18	F
BIOREF Score=5	--	>92	>29	<5.8	>3.33	20-16	**F**ull
BIOREF Score=3	--	92-46	29-15	5.8-7.9	3.33-1.67	14-10	**P**artial
BIOREF Score=1	--	<46	<15	>7.9	<1.67	8-4	**N**on

MSCI Scoring Table (bottom) developed from BIOREF streams (n=6); TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index
Bold=less than optimum BIOREF score; 1a and 1b=QC duplicates

Table 7
Control Criteria Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (Δ MSCI) Scores, Highlighting Changes (**in Bold**) in Scores Using Similar Size Stream Criteria, Spring 2009

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	Δ MSCI	Δ Support
Fountain Farm Branch #1	0930001	100	31	**5.4**	3.50	**20-18**	F
Pond Creek #2	0930003	**90**	24	6.1	**3.16**	**12** to **16**	**P to F**
Pond Creek #1	0930002	**90**	26	**5.5**	3.69	16	F
Shibboleth Branch #3	0930012	69	18	4.3	**3.23**	**14** to **16**	**P to F**
Shibboleth Branch #2	0930006	97	30	**5.6**	3.47	**20 to 18**	F
Shibboleth Branch #1	0930005	112	33	5.8	3.78	18	F
Salt Pines Creek #1	0930004	71	21	6.3	**3.22**	**12 to 14**	P
Trib. Old Mines #1	0930007	**90**	23	**5.4**	**3.22**	**14** to **16**	**P to F**
Control Criteria Score=5	--	>81	>26	<4.5	>3.00	20-16	**F**ull
Control Criteria Score=3	--	81-41	26-13	4.5-7.3	3.00-1.50	14-10	**P**artial
Control Criteria Score=1	--	<41	<13	>7.3	<1.50	8-4	**N**on

MSCI Scoring Table (in light gray) developed from Control streams (n=6); TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

3.2.1.3 MSCI Scores – Fall 2009

The MSCI scores were generated from the BIOREF criteria for the two Shibboleth Branch stations that were sampled in the fall of 2009 (Table 8). Shibboleth Branch #3 was partially supporting with a score of 14. Low TR, EPTT, and SDI contributed to the scores. Shibboleth Branch #2 was fully supporting with a slightly elevated BI.

To identify potential effects of stream size, similar size control criteria were generated for the Shibboleth Branch stations for fall 2008 (Table 9). Shibboleth Branch #3 and #2 MSCI scores remained the same, suggesting that stream size was not an obvious influence in the earlier BIOREF comparison. However, the TR score moved to the optimum range and the BI increased to a less than optimum score, which negated any change in the support category.

Table 8
Biological Criteria (BIOREF) Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (MSCI) Scores for Tributaries, Fall 2009

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Shibboleth Branch #3	0918402	**76**	**18**	5.4	**2.83**	**14**	**P**
Shibboleth Branch #2	0918401	93	22	**6.3**	3.48	18	F
BIOREF Score=5	--	>79	>21	<5.8	>3.09	20-16	**F**ull
BIOREF Score=3	--	79-39	21-11	5.8-7.9	3.09-1.55	14-10	**P**artial
BIOREF Score=1	--	<39	<11	>7.9	<1.55	8-4	**N**on

MSCI Scoring Table (in light gray) developed from BIOREF streams (n=7); TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index
Bold=less than optimum BIOREF score

Table 9
Control Criteria Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (MSCI) Scores, Highlighting Changes (**in Bold**) in Scores Using Similar Size Stream Criteria, Fall 2009

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	Δ MSCI	Δ Support
Shibboleth Branch #3	0918402	**76**	18	**5.4**	2.83	14	P
Shibboleth Branch #2	0918401	93	22	6.3	3.48	18	F
Control Criteria Score=5	--	>75	>21	<5.1	>2.97	20-16	**F**ull
Control Criteria Score=3	--	75-37	21-11	5.1-7.5	2.97-1.49	14-10	**P**artial
Control Criteria Score=1	--	<37	<11	>7.9	<1.49	8-4	**N**on

MSCI Scoring Table (in light gray) developed from Control streams (n=6); TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

3.2.1.4 Dominant Macroinvertebrate Families – Fall 2008

The dominant macroinvertebrate families were compiled for the fall of 2008 (Table 10). Controls were dominated by Ephemerellidae as one of the DMFs. This was followed generally by Chironomidae and Heptageniidae, which was slightly different from the tributaries of Mill Creek and Mineral Fork.

Mill Creek tributaries DMFs were slightly different from the controls in the fall (Table 10). The DMFs highest across all sites were caenids, chironomids, elmid beetles, and heptageniids. Caenids were generally slightly more prevalent at the tributaries than the controls. Chironomids dropped from tributaries to controls, while elmids were evenly distributed. Heptageniid mayflies followed next and were consistently among the DMFs at the tributaries and controls.

The Mineral Fork tributaries were composed of similar DMFs of the tributaries with one exception, in the fall of 2008 (Table 10). Asellidae (isopods) was the most dominant family at both Salt Pines Creek and Trib. Old Mines Creek. This family was followed by Caenidae, Chironomidae, Elmidae, and Heptageniidae. Ephemerellids were among the dominant taxa at Trib. Old Mines Creek.

Table 10
Dominant Macroinvertebrate Families (DMF) as a Percentage of the Total Number of Individuals per Station for Tributaries and Controls, Fall 2008

Family	FFB	PC2	PC1	SB3	SB2	SB1	SPC	TOM	BC	CC	EFH	WFH	SC
Caenidae	37	39	11	*	22	36	20	16	5	-/4	9	-	38
Chironomidae	10	18	10	*	17	10	7	7	6	6/9	15	26	6
Heptageniidae	10	6	12	*	6	8	6	5	12	5/4	9	8	7
Simuliidae	9	-	-	*	6	-	-	-	-	-	-	11	-
Elmidae	5	10	14	*	7	8	7	5	11	16/21	10	6	15
Ephemerellidae	**3**	-	**6**	*	-	-	**5**	-	**35**	**20/23**	**10**	**-**	**3**
Psephenidae	3	-	-	*	-	-	-	-	-	-	7	-	3
Tubificidae	-	3	-	*	-	3	-	-	-	-	-	-	-
Hydropsychidae	-	-	6	*	-	-	-	9	**8**	**7/5**	**-**	**5**	**-**
Asellidae	-	-	-	*	12	10	**42**	**23**	-	-	-	-	-
Gomphidae	-	-	6	*	-	-	-	-	-	-	-	-	-
Isonychiidae	-	-	-	*	7	3	-	-	-	-	-	-	-
Baetidae	-	-	-	*	-	-	1	-	-	5/-	-	5	-
Philopotamidae	-	-	-	*	-	-	-	11	-	-	-	-	-
Leptophlebiidae	-	-	-	*	-	-	-	-	10	-	-	8	3
Pleuroceridae	-	-	-	*	-	-		-	-	15/10	-	-	-
Hyalellidae	-	-	-	*	-	-	-	-	-	-	7	-	-

* SB #3 not sampled in Fall 2008; CC duplicate a/b

Key: Test Stations=FFB-Fountain Farm Branch, PC-Pond Creek, SB-Shibboleth Branch, SP-Salt Pines Creek, TOM-Trib. Old Mines Creek
Controls=BC-Brazil Creek, CC-Courtois Creek, EFH-East Fork Huzzah Creek, WFH-West Fork Huzzah Creek, SC-Shoal Creek

3.2.1.5 Dominant Macroinvertebrate Families – Spring 2009

Dominant macroinvertebrate families were compiled for the spring of 2009 (Table 11). Controls were dominated by chironomids that were followed by leuctrid stoneflies. Ephemerellid and baetid mayflies were also among the more dominant families at most controls, but only the higher scoring Mill Creek stations.

Mill Creek tributaries were also dominated by chironomids in the spring (Table 11). The percentage of chironomids ranged from low 30s to mid-50s across all stations. They were followed in prevalence by caenid mayflies, black fly larvae (Simuliidae), and leuctrid stoneflies at most tributaries.

The DMF at Mineral Fork tributaries were dominated by Chironomidae. Asellidae again was dominant at Salt Pines Creek and Trib. Old Mines Creek, generally followed by Caenidae in the spring of 2009 (Table 11). Chironomids ranged between 48 and 50 percent of the total number of individuals per station. Heptageniids were also among the DMFs.

Table 11
Dominant Macroinvertebrate Families (DMF) as a Percentage of the Total Number of Individuals per Station for Tributaries and Controls, Spring 2009

Family	FFB	PC2	PC1	SB3	SB2	SB1	SPC	TOM	BC	CC	EFH	WFH	SC
Chironomidae	52	35	45	36	39	47	50	48	33/30	39	53	44	33
Simuliidae	17	3	11	6	8	-	2	-	2/4	-	-	4	6
Caenidae	7	25	5	-	10	11	5	10	-	-	2	-	11
Elmidae	3	3	5	3	5	6	-	-	7/5	8	3	3	12
Arachnoidea	3	-	-	-	-	-	-	-	-	-	-	-	-
Perlidae	2	-	-	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	2	-	7	-	-	3	-	-	9/7	8	5	-	4
Heptageniidae	-	6	3	6	3	6	2	1	-	-	5	6	-
Empididae	-	6	-	3	-	-	-	2	-	-	-	-	-
Gammaridae	-	3	-	-	-	-	-	-	-	3	-	5	-
Leuctridae	-	-	3	23	4	3	-	14	23/29	24	14	19	3
Hydropsychidae	-	-	-	4	-	-	3	-	-	-	-	-	-
Asellidae	-	-	-	-	13	7	19	5	-	-	-	-	-
Planariidae	-	-	-	-	-	-	8	-	-	-	-	-	-
Baetidae	-	-	-	-	-	-	-	5	8/9	-	6	5	6
Nemouridae	-	-	-	-	-	-	-	-	4/5	2	-	-	-
Pleuroceridae	-	-	-	-	-	-	-	-	-	2	-	-	-

Key: Test Stations=FFB-Fountain Farm Branch, PC-Pond Creek, SB-Shibboleth Branch, SP-Salt Pines Creek, TOM-Trib. Old Mines Creek
Controls=BC-Brazil Creek, CC-Courtois Creek, EFH-East Fork Huzzah Creek, WFH-West Fork Huzzah Creek, SC-Shoal Creek

3.2.1.6 Dominant Macroinvertebrate Families – Fall 2009

Dominant macroinvertebrate families of Shibboleth Branch stations were compiled for the fall of 2009 (Table 12). Chironomidae was the single most dominant family at both stations. Isonychiids, elmids, and baetids were dominant at both stations in the fall. Heptageniids and hydropsychid caddisflies were found at Shibboleth Branch #3, but were not dominant at #2. Conversely, caenids, asellids, and simuliids were dominant at #2, but not #3.

Table 12
Dominant Macroinvertebrate Families (DMF) as a Percentage of the Total Number of Individuals per Station for Shibboleth Branch Stations, Fall 2009

Family	SB3	SB2
Chironomidae	52	33
Heptageniidae	10	-
Isonychiidae	6	3
Elimdae	5	8
Baetidae	5	6
Hydropsychidae	5	-
Empididae	3	-
Caenidae	-	17
Asellidae	-	10
Simuliidae	-	4

3.2.2 Physicochemical Water Quality Analyses

General physicochemical water parameters are examined in this section grouped by season and watershed. Results are generally unremarkable and all parameters were found within acceptable WQSs (MDNR 2009c) during all three seasons. However, results were compared to the controls to identify elevated parameters. Several of these slight increases were compared to other test streams or the control streams that may identify intermittent influences.

3.2.2.1 General Water Quality – Fall 2008

Two streams had slightly elevated parameters in Mill Creek and Mineral Fork tributaries during the fall 2008 season (Table 13a). Concentrations were only slightly elevated and none exceeded WQSs (MDNR 2009c).

Mill Creek tributaries had a few notable water quality parameters when compared to the controls in the fall (Table 13a). All stations except Pond Creek #2 had elevated conductivity. Fountain Farm Branch had slightly elevated chloride. Shibboleth Branch stations #2 and #1 had slightly elevated total nitrogen, nitrate, and the indicator chloride when compared to control samples (Table 13b). All tributaries, except Pond Creek #2, had conductivity above control concentrations in the fall.

Table 13a
Physicochemical Water Parameters for the Tributaries
Fall 2008

Station Variable/Date	Fountain Farm Br #1	Pond Creek #2	Pond Creek #1	Shibboleth Branch #2	Shibboleth Branch #1	Salt Pines Creek #1	Trib. Old Mines Creek #1
Sample Number	0810005	0810006	0810004	0810008	0810007	0810002	0810001
pH (Units)	8.3	8.3	8.1	8.3	8.2	8.1	8.0
Temperature (°C)	18.0	17.0	16.0	18.0	17.0	18.0	17.0
Conductivity (µS)	395	199	366	365	371	408	423
Dissolved O_2	8.10	7.21	7.97	7.86	7.97	7.76	7.24
Discharge (cfs)	3.28	1.56	5.37	5.71	6.43	0.92	0.71
*NFR	-	<5.0	<5.0	<5.0	<5.0	-	-
Turbidity (NTUs)	1.73	1.55	7.18	10.2	2.44	3.02	1.99
Total Nitrogen	0.10	0.17	0.09	**0.22**	**0.24**	0.18	0.16
Nitrate+Nitrite-N	0.01	<0.01	<0.01	**0.08**	**0.11**	0.02	0.03
Ammonia-N	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chloride	**3.94**	2.01	2.85	**3.29**	**3.36**	2.68	2.69
Total Phosphorus	0.01	0.01	0.01	0.02	0.01	0.01	0.01

* NFR collected January 22, 2009; Units mg/L unless otherwise noted; **Bold**=Out of WQS acceptable range or trend

Table 13b
Physicochemical Water Parameters for Controls
Fall 2008

Station Variable/Date	Brazil Creek #1	Courtois Creek #1a	Courtois Creek #1b	East Fork Huzzah Creek #1	West Fork Huzzah Creek #1	Shoal Creek #1
Sample Number	0810003	0810010	0810011	0810012	0810015	0810009
pH (Units)	8.2	7.75	--	7.32	7.77	8.3
Temperature (°C)	18.0	15.0	--	18.0	17.0	20.0
Conductivity (µS)	252	266	--	344	268	385
Dissolved O_2	7.20	8.55	--	7.45	7.93	8.00
Discharge (cfs)	2.73	3.55	--	5.14	2.84	3.03
Turbidity (NTUs)	1.10	<1.0	<1.0	5.47	1.08	<1.00
Total Nitrogen	**0.30**	0.03	0.05	0.13	0.11	0.10
Nitrate+Nitrite-N	**0.13**	0.01	0.04	0.08	0.02	0.02
Ammonia-N	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chloride	1.72	1.81	1.80	2.76	2.68	2.56
Total Phosphorus	0.03	0.01	0.01	0.02	0.01	0.01

NFR was not sampled for controls in the fall; Units mg/L unless otherwise noted; **Bold**=Out of WQS acceptable range or trend

Mineral Fork tributaries had few notable water quality parameters in the fall 2008 season (Table 13a). Salt Pines Creek and Trib. Old Mines Creek had the highest conductivity in the fall samples. Conductivity was nearly twice as high as the controls.

Parameters in most controls were generally unremarkable with the exception that Brazil Creek had the highest total nitrogen and nitrate+nitrite-N of all controls and tributaries. (Table 13b)

3.2.2.2 General Water Quality – Spring 2009

The spring 2009 water quality parameters were not exceptional at Mill Creek and Mineral Fork tributaries (Table 14a). However, slight increases at several streams may be indicators of organic input. Parameter concentrations were low and none exceeded WQSs (MDNR 2009c).

General water quality parameters were again relatively unremarkable in Mill Creek in the spring 2009 samples (Table 14a). Chloride was slightly elevated at Shibboleth Branch #3. The Fountain Farm Branch chloride concentration was 7.70 mg/L, nearly twice all other test streams. All Shibboleth Branch stations had total nitrogen concentrations higher than other stations, while #2 and #1 also had nitrate+nitrite-N above the levels found at controls. Discharge was lower in Pond Creek #2 and Shibboleth Branch #3.

Table 14a
Physicochemical Water Parameters for Tributaries
Spring 2009

Station Variable/Date	Fountain Farm Br #1	Pond Creek #2	Pond Creek #1	Shibboleth Branch #3	Shibboleth Branch #2	Shibboleth Branch #1	Salt Pines Creek #1	Trib. Old Mines #1
Sample Number	0912001	0912003	0912002	0912012	0912006	0912005	0912004	0912007
pH (Units)	8.5	8.2	8.4	8.0	8.5	8.5	8.3	8.3
Temp (°C)	12.0	14.0	12.0	11.0	11.0	10.0	14.5	13.0
Cond (µS)	454	326	435	265	375	386	**523**	**451**
Diss O_2	10.9	10.4	11.2	9.21	10.8	11.3	10.1	9.10
Discharge (cfs)	1.54	0.51	1.27	3.03	6.70	9.63	0.34	0.67
NFR	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Turb (NTUs)	2.00	3.00	1.00	3.83	5.98	6.56	1.00	2.55
Total N	0.09	0.08	0.08	**0.20**	**0.24**	**0.28**	0.12	0.13
NO_2+NO_3-N	0.02	0.02	<0.01	0.02	**0.10**	**0.13**	0.02	0.03
NH_3-N	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cl	**7.70**	3.81	4.72	4.26	4.03	4.10	3.41	3.53
Total P	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Units mg/L unless otherwise noted; **Bold**=Out of WQS acceptable range or trend

Conductivity was slightly elevated in Mineral Fork tributaries in the spring of 2009 (Table 14a). Salt Pines had the highest conductivity of all tributaries at 523 µS/cm. Trib. Old Mines Creek was third highest at 451 µS/cm, well above controls. Discharge was below 0.7 cfs at both small tributaries.

Water quality parameters for control streams were within acceptable levels with no noticeable exceptions for the spring of 2009 (Table 14b).

Table 14b
Physicochemical Water Parameters for Controls
Spring 2009

Station Variable/Date	Brazil Creek #1a	Brazil Creek #1b	Courtois Creek #1	East Fork Huzzah Creek #1	West Fork Huzzah Creek #1	Shoal Creek #1
Sample Number	0912009	0912010	0912011	0912016	0912017	0912008
pH (Units)	8.1	--	8.2	8.4	8.7	8.6
Temperature (°C)	10.0	--	12.0	11.0	14.0	15.0
Conductivity (µS)	235	--	171	275	226	329
Dissolved O_2	9.66	--	9.16	9.40	10.7	9.91
Discharge (cfs)	5.23	--	17.7	10.9	3.56	10.5
NFR	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Turbidity (NTUs)	2.05	1.84	2.80	<1.0	1.01	4.90
Total Nitrogen	0.16	0.16	0.08	0.11	0.12	0.14
Nitrate+Nitrite-N	0.07	0.07	<0.01	0.04	0.04	<0.01
Ammonia-N	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chloride	1.54	1.60	2.02	2.58	2.90	2.25
Total Phosphorus	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

(Units mg/L unless otherwise noted; **Bold**=Out of WQS acceptable range or trend)

3.2.2.3 General Water Quality – Fall 2009

Shibboleth Branch #3 and #2 were sampled and analyzed for water quality parameters for the fall of 2009 (Table 15). General water quality parameters exhibited notable results at the Mill Creek stations in the fall of 2009. Shibboleth Branch #3 and #2 contained slightly elevated total nitrogen. Nitrate+nitrite-N and an NFR of 6.0 mg/L were observed at Shibboleth Branch #2. Chloride was also slightly higher when compared to fall 2008 (Table 13b) concentrations at the control streams. General water quality parameters were observed in low concentrations and were within acceptable WQSs (MDNR 2009c). Discharge was below 0.4 cfs at Shibboleth Branch #3.

Table 15
Physicochemical Water Parameters for Shibboleth Branch Stations, Fall 2009

Station Variable/ Date	Shibboleth Branch #3 9/15/09	Shibboleth Branch #2 9/15/09
Sample Number	0912012	0912006
pH (Units)	8.1	8.3
Temperature (°C)	20.0	19.0
Conductivity (µS)	336	455
Dissolved O_2	7.36	7.23
Discharge (cfs)	0.49	3.40
NFR	<5.0	**6.0**
Turbidity (NTUs)	1.30	4.19
Total Nitrogen	**0.16**	**0.18**
Nitrate+Nitrite-N	<0.05	**0.10**
Ammonia-N	0.03	0.03
Chloride	**3.85**	**4.08**
Total Phosphorus	<0.01	0.01

Units mg/L unless otherwise noted; **Bold**=Out of WQS acceptable range, or trend

3.2.3 Dissolved Metals

All Mill Creek and Mineral Fork tributaries contained slightly elevated concentrations of dissolved metals (barium, cadmium, lead, and zinc) in all seasons when compared to the similar size controls. Concentrations were only slightly elevated during all seasons, and were within acceptable WQSs (MDNR 2009c).

3.2.3.1 Dissolved Metals – Fall 2008

Water samples in Mill Creek tributaries contained elevated dissolved metals in the fall of 2008 (Table 16). Fountain Farm Branch contained barium, lead, and zinc concentrations above the control levels. Pond Creek contained barium concentrations from 557 to 618 mg/L barium from upstream to downstream. Shibboleth Branch #2 and #1 had barium in the mid 700 mg/L range, while station #1 also contained zinc above the control levels.

Water samples at Mineral Fork tributaries contained elevated dissolved metals in higher concentrations than the controls in the fall of 2008 (Table 16). Salt Pines Creek had elevated barium and lead. Trib. Old Mines Creek water samples contained the highest barium, lead, and zinc concentrations of all the tributaries.

None of the dissolved metals exceeded WQSs (MDNR 2009c) in the fall.

3.2.3.2 Dissolved Metals – Spring 2009

Fountain Farm Branch, Pond Creek, and Shibboleth Branch exhibited notable dissolved metals trends in the spring of 2009 (Table 17). Fountain Farm Branch had elevated barium, nickel, and zinc concentrations. Pond Creek #2 and #1 had barium and zinc above the control levels. Shibboleth Branch #3, #2, and #1 had barium, lead, and nickel while #2 and #1 had the highest concentrations of zinc.

Salt Pines Creek and Trib. Old Mines Creek had several notable dissolved metals concentrations in the spring of 2009 (Table 17). Salt Pines Creek contained higher concentrations of barium and nickel. Trib. Old Mines Creek contained barium, nickel, and zinc above control levels.

The dissolved metals concentrations at the controls were generally not extraordinary in the spring of 2009, with two exceptions (Table 17). Nickel was detected in Brazil Creek and Shoal Creek in the spring 2009 samples. The presence of nickel at only one of the Brazil Creek duplicates suggests that the sample was contaminated, either in the field or at the lab. However, at both stations, the metals concentrations were the lowest among samples and below the Practical Quantitation Limit (**PQL**). Because these levels were below the PQL, the concentration determined by CAS was an estimated value.

None of the concentrations exceeded WQSs (MDNR 2009c) in the spring water samples.

3.2.3.3 Dissolved Metals – Fall 2009

Water samples were collected from the two most upstream stations on Shibboleth Branch in the fall of 2009 (Table 18) and compared to controls from fall 2008. Shibboleth Branch #3 had the highest barium concentrations at 1680 µg/L. Shibboleth Branch #2 had elevated barium, lead, and zinc concentrations. None exceeded WQSs (MDNR 2009c).

3.3 Fine Sediment Coverage and Character

Fine sediment coverage was significantly greater ($p<0.05$) at most Mill Creek and Mineral Fork tributaries than the mean of controls (19.2 percent).

All but one of the Mill Creek tributaries had significantly higher fine sediment coverage than the control (Table 19; Appendix C). Fine sediment mean coverage ranged from 37 to 93 percent coverage at the Mill Creek tributaries. Fountain Farm Branch, Pond Creek, and Shibboleth Branch stations had significantly higher ($p<0.05$) percent coverage than the controls. Shibboleth Branch #3 did not have significantly more fine sediment coverage than the grouped control/reference stations, due to a failure of normality and high standard deviation.

Fine sediment coverage was significantly higher at one of the two Mineral Fork tributaries (Table 19; Appendix C). Salt Pines Creek coverage was not significantly higher (17.1 $\pm$15.1) than the coverage of controls. Trib. Old Mines Creek had significantly greater coverage (55.2 $\pm$ 32.9) than the controls.

Table 16
Dissolved Metals and Hardness for Tributaries and Controls, Fall 2008

Parameter Station	Ba	Cd	Ca	Co	Cu	Pb	Mg	Ni	Zn	HARD $CaCO_3$
Fountain Farm Br #1	**674**	<0.20	43.5	<1.0	0.95	**0.30**	25.8	<0.25	**11.0**	215
Pond Cr #2	**557**	<0.20	20.2	<1.0	0.78	<0.25	12.1	<0.25	3.18	100
Pond Cr #1	**618**	<0.20	40.9	<1.0	0.55	<0.25	24.1	<0.25	5.61	202
Shibboleth Br #2	**748**	<0.20	40.3	<1.0	0.80	<0.25	23.7	<0.25	**13.1**	198
Shibboleth Br #1	**758**	<0.20	41.5	<1.0	0.79	<0.25	24.8	<0.25	7.35	206
Salt Pines Cr #1	**877**	<0.20	48.1	<1.0	1.34	**0.37**	29.5	<0.25	2.60	242
Trib. Old Mines #1	**1030**	<0.20	45.1	<1.0	2.08	**0.49**	29.7	<0.25	**22.0**	235
Brazil Cr #1 c	86.1	<0.20	27.9	<1.0	0.70	<0.25	16.3	<0.25	2.28	137
Courtois Cr #1A c	45.8	<0.20	28.7	<1.0	0.59	<0.25	17.3	<0.25	1.50	143
Courtois Cr #1B c	45.1	<0.20	28.7	<1.0	0.51	<0.25	17.3	<0.25	1.34	143
E Fk Huzzah Cr #1 c	48.9	<0.20	36.4	<1.0	0.75	<0.25	22.4	<0.25	8.13	183
W Fk Huzzah Cr #1 c	38.8	<0.20	29.3	<1.0	0.52	<0.25	17.6	<0.25	1.36	146
Shoal Creek #1 c	51.0	<0.20	42.9	<1.0	1.81	<0.25	25.8	<0.25	3.34	213

Units µg/L; **Bold**=trend; Shibboleth Br #3 not sampled Fall 2008

Table 17
Dissolved Metals and Hardness for Tributaries and Controls, Spring 2009

Parameter Station	Ba	Cd	Ca	Co	Cu	Pb	Mg	Ni	Zn	HARD $CaCO_3$
Fountain Farm Br #1	**565**	<0.20	46.6	<1.0	1.28	<0.25	27.7	**0.37**	**21.3**	231
Pond Cr #2	**469**	<0.20	32.2	<1.0	1.24	<0.25	18.7	<0.25	**9.83**	158
Pond Cr #1	**612**	<0.20	43.9	<1.0	1.26	<0.25	26.7	<0.25	**8.46**	220
Shibboleth Br #3	**980**	<0.20	24.9	<1.0	1.02	**0.52**	15.1	**0.44**	6.63	124
Shibboleth Br #2	**609**	<0.20	37.1	<1.0	1.24	**0.32**	22.3	**0.47**	**28.1**	184
Shibboleth Br #1	**604**	<0.20	38.2	<1.0	1.34	**0.26**	22.8	**0.45**	**20.9**	189
Salt Pines Cr #1	**1130**	<0.20	54.6	<1.0	1.23	<0.25	32.9	**0.33**	1.90	272
Trib. Old Mines #1	**867**	<0.20	44.4	<1.0	1.34	<0.25	29.5	**0.43**	**20.1**	232
Brazil Cr #1A	75.9	<0.20	23.9	<1.0	1.00	<0.25	13.8	**0.30**	7.77	116
Brazil Cr #1B	70.7	<0.20	23.7	<1.0	0.64	<0.25	13.7	<0.25	2.21	116
Courtois Cr #1	28.6	<0.20	17.2	<1.0	0.92	<0.25	9.91	<0.25	2.28	83.7
E Fk Huzzah Cr #1	28.5	<0.20	30.4	<1.0	0.71	<0.25	18.7	<0.25	6.82	153
W Fk Huzzah Cr #1	32.7	<0.20	24.2	<1.0	0.54	<0.25	14.6	<0.25	1.65	121
Shoal Cr #1	38.7	<0.20	34.6	<1.0	1.23	<0.25	20.5	**0.29**	2.09	171

Units µg/L; **Bold**=trend

Table 18
Dissolved Metals and Hardness for Tributaries, Fall 2009

Parameter Station	Ba	Cd	Ca	Co	Cu	Pb	Mg	Ni	Zn	HARD $CaCO_3$
Shibboleth Br #3	**1680**	<0.20	34.9	<1.0	0.52	<0.25	20.9	<0.25	3.51	173
Shibboleth Br #2	**858**	<0.20	47.8	<1.0	0.48	**0.35**	30.1	<0.25	**14.8**	243
c=Fall 2008 Controls										
Brazil Cr #1 c	86.1	<0.20	27.9	<1.0	0.70	<0.25	16.3	<0.25	2.28	137
Courtois Cr #1A c	45.8	<0.20	28.7	<1.0	0.59	<0.25	17.3	<0.25	1.50	143
Courtois Cr #1B c	45.1	<0.20	28.7	<1.0	0.51	<0.25	17.3	<0.25	1.34	143
E Fk Huzzah Cr #1 c	48.9	<0.20	36.4	<1.0	0.75	<0.25	22.4	<0.25	8.13	183
W Fk Huzzah Cr #1 c	38.8	<0.20	29.3	<1.0	0.52	<0.25	17.6	<0.25	1.36	146
Shoal Creek #1 c	51.0	<0.20	42.9	<1.0	1.81	<0.25	25.8	<0.25	3.34	213

Units µg/L; **Bold**=trend; c=Control data from Table 16, p29. Dissolved Metals and Hardness for Controls, Fall 2008

Table 19
Fine sediment percent coverage by station, grid, and transect. Mean, standard deviation, and significance level ($p<0.05$) using Kruskal-Wallis One Way Analysis of Variance on Ranks (Analyses in Appendix C).

Grid-Transect	FFB#1	PC #2	PC #1	SB #3	SB #2	SB #1	SPC#1	TOM#1	BC #1	CC #1	EFHC #1	WFHC #1	SC #1
1-1	10	92	25	6	13	40	11	80	30	27	3	3	3
1-2	4	99	55	3	13	43	11	89	15	17	4	3	1
1-3	13	95	10	90	55	15	17	90	7	7	7	3	1
1-4	19	95	40	25	68	17	37	95	40	10	9	7	1
1-5	10	90	5	7	37	33	33	77	23	4	1	7	7
1-6	13	85	50	13	19	20	43	93	23	7	4	1	1
2-1	65	98	27	5	7	77	11	75	9	3	4	4	23
2-2	80	95	45	6	13	13	11	83	5	1	3	3	20
2-3	15	95	10	5	81	23	14	75	80	10	1	2	23
2-4	20	95	25	85	5	10	9	50	35	17	5	3	87
2-5	43	90	55	5	23	7	37	45	40	5	1	70	80
2-6	47	89	13	3	13	15	47	50	35	1	5	53	63
3-1	91	95	75	90	33	43	4	35	2	35	45	3	3
3-2	93	95	23	17	73	77	2	17	9	12	45	1	15
3-3	95	87	70	87	85	80	2	20	1	70	17	5	7
3-4	95	97	93	87	80	85	2	7	23	25	17	7	20
3-5	95	90	27	95	95	77	5	4	15	1	7	2	8
3-6	91	97	23	95	95	67	11	9	7	13	13	3	13
MEAN	**49.9**	**93.3**	**37.3**	40.2	**44.9**	**41.2**	17.1	**55.2**	**22.2**	**14.7**	**10.6**	**10.0**	**20.9**
S.D.	**41.1**	**3.9**	**24.8**	41.1	**33.5**	**28.4**	15.1	**32.9**	**19.5**	**16.8**	**13.4**	**19.1**	**27.1**
KW ANOVA	**p<0.05**	**p<0.05**	**p<0.05**	NS	**p<0.05**	**p<0.05**	NS	**p<0.05**	19.2 Mean of controls				

Key: Test Stations=FFB-Fountain Farm Branch, PC-Pond Creek, SB-Shibboleth Branch, SPC-Salt Pines Creek, TOM-Trib. Old Mines Creek
Controls=BC-Brazil Creek, CC-Courtois Creek, EFHC-East Fork Huzzah Creek, WFHC-West Fork Huzzah Creek, SC-Shoal Creek

The fine sediment in the substrate at Mill Creek and Mineral Fork contained high levels of metals, such as cadmium, lead, and zinc (Table 20).

Mill Creek tributaries contained elevated levels of heavy metals in the fine sediment (Table 20). All tributaries had elevated barium levels compared to the controls, however, no PEC has been assigned. Several other metals were above PECs in the fine sediment of all tributaries. Fountain Farm Branch had high lead and zinc levels in the fine sediment, above PECs. Both Pond Creek stations had high zinc levels above the PEC. All Shibboleth Branch stations had lead and zinc above the respective PECs. Shibboleth Branch #1 also had cadmium above the PEC.

Total metals concentrations in the fine sediment were detected above PECs (MacDonald et al. 2000) at Mineral Fork tributaries (Table 20). Salt Pines Creek #1 and Trib. Old Mines Creek #1 had elevated barium, but no PEC has been assigned. Salt Pines had lead at 660 mg/kg and zinc at 1220 mg/kg. Trib. Old Mines Creek had lead at 707 mg/kg and zinc at 1610 mg/kg. The PECs for lead and zinc were greatly exceeded at both Salt Pines Creek and Trib. Old Mines Creek.

Table 20
Total Metals Character in the Fine Sediment (<2.0mm): Barium, Cadmium, Lead, and Zinc Concentrations (mg/kg Dry Weight)

Parameter Station	Barium	Cadmium	Lead	Zinc
Fountain Farm Br#1	1930	0.481	**237**	**606**
Pond Creek #2	1580	0.683	46.6	**488**
Pond Creek #1	1460	0.594	96.8	**525**
Shibboleth Branch #3	2890	0.638	**836**	**697**
Shibboleth Branch #2	2350	0.544	**246**	**845**
Shibboleth Branch #1	428	**9.52**	**607**	**553**
Salt Pines Creek #1	3050	2.09	**660**	**1220**
Trib. Old Mines #1	2940	1.56	**707**	**1610**
Brazil Creek #1	24.8	0.101	49.3	54.6
Courtois Creek #1	13.3	0.100	8.7	9.5
E Fk Huzzah Cr#1a	19.0	0.599	15.1	64.5
E Fk Huzzah Cr#1b	18.6	0.381	13.4	45.6
W Fk Huzzah Cr#1	21.6	0.100	10.8	9.5
Shoal Creek #1	15.7	0.169	15.9	45.4
PEC	--	**4.98** mg/kg	**128** mg/kg	**459** mg/kg

PEC=Probable Effects Concentration, MacDonald et al. 2000; a and b=duplicate; light gray=candidate reference stations; **Bold**=above PEC

4.0 Discussion

The discussion is arranged by the tributaries of Mill Creek and Mineral Fork. The macroinvertebrate community, water quality, and fine sediment coverage and character are discussed for each stream. It appears that stream size may have played a role in categorization of the impaired streams in the spring and that metals character of the sediment was also potentially important.

4.1 Mill Creek Tributaries

Mill Creek tributaries included in this project are Fountain Farm Branch, Pond Creek, and Shibboleth Branch. Stream habitat assessments, macroinvertebrate community, water quality including dissolved metals, and fine sediment percentage and character are discussed.

4.1.1 Stream Habitat Assessment

The SHAPP scores for the tributaries were comparable to the controls, by reaching the required 75 percent similarity with the control mean. General observations were made about two of the streams, which were impaired in their upper reaches.

Pond Creek #2 was predominantly a small bedrock dominant stream segment with a shallow coating of fine sediment over algae. The lack of suitable habitat may have contributed to impairment. Pond Creek #1 was larger with more heterogeneous epifaunal substrate and less sediment deposition.

All stations on Shibboleth Branch exceeded the minimum 75 percent comparability threshold to the SHAPP controls. Shibboleth Branch #3 was assessed twice; once in spring 2009 and once in fall 2009. The score in the fall was lower than the spring score mainly due to the presence of a much higher percentage of fine sediment deposition. This suggests that sediment deposition may fluctuate within that station, which may affect the macroinvertebrate community.

4.1.2 Macroinvertebrate Community

Most tributaries to Mill Creek in this study were fully supporting of the AQL designated use. Fountain Farm Branch was fully supporting during both seasons. Pond Creek #2 and Shibboleth Branch #3 were partially supporting during both seasons. Shibboleth Branch was influenced by less than optimum TR, EPTT, and SDI. Optimum BI scores at Shibboleth Branch #3 during both seasons suggest that any consistent impairment is probably not due to organic influences. Pond Creek #2 was influenced by all individual metrics (TR, EPTT, BI, SDI) during both seasons. Pond Creek #1 and Shibboleth Branch stations #2 and #1 were fully supporting in all seasons, which illustrates that the impairment did not extend downstream in either stream.

The tributaries were generally smaller than the typical wadeable/perennial reference stream used to create the BIOREF criteria. In order to identify if the size of the stream influenced the metric scores, we generated a criteria scoring range using only the similar size control streams. Called “control criteria,” we observed changes when test metrics

were compared to the "control criteria" scoring range. Using these criteria, the Pond Creek #2 score increased in the fall, but not enough to increase the support category. Both Pond Creek #2 and Shibboleth Branch increased from partial to full support in the spring. Shibboleth Branch did not increase its support category in the fall of 2009. This suggests that size of the stream may have influenced the MSCI scores and that 1) the tributaries may not have been impaired or 2) the controls were low quality.

Care was taken to find candidate references (controls) with no known outfalls or barium mine influences upstream. Low BIs in the control streams during both seasons suggest that they are not impaired by organic pollution. Low concentrations of dissolved metals and sediment metals and relative amounts of fine sediment at the controls suggest they were not poor quality and had no mining influences. The implication is that there may be a need to sample and identify small/headwater reference streams for each EDU to generate small/headwater criteria, as we have for larger wadeable BIOREFs.

Generally intolerant ephemerellids and hydropsychids occurred mainly in the controls and usually at higher scoring stations. The presence of these relatively intolerant taxa groups may indicate higher quality or inconsistent impairment. Dominance of Leuctrid stoneflies and ephemerellid and baetid mayflies explain the consistently higher scores found at Fountain Farm Branch, Pond Creek #1, and Shibboleth Branch #1. Heptageniids in general may be considered relatively intolerant taxa and were dominant in test stations. Heptageniids present were usually represented by the tolerant *Stenacron* sp. to the intolerant *Maccaffertium pulchellum* and *M. mediopuntatum*. The taxa present in the tributaries and controls were similar to the taxa found by Poulton et al. (2009) in the Viburnum trend mining study.

4.1.3 General Water Quality

The water quality parameters in the Mill Creek watershed tributaries were relatively unremarkable in all seasons. All tested parameters were found in low concentrations and were within WQSs (MDNR 2009c). All tributaries, with two exceptions, had continuously high conductivity, possibly due to mining influences. The exceptions were Pond Creek #2 and Shibboleth Branch #3, possibly due to their small watersheds and proximity to large tailings ponds or settling basins. Fountain Farm Branch had slightly elevated chloride and conductivity during both seasons, which may be evidence of mine-related or wastewater input. Pond Creek #2 had a higher BI, but nutrient levels did not support organic impairment. Shibboleth Branch had evidence of nutrient input, such as total nitrogen and nitrate+nitrite-N at most stations in all seasons and elevated BIs downstream. Allert et al. (2009) found that conductivity and nutrients were significantly higher in mine sites than references. This may be evidence of continued mine input in the test streams.

The two impaired tributaries usually had lower discharge than all other tributaries and the controls. This low flow may have contributed to the impairment of Pond Creek #2 and Shibboleth Branch #3. Discharge, alone or combined with other factors, may have contributed to impairment of the two tributaries.

4.1.4 Dissolved Metals

Dissolved metals were detected in all Mill Creek tributaries in all seasons, however, none exceeded WQSs. Dissolved barium was found in all test stations at concentrations above control levels, regardless of season. Fountain Farm Branch continuously contributed zinc, while lead and nickel fluctuated between sample seasons. Pond Creek stations contributed dissolved zinc in the spring. Shibboleth Branch #3 had lead and nickel during the spring. Shibboleth Branch #2 was sampled three times and zinc was found in all samples. Lead was detected in two seasons, while nickel occurred only in the spring. Shibboleth Branch #1 contained lead, nickel, and zinc in the spring. Presence of these dissolved metals is evidence of continuous input of mine-related metals from the tributaries to Mill Creek, however, we did not find particular metals or outstanding concentrations only in the impaired tributaries. Because concentrations were low and not exclusively found in impaired tributaries, they were not obvious contributors to the impairment. However, the source of the dissolved metals should be identified.

4.1.5 Fine Sediment Coverage

Most Mill Creek tributaries had significantly greater ($p<0.05$) relative coverage of fine sediment than did the controls. Fountain Farm Branch, Pond Creek #2 and #1, and Shibboleth Branch #2 and #1 had significantly higher percentages of fine sediment than the median of controls. However, these streams were fully biologically supporting during both seasons and not apparently affected by high fine sediment. Pond Creek #2 and Shibboleth Branch #3 were partially supporting during all seasons, which may be associated with the relative percentage of fine sediment on the substrate.

At Pond Creek #2, approximately 90 percent of the bedrock was covered with a thin coating of fine sediment. The fine sediment seemed to be clay-like reddish material captured by the algae that covered the bedrock substrate. The fine sediment was much lower downstream at Pond Creek #1, but still significantly higher than the controls. The quantity of fine sediment is a potential contributor that may have altered community in the upstream station, as observed in the MSCI score. Coverage at station #1 was patchy and therefore not normally distributed. Evidence of this is found in the individual taxa lists, where the burrowing mayfly *Hexagenia* were found in the same station with *Isonychia*, a mayfly taxon that is intolerant to fine sediment (Zweig and Rabeni 2001).

Shibboleth Branch #3 did not have a statistically significantly different coverage of fine sediment compared to controls because of a high standard deviation. Fine sediment at Shibboleth Branch #3 was patchy, occurring in higher percentages (i.e. >90%) in some low flow areas as well as occurring in very low percentages in other areas. This patchiness led to a high standard deviation and non-normal distribution. On September 3, 2009, while conducting a SHAPP at Shibboleth Branch #3, we observed a coating of fine sediment covering most (approximately 70 percent average) of the substrate. This observation and the high standard deviation suggest that fine sediment coverage fluctuates at this station. These fluctuations in fine sediment may affect the ability of the stream to support the AQL designated use.

The fine sediment was significantly higher downstream in Shibboleth Branch. The sediment coverage and character extended downstream at Shibboleth Branch into WBID 2119. Both stations had heavy deposits of soil that continue nearly from bank to bank in two areas (Appendix D; shown during higher flow). Water willows have stabilized the majority of the areas, while the remainder is highly braided. The streams are fast flowing in these areas of deposition. Highly braided and fast flowing streams are not commonly found together without disturbance. These deposits do not appear to be from bank slumping because they extend from bank to bank, where the banks are relatively low or stable. The deposits could be remnants of past mining or from the Dresser barite dam failure in 1975, documented by Duchrow (1978). Alternatively, the fine sediment may have deposited during years of mining in the watershed. Regardless, mine-related material was found as a significant portion of the substrate in Shibboleth Branch and it could be contributing to the fine sediment bedload and metals laden material downstream to Mill Creek.

The presence of taxa such as *M. pulchellum*, *M. mediopunctatum*, *Caenis* sp., *Isonychia* sp., and hydopsychids in Shibboleth Branch #3, which are considered intolerant to fine sediment (Zwieg and Rabeni 2001), suggests that fine sediment alone may not be the consistent impairment source.

4.1.6 Fine Sediment Character

The fine sediment in the Mill Creek tributaries contained high levels of total cadmium, lead, or zinc that exceeded PECs. Fountain Farm Branch fine sediment exceeded the PECs for lead and zinc. Pond Creek #2 and #1 sediments exceeded the PEC for zinc. All three Shibboleth Branch stations contained fine sediment with high lead and zinc, while downstream #1 also had cadmium at twice the PEC. The metals of the fine sediment in the controls were not above PECs, suggesting these were not naturally occurring or background levels but are due to mining activity.

The TR and EPTT were much reduced from the metrics at most test stations and BIOREF streams, which may be indicators of fine sediment impairment (Zweig and Rabeni 2001) or heavy metal impairment (Rainbow 1996; Carlisle et al. 1999; Soucek et al. 2000; Clements et al. 2000; Poulton et al. 2009). The impaired tributaries usually had the lowest flow of all the tributaries and controls. Discharge, alone or combined with other factors such as metals in the sediment, may have contributed to the impairment. Pore water or interstitial water should be analyzed for metals concentrations and compared to acceptable limits.

4.2 Mineral Fork Tributaries

Mineral Fork tributaries included in this study are Salt Pines Creek and Trib. Old Mines Creek. Stream habitat assessments, macroinvertebrate community, water quality including dissolved metals, and fine sediment percentage and character are discussed in this section.

4.2.1 Stream Habitat Assessment

All stations in the Mineral Fork tributaries had SHAPP scores that were comparable to the controls. Salt Pines Creek and Trib. Old Mines Creek were above the 75 percent similarity with the mean of SHAPP controls. Both are very small streams.

4.2.2 Macroinvertebrate Community

Mineral Fork tributaries were continuously impaired during the study. Salt Pines Creek and Trib. Old Mines Creek had only partial support of the AQL designated use during both seasons. All of the individual metrics (TR, EPTT, BI, SDI) influenced the scores in the fall for both tributaries. Salt Pines Creek was again influenced by less than optimum individual metric scores in the spring. Trib. Old Mines was influenced by all metrics in the spring, with the exception of the BI. This suggests that it was probably not impaired by organic influences.

Again we saw a stream size influence when the control criteria scoring range was applied to Mineral Fork tributaries. Salt Pines Creek and Trib. Old Mines Creek did not change support category in the fall, as was observed in the Mill Creek tributaries. However, in the spring, MSCI scores increased at both tributaries. Salt Pines Creek increased its score but not enough to change support category. Trib. Old Mines increased from partial to the full support category. Again, this suggests that the size of the streams influenced the support category in the spring and that the macroinvertebrate community in small streams is different from larger wadeable streams. This suggests that small/headwater streams should be surveyed in each EDU to identify reference quality streams and generate separate criteria for appropriate comparisons.

4.2.3 General Water Quality

Physicochemical water quality at Mineral Fork tributaries was notable. Salt Pines Creek and Trib. Old Mines Creek had the highest conductivity of all test or control stations during both seasons. Conductivity has been shown to be significantly higher at mined sites than references (Allert et al. 2009). Conductivity, hardness, sulfate, and nitrogen ions are often elevated below mining sites and useful in identifying the extent of mining impacts (Gray 1998, Tiwary 2001; Allert et al. 2009). This again may be evidence of continued input from the upstream mined areas to the tributaries.

The two impaired streams consistently had very low discharge. Salt Pines Creek and Trib. Old Mines Creek consistently had the lowest discharge of all tributaries and controls. Discharge, alone or combined with other factors, may have contributed to the impairment.

4.2.4 Dissolved Metals

The tributaries within the Mineral Fork watershed contained dissolved metals above the controls but in low concentrations. Both Salt Pines Creek and Trib. Old Mines Creek receive a continuous input of dissolved barium in higher concentrations than the controls. Salt Pines contained lead during the fall and nickel in the spring. Trib. Old Mines Creek contained zinc during both seasons, lead in the fall, and nickel in the spring. None of the

dissolved metals concentrations exceeded WQSs (MDNR 2009c) during any season. These dissolved metals are indicators of mining and suggest there is a continuous influence into Old Mines Creek, a tributary of Mineral Fork. However, no metals or particular concentration were found exclusively in the impaired streams. This suggested that the fluctuating and low level dissolved metals we collected in the water column were not obvious contributors to impairment. Perhaps examinations closer to a potential source such as pore water or interstitial water may be important.

4.2.5 Fine Sediment Coverage

The fine sediment percentage that was observed on the substrate was not uniform between streams. Salt Pines Creek had approximately 17 percent coverage. Trib. Old Mines Creek had approximately 55 percent coverage on average, which was significantly higher ($p<0.05$) than the mean of controls. The relative coverage of fine sediment is a potential contributor to impairment (Zweig and Rabeni 2001), however, there is no obvious relation to the impaired stream segments exclusive of fully supporting tributaries.

4.2.6 Fine Sediment Character

The fine sediment that was present on the substrate contained total lead and zinc, far exceeding their respective PECs. Salt Pines did not have high amounts of fine sediment, but the sediment that was there had high barium as well as zinc far above the PEC. Trib. Old Mines Creek likewise had elevated lead and zinc, as much as four times higher than the respective PECs. Metals in the fine sediment of control streams were not above PECs, suggesting that the material with high concentrations was not naturally occurring or background levels. Presence of the metals may be attributed to mining activity and elevated metals may affect the macroinvertebrate community. Lower TR and EPTT found at both streams may be a result of fine sediment impairment (Zweig and Rabeni 2001) or heavy metal impairment (Rainbow 1996; Carlisle et al. 1999; Soucek et al. 2000; Clements et al. 2000; Poulton et al. 2009). Discharge, alone or combined with other factors such as metals in the fine sediment, may have contributed to the impairment. Pore water or interstitial water should be analyzed for metals concentrations and compared to acceptable limits.

Moreover, the metals contained in the substrate were also found in the dissolved fraction of the water column, but not consistently. The source and availability of metals should be examined. Poulton et al. (2009) found a good correlation between pore water cadmium, nickel, lead, and zinc and MSCI scores at mine area streams in the Viburnum Trend. Allert (et al. 2008) found elevated metals burdens in animals and benthos of the Black River watershed identifying the metals bioavailability. Pore water should be sampled and analyzed for metals concentration where PECs were exceeded.

4.3 Control Streams

The streams were chosen based on size, location, absence of known mining influences, and point sources. Several of the controls had less than optimum scores when compared to the larger BIOREF scoring ranges.

4.3.1 Stream Habitat Assessment

The streams used as controls scored well using the Stream Habitat Assessment Project Procedure (MDNR 2003d). The mean of the control scores was good at 156. Habitat appeared to be representative of relatively undisturbed streams. These streams may be used again as similar size SHAPP control streams.

4.3.2 Macroinvertebrate Community

Several control streams were considered to have partial support of the AQL designated use in both seasons. Brazil Creek was impaired during both seasons, yet had optimum BI values. In fact, all controls had optimum BIs during both seasons, with the exception of Shoal Creek which was close to the optimum. This clearly suggests that most of the streams were not impaired due to organic influences during either season. Courtois Creek was possibly impaired during both seasons; one duplicate in the fall lacked a single EPT taxa, which resulted in a reduced MSCI score. East Fork Huzzah did not reach the full support category in the spring. Overall, the TR, EPTT, and SDI were responsible for the lower scores.

Control stations contained dominant families that were not commonly found in the lower scoring test stations during both seasons. The generally intolerant ephemerellid mayflies and hydropsychid caddisflies were prevalent at controls, but not dominant at the lower scoring test streams. These were also dominant in Fountain Farm Branch and Pond Creek #1, which were among the higher scoring test stations. These taxa contributed to higher TR and EPT taxa and generally lower BI and SDI values at control stations. They also suggested that organic influences were probably not a contributor to lower scores at some controls.

We compared the BIOREF scoring range to the control criteria scoring range to identify differences in the macroinvertebrate community at small streams. We found that in the fall the small control streams had fewer taxa with a lower tolerance and lower diversity and evenness. In the spring, the control streams had fewer taxa with a lower tolerance, fewer EPT taxa, and less diversity and evenness than the larger BIOREF streams.

Changes in MSCI scores due to the different scoring range suggest that the four tributaries may not actually be impaired 1) when they are compared to high quality similar size reference streams, or 2) the controls may actually be poor quality small streams. As a great deal of care was taken to find controls with no known outfalls or barium mine influences upstream from the stations, it is unlikely that they were of poor quality. All controls had low BIs, except Shoal Creek in fall 2008, which was slightly above the optimum. That BIs at the controls were similar during both seasons suggests that they were not impaired by organic influences.

4.3.3 General Water Quality

Most controls had unremarkable water parameters. Water quality at Brazil Creek was a possible exception among the controls. Low concentrations of nitrate+nitrite-N and total nitrogen were found in the fall in Brazil Creek. This is only slightly higher than the other

controls, but the levels are higher than all tributaries. This may suggest that there is a nutrient influence upstream of the station. Brazil Creek had depressed TR, EPTT, and SDI, but the BI was in the optimum range, suggesting that organic input probably did not contribute to the impairment. All parameters were well within WQSs (MDNR 2009c).

4.3.4 Dissolved Metals

The controls had low concentrations of dissolved metals and were used to identify higher levels at tributaries. However, there were two stations with dissolved metals slightly elevated compared to the remainder of the controls. Nickel was found in low concentrations at one of the Brazil Creek duplicates and once in Shoal Creek in the spring. The results could indicate that there is an upstream influence or background that is not a consistent input. However, levels were below the PQL and the values were estimated. All other metals were low or not detected at these two streams and the remainder of the controls. Alternatively, these two controls may have a background metals or an upstream metals influence. Dissolved metals analyses should be conducted on control streams in areas where natural background metals or other possible sources may be confounding influences.

4.3.5 Fine Sediment Coverage and Character

The fine sediment at controls had low percent coverage and low metals concentrations. The mean coverage among the controls was approximately 19 percent, significantly less than all but two tributaries. The fine sediment found in these streams had low metals concentrations that were much lower than PECs. It appears that the controls did not have a fine sediment influence similar in percent coverage or metals character compared to the tributaries.

5.0 Summary

Because of the large number of tributaries of interest, results are summarized in this section. Support of the AQL designated use, change in MSCI using control criteria, water quality, dissolved metals, and fine sediment coverage and metals character are summarized for all tributaries.

<u>Fountain Farm Branch</u>

- Full support in both seasons using BIOREF criteria
- MSCI score slight decrease in spring using control stream criteria
- Continuous high conductivity, with chloride indicator of mining or wastewater
- Continuous dissolved barium and zinc, fluctuating lead and nickel
- Fine sediment significantly higher than controls
- Lead and zinc above PECs

Pond Creek #2

- Partial support in both seasons using BIOREF criteria
- MSCI score increased to full support in spring and a slight increase in fall using control stream criteria
- Conductivity fluctuated
- Continuous elevated dissolved barium concentrations while zinc fluctuated
- Fine sediment coverage significantly higher than controls
- Zinc above PEC in sediment

Pond Creek #1

- Full support in both seasons using BIOREF criteria
- MSCI slight decrease in fall using control stream criteria
- Continuous high conductivity
- Continuous elevated dissolved barium concentrations while zinc fluctuated
- Fine sediment coverage significantly higher than controls
- Zinc above PECs in sediment

Shibboleth Branch #3

- Partial support in both seasons using BIOREF criteria
- MSCI increased to full support in spring using control stream criteria
- Fluctuating conductivity low to high
- Continuous elevated dissolved barium in all seasons while lead and nickel fluctuated, occurring only in the spring sample
- Fine sediment not significantly different from controls
- Lead and zinc in sediment above PEC

Shibboleth Branch #2

- Full support in all three seasons using BIOREF criteria
- MSCI slight decrease in spring using control stream criteria
- Continuous high conductivity, elevated nutrients and chloride, fluctuating NFR
- Continuous elevated dissolved barium and zinc, lead two seasons, nickel occurred in the fall
- Lead and zinc in sediment above PECs

Shibboleth Branch #1

- Full support in both seasons using BIOREF criteria
- MSCI slight increase in fall using control stream criteria
- Continuous high conductivity, elevated nutrients and chloride
- Continuous elevated dissolved barium, fluctuating lead, nickel, and zinc
- Cadmium, lead, and zinc in sediment above PECs

Salt Pines Creek

- Partial support in both seasons using BIOREF criteria
- MSCI slight increase in spring using control stream criteria
- Continuous high conductivity
- Continuous elevated dissolved barium, fluctuating lead and nickel
- Lead and zinc in sediment above PECs

Trib. Old Mines Creek

- Partial support in both seasons using BIOREF criteria
- MSCI increased to full support in spring using control stream criteria
- Continuous high conductivity
- Continuous elevated dissolved barium, fluctuating lead, nickel, and zinc
- Lead and zinc in sediment above PECs

6.0 Conclusion

The objectives were met for this project. Stream habitat quality was similar between the tributaries and the controls. Pond Creek #2, Shibboleth Branch #3, Salt Pines Creek, and Trib. Old Mines Creek were continuously impaired. Impairment may be due to the small size of the tributaries, as these were the smallest of the tributaries tested. The MSCI scores increased enough in three of the four tributaries to change from partial to full support of the AQL designated use in the spring, when the metrics were compared with control criteria. Fall scores changed at some of the tributaries but not enough to change category. This suggests that these streams were not continuously impaired. It also backs up the contention that the impairment may have been due to comparisons of the small tributaries to the larger BIOREF streams. The small control streams had fewer TR, lower BI, lower SDI, and seasonally lower EPTT than the BIOREFs, showing a distinct difference based on size. Regardless, these four tributaries were impaired during one season. These four stations are also closest to mine tailings ponds.

It appears that all Mill Creek and Mineral Fork tributaries show evidence of mine-related activity. Consistently high conductivity, presence of dissolved metals such as barium, lead, nickel, and/or zinc, and increased nutrients may indentify mine-related activity in their watersheds. However, dissolved metals concentrations were low (below WQSs) and not found exclusively in impaired tributaries. The concentrations may fluctuate, but dissolved metals were not obvious contributors to the impairment during our visits.

The percent coverage of fine sediment was significantly higher than the controls at two of the four impaired tributaries. Sediment coverage appeared to fluctuate at one of the impaired tributaries, suggesting that the amount changes and it could have altered the community. The presence of taxa intolerant to fine sediment suggests that fine sediment alone may not be impairing the stream.

The fine sediment contained barium, cadmium, lead, and zinc above PECs and identified the mining influence at potentially damaging levels. However, the metals found in the impaired tributaries were also found in the fully supporting tributaries. Again, these

impaired tributaries were the smallest of the streams in the study, with the lowest discharge of the tributaries and controls. Concentrations of metals in the lower flow streams in the pore water or interstitial spaces may have contributed to the impairment.

Testing the null hypotheses resulted in the following:

1) Stream habitat quality was similar between tributaries and similar size control streams;

2) Biological metrics and MSCI scores were more similar between tributaries and control streams, but several of the tributaries were impaired compared to the BIOREFs;

3) Physicochemical water quality was similar between tributaries, however, some slight nutrient enrichment was evident at a few of the tributaries. Dissolved metals were slightly higher in tributaries compared to most controls;

4) The relative percent fine sediment coverage was greater at most tributaries than the controls;

5) Total barium, cadmium, lead, and zinc levels in the fine sediment were much higher in the tributaries than the controls; cadmium, lead, and zinc were found above PECS in the tributaries, but not in the controls.

7.0 Recommendations

1) Dissolved metals analyses should be conducted on control streams in areas where natural background metals or other possible sources may be confounding influences.

2) Small or headwater streams should be surveyed to identify reference quality streams and separate small stream criteria should be generated.

3) Pore water or interstitial water should be tested for cadmium, nickel, lead, and zinc in streams with metals above PECs.

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Appendix A

Biological and Sediment Assessment Study Plan of Barite Mining Effects on
Mill Creek and Mineral Fork Tributaries
Washington, Crawford, Dent, and Iron Counties
August 12, 2008

Missouri Department of Natural Resources
Field Services Division
Environmental Services Program
Water Quality Monitoring Section

August 12, 2008

Biological and Sediment Assessment Study Plan of Barite Mining Effects on Mill Creek and Mineral Fork Tributaries, Washington, Crawford, Dent, and Iron Counties

1.0 Background

The watersheds of Mill Creek and Mineral Fork have been extensively mined for barium in the past. In 1975, the collapse of a barite tailings pond released a significant amount of metals laden fine sediment into Shibboleth Creek, a tributary to Mill Creek (Duchrow 1978) and metal contamination in fish was found by Czarnezki and Trial (1997) in Mill Creek. The long-term impact of tailings and general barite mining on these tributaries is not known.

In the fall of 2005 and spring of 2006, the Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) conducted biological assessments on Mill Creek and Mineral Fork, Washington Counties (MDNR 2007a; MDNR 2007b). Mill Creek appeared to have a contribution of dissolved barium from watershed runoff. Mineral Fork had relatively high level of dissolved barium concentrations in the water, and a continuous low level of chloride; indicators of human wastewater influence or mine related activity.

The results of MDNR studies (2007a; 2007b) recommended that biological assessments and fine sediment studies be conducted on the tributaries of Mill Creek and Mineral Fork, Washington County. Specifically, biological assessments and fine sediment studies will be conducted on Mill Creek tributaries such as Fountain Farm Branch, Pond Creek, and Shibboleth Branch and Mineral Fork tributaries such as Old Mines Creek, Salt Pines Creek and an unnamed tributary.

2.0 Objectives

- Assess aquatic life protection designated use status of the macroinvertebrate community

- Document nutrient and dissolved metals levels in the tributaries and assess water quality (MDNR 2005).

- Identify the relative quantity of fine sediment per area; and quantify sediment metals content

- Assess the quality of stream habitat

2.1 Null Hypotheses

5. Biological metrics and Macroinvertebrate Stream Condition Index (**MSCI**) scores will be similar between test and control streams; as well as wadeable/perennial stream biological criteria.

6. Physicochemical water quality will be similar at all stations and parameters will meet the Water Quality Standards (**WQS**) of Missouri (MDNR 2005b).

7. The relative percent coverage of fine sediment observed in test streams will be similar to that of control streams.

8. Stream habitat quality will be similar between tributaries.

3.0 Study Design

The study area, biological assessment, fine sediment study, and stream habitat assessment are described below.

3.1 Study Area

The tributaries of Mill Creek, and Old Mines Creek, itself a tributary to Mineral Fork and the control streams are shown in Figure 1 and described in Table 1. Thirteen stations are allocated to this project. Seven stations will be used for the Mill Creek and Mineral Fork tributaries. Mill Creek tributaries stations include two on Shibboleth Branch, one on Fountain Farm Branch and two on Pond Creek. Mineral Fork or more specifically Old Mines Creek tributary stations include a tributary to Old Mines and Salt

Pines Creek. All streams are located in the Ozark/Meramec Ecological Drainage Unit (**EDU**).

Reference streams are listed in Table 1. All of the classified control streams have similar 5-parameter valley segment types (**VST**) relative to the majority of test streams with the exception of gradient. Most test streams were high gradient, whereas several of the controls are medium gradient. References/controls stations were also selected by having no known outfall or mining influence upstream in their watershed.

3.2 Biological Assessment

A biological assessment consists of macroinvertebrate community and physicochemical water evaluation.

3.2.1 Macroinvertebrate Sampling and Analyses

As specified in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP,** MDNR 2003d), macroinvertebrates will be sampled from three specific habitats. These target habitats are based on stream type (MDNR 2003d). The tributaries are considered riffle/pool dominant streams in which flowing water over coarse substrate, non-flowing water over depositional substrate and rootmat habitats will be sampled. Macroinvertebrates will be subsampled according to the SMSBPP and identified to specific taxonomic levels (MNDR 2005a) in order to calculate metrics in a standardized fashion (MDNR 2003d; MDNR 2005a).

Macroinvertebrate community data will be analyzed using three strategies. Macroinvertebrate Stream Condition Index scores, individual biological criteria metrics, and dominant macroinvertebrate families will be examined and compared between test and reference streams.

3.2.2 Data Recording and Analyses

Macroinvertebrate data will be entered in a Microsoft Access database in accordance with Quality Control Procedures for Data Processing, MDNR-WQMS-214 (MDNR 2003b). Data analysis is automated within the Access database. A total of four standard metrics will be calculated for each sample reach according to the SMSBPP: Taxa Richness (TR); Ephemeroptera,

Plecoptera, Trichoptera Taxa (EPTT); Biotic Index (BI); and the Shannon Diversity Index (SDI).

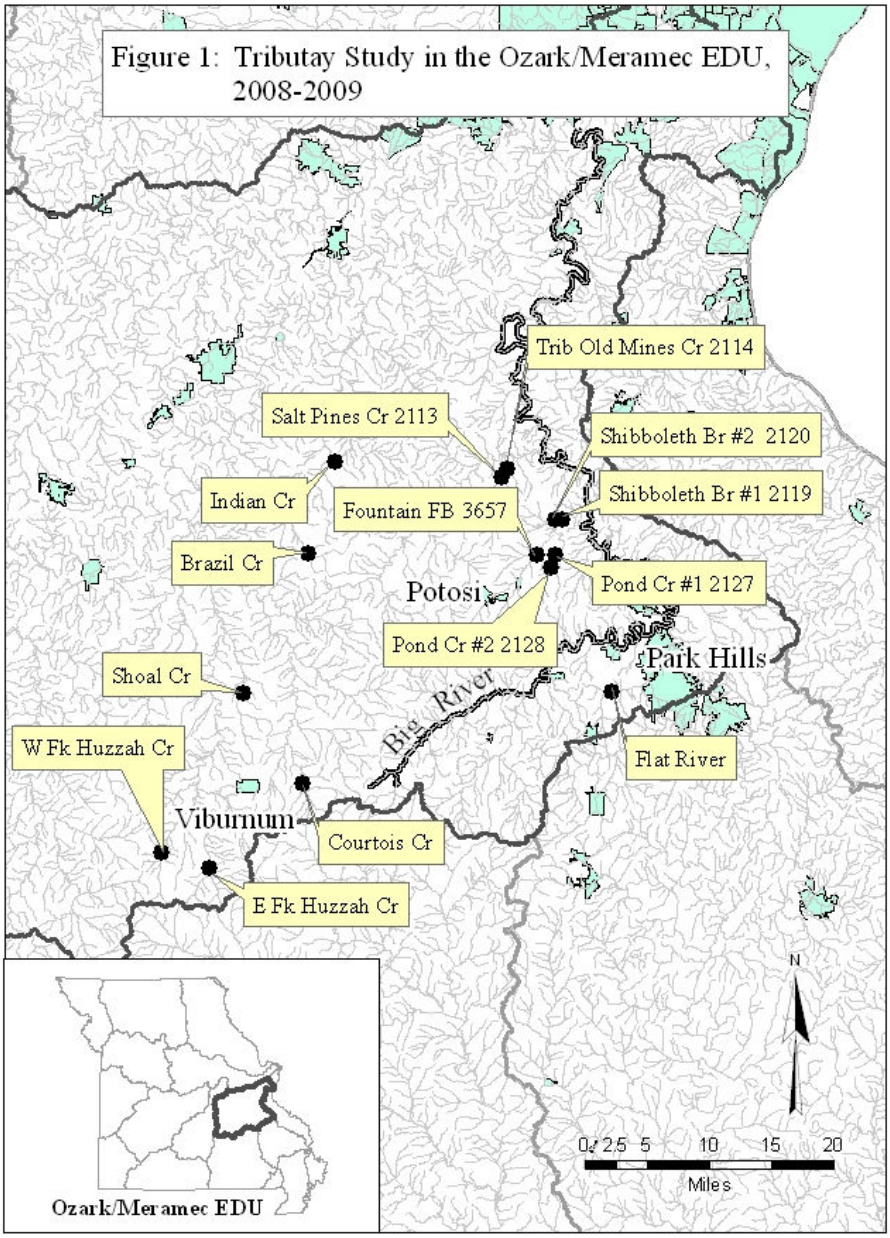


Table 1 Sampling Station Location

Station	County	Location	Description; WBID	Purpose
Trib. Old Mines Cr	Washington	NW Sec. 30; T. 39N., R3E E698562 N4216811	North/Downstream of MO Hwy 21; 2114	Test
Salt Pines Creek	Washington	NE Sec. 31; T. 39NR3E E697830 N4215928	North/Downstream of MO Hwy 21; 2113	Test
Shibboleth Branch #2	Washington	NW Sec. 14; T. 38N., R3E. E704807 N4210506	End Johnson Road; 2120	Test
Shibboleth Branch #1	Washington	NW Sec. 13; T. 38N.,R.3E. E705671 N4210490	Bridge Johnson Road; 2119	Test
Pond Creek #2	Washington	NE Sec.3; T. 37N.,R.3E. E703719 N4203308	Downstream Pond Creek Road; 2128	Test
Pond Creek #1	Washington	NW Sec. 35; T.38N.,R.3E. E704868 N4205941	Upstream confluence with Mill Creek; 2127	Test
Fountain Farm Br #1	Washington	NE Sec. 33; T.38N.,R.3E. E702139 N4205858	Upstream confluence with Mill Creek; 3657	Test
Brazil Creek	Washington	NE Sec. 28; T.38N.,R1W. E672696 N4206120	USFS-Brazil Creek Campground	Control
Shoal Creek	Crawford	NW Sec. 22; T.36.N.,R2W E663955 N4187505	USFS -Big Shoal Cr. Rd. ca.3 miles NE Davisville	Control
Indian Creek	Washington	SW Sec. 24; T.39.N.,R. 1W. E676305 N4217749	Downstream MO Hwy 185	Alternate Control
West Fork Huzzah Creek	Dent	SW Sec. 15; T.34 N.,R.3 W. E653573 N4166719	USFS-Downstream MO Hwy 32 at Howes Mill, MO	Control
East Fork Huzzah Creek	Dent	SW Sec. 20; T.34.N.,R.2 W. E659956 N4164882	Downstream LWB app. 2mi S on AC at Boss, MO	Control
Flat River	St. Francois	SW Sec. 21. T. 36N.,R. 4E. E710789 N4187399	Downstream Old Irondale Road	Alternate Control
Courtois Creek	Iron	SW Sec. 28; T. 35N.,R. 1W. E672115 N4175783	Downstream CR80A @ Goodwater, MO	Control

LWB = low-water bridge; CR = county road; MO = Missouri; USFS= US Forest Service

4.0 Physicochemical Water Sampling and Analyses

Physicochemical water samples were handled according to the appropriate MDNR, Standard Operating Procedure (**SOP**) and/or Project Procedure (**PP**) for sampling and analyzing physicochemical water samples. Results for physicochemical water parameters will be examined by season and station.

Fall 2008 and spring 2009 physicochemical water samples will either be measured *in-situ* or collected as grab samples and analyzed at the Environmental Services Program laboratory. Temperature (C^o), pH, conductivity (uS), dissolved oxygen (mg/L), and discharge in cubic feet per second (**cfs**) will be measured *in-situ*. Grab samples will be collected and handled according to the SOP MDNR-FSS-001 Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2003c). All samples will be kept on ice during transport to ESP. Turbidity samples (NTU) will be measured and recorded in the WQMS biology laboratory. The ESP, Chemical Analysis Section (**CAS**) will conduct analyses for hardness (mg/L), ammonia-nitrogen (mg/L), nitrate+nitrite-nitrogen (mg/L), total nitrogen (mg/L), chloride (mg/L), total phosphorus (mg/L), and dissolved metals. Dissolved metals samples will include barium, cadmium, calcium, cobalt, copper, lead, magnesium, nickel, and zinc. Samples for metals will be filtered in the field.

Physicochemical results will be compared between stations from upstream to downstream, as well as with Missouri's WQS (MDNR 2005b). Interpretation of acceptable limits in the WQS may be dependent on a stream's classification and its beneficial-use designation (MDNR 2005b). The majority of tributaries are class "C" streams with designated uses for AQL, LWW, and WBC-category B. Furthermore, acceptable limits for some parameters, such as dissolved metals, may be dependent on the rate of exposure. These exposure or toxicity limits are based on the lethality of a toxicant given long-term exposure (chronic toxicity, **c**) or short-term exposure (acute toxicity, **a**).

4.1 Discharge

Stream flow will be measured at each station using a Marsh-McBirney Flowmate™ flow meter. Velocity and depth measurements will be recorded at each station according to SOP MDNR-WQMS-113 Flow Measurement in Open Channels (MDNR 2003a).

4.2 Data Reporting

Water quality data will be entered in the Laboratory Information Management System (LIMS) database. Results of the study will be summarized and interpreted in report format.

5.0 Fine Sediment

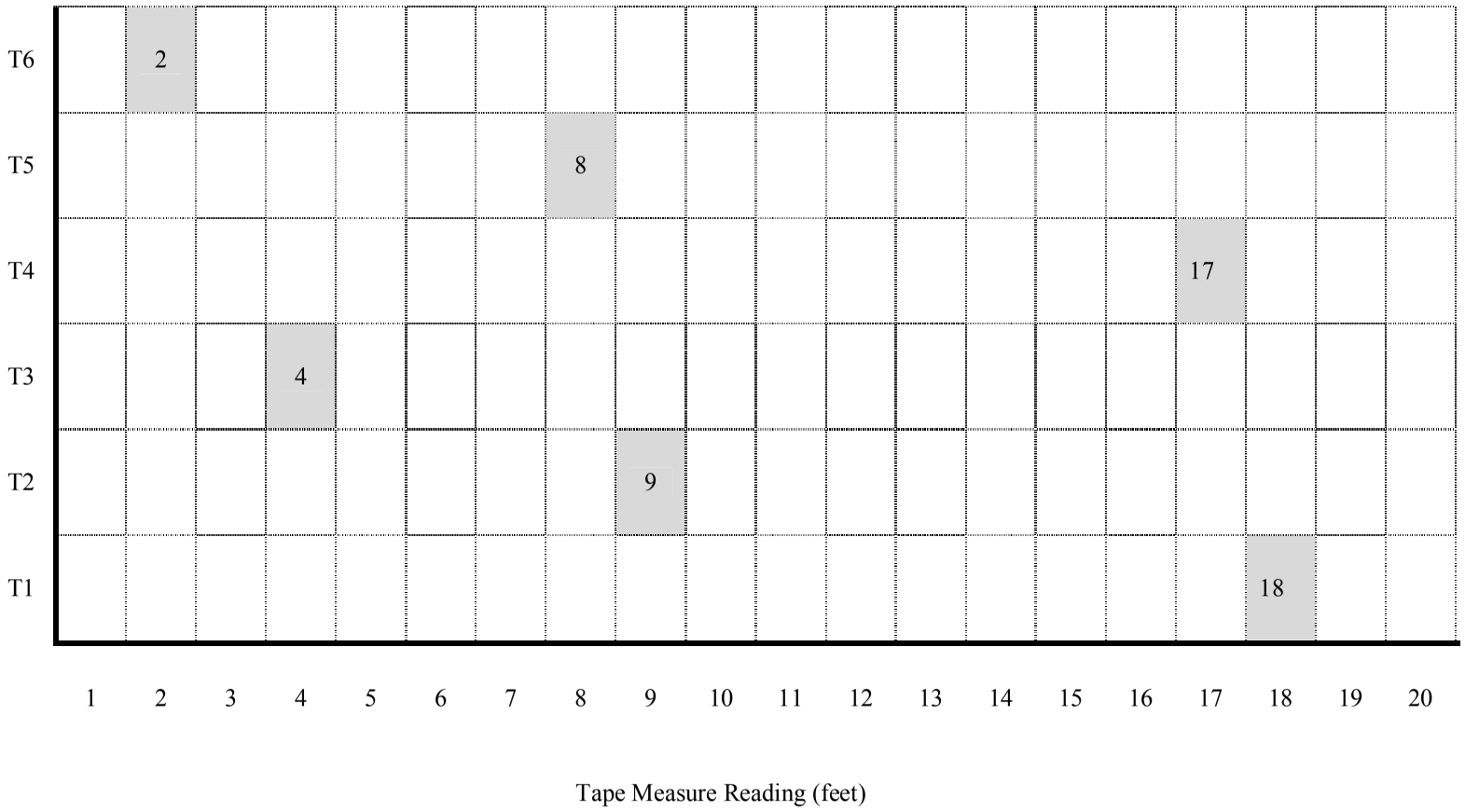
In-stream deposits of fine sediment (e.g. particle size ca. <2 mm) will be estimated for percent coverage and characterized for composition of total recoverable metals (**TR**, ug/kg). This will be done once in September 2008.

5.1 Fine Sediment Percent Coverage

The relative percentage of fine sediment will be estimated and characterized for each station. Each sampling station will contain three sediment estimation areas called **grids**. In order to ensure sampling method uniformity, grids will be located between the downstream margin of a riffle or run and the upstream margin of a pool. Depths of the sample areas will not exceed two (2.0) feet and water velocity will be less than 0.5 feet per second (fps). A Marsh McBirney flow meter will be used to ensure that water velocity of the sample area will be within this range.

The percentage of fine sediment will be estimated at each station by constructing a virtual grid of potential **quadrats** (Figure 2). A tape measure will be anchored from bank to bank that comprises the downstream edge of each grid. Each grid consists of six contiguous transects that traverse the stream. One sample quadrat (ca. 10” x 10”) will be randomly placed directly on the substrate within each of the six transects. Placement of the quadrat within each transect will be determined by using a random number that equates to one foot increments from one bank. The trailing edge of the quadrat will be placed on the downstream transect edge. Two investigators will estimate the percentage of the stream bottom that consists of fine sediment sized particles within each quadrat. The estimates will be accepted if the two observations are within a ten percent. If estimates diverged more than ten percent, the investigators will repeat the process until the estimates are within the acceptable margin of error. An average of these two estimates will be recorded and used for analyses.

Figure 2: Grid of transects (T) and quadrats (in gray, numbered) used in estimating percent fine sediment; Example: stream 20' wide; quadrat placement based on random numbers (e.g. 18, 9, 4, 17, 8, and 2).



5.2 Fine Sediment Metals Characterization

Fine sediment will be characterized for metals by determining its content of total recoverable barium, lead, cadmium, and zinc (ug/kg). One composite sample of the fine sediment will be collected at each grid for a total of three samples per station. Each composite consists of three (3) two-ounce samples of fine sediment sized particles that will be dredged from the substrate and placed into an eight ounce clear glass jar.

Dredging will not exceed a depth of two inches. The lid of the two-ounce jar will be used to retain the fine sediment while retrieving the sample through the water column. If fine sediment is not found in sufficient quantities within the grid, a representative composite collection will be taken from an area near the study grid. Samples will be kept on ice and delivered to the ESP CAS in Jefferson City, Missouri for analyses.

5.3 Fine Sediment Data Analyses

Statistical analyses of the percentage of fine sediment found in the substrate will be conducted using Sigmastat Version 3.5 (2006). Kruskal-Wallis One Way Analysis of Variance on ranks (ANOVA on ranks) will be used to determine significant differences between sample stations. If significant differences ($p<0.05$) are detected between stations, an All Pair-wise Multiple Comparison Procedure Tukey Test will be conducted to identify where differences ($p<0.05$) are found. Each station's data ($n=18$ quadrats) will be included in the comparison between stations. Two hundred thirty four quadrat observations will be included for the 13 sample tributaries.

Statistical analyses for metals content (character) between stations will also be conducted using Kruskal-Wallis ANOVA on ranks. Since each station consists of three composite samples, each stations' data ($n=9$) will be used in the analysis. Significant differences ($P<0.05$) will be identified as before. Dunn's test or other comparison procedures may be used to determine where differences occur.

6.0 Quality Control

Quality control will be used as stated in the MDNR Standard Operating Procedures and Project Procedures.

7.0 Stream Habitat Assessment

Stream habitat will be assessed as outlined in the Stream Habitat Assessment Project Procedure (**SHAPP**) for Riffle/Pool prevalent streams (MDNR 2003d). The SHAPP assesses the quality of the stream habitat and the potential influence habitat might have on the aquatic biological community. Stream habitat quality is scored for each station and the test scores are compared with mean SHAPP reference station scores. Stream habitat scores will also be compared between tributaries.

8.0 Literature Cited

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MDNR. 2007b. Biological Assessment Report: Mineral Fork, Washington County, 2005-2006. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102-176. 19 pp + Appendices.

Appendix B

Macroinvertebrate Bench Sheet Report for Tributaries and Control Streams
Fall 2008 – Spring 2009 – Fall 2009

Order: Fountain Farm Branch, Pond Creek, Shibboleth Branch,
Salt Pines Creek, Trib. Old Mines Creek, Brazil Creek, Courtois Creek, East Fork
Huzzah Creek, West Fork Huzzah Creek, Shoal Creek

Aquid Invertebrate Database Bench Sheet Report
Fountain Farm Br [0804106], Station #1, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	7	18	1
AMPHIPODA			
Hyalella azteca		1	28
BRANCHIOBDELLIDA			
Branchiobdellida	1		1
COLEOPTERA			
Berosus		1	
Dubiraphia	7	15	14
Ectopria nervosa	7	20	4
Helichus basalis	2		5
Heterosternuta	1	1	3
Lutrochus	1	2	
Neoporus			1
Optioservus sandersoni	6	3	4
Paracymus			1
Psephenus herricki	1	6	
Stenelmis	9	2	
DECAPODA			
Orconectes hylas		1	
Orconectes luteus			-99
Orconectes medius	7	1	
Orconectes punctimanus		5	-99
Orconectes virilis			-99
DIPTERA			
Ablabesmyia		6	
Atherix	1		
Caloparyphus		2	
Chironomidae			1
Cladotanytarsus	1		1
Corynoneura	1	1	1
Cricotopus/Orthocladius	3	2	2
Dolichopodidae	1		
Eukiefferiella	2		
Forcipomyiinae	1		
Gymnometriocnemus			1
Hemerodromia			1
Labrundinia		1	
Microtendipes	4	2	
Parakiefferiella	1		
Parametriocnemus	2		

Aquid Invertebrate Database Bench Sheet Report
Fountain Farm Br [0804106], Station #1, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Paratanytarsus			1
Phaenopsectra		2	
Polypedilum convictum	4		
Polypedilum illinoense grp			4
Pseudochironomus	3	2	
Rheotanytarsus	5		11
Simulium	103		
Stempellinella	11	10	4
Tabanus	1		
Tanytarsus	4	2	6
Thienemanniella	2		3
Thienemannimyia grp.	3	3	5
Tipulidae	2		
Zavrelimyia		1	
EPHEMEROPTERA			
Baetis	15	2	
Baetisca lacustris		1	
Caenis anceps	69	65	42
Caenis latipennis	118	43	87
Callibaetis			2
Choroterpes		1	
Ephemera simulans		4	
Eurylophella	3	14	21
Isonychia bicolor	11		
Leptophlebiidae	1	6	5
Maccaffertium mediopunctatum	1		
Maccaffertium pulchellum	44	1	2
Stenacron	30	11	1
Stenonema femoratum	12	14	1
Tricorythodes	5		
HEMIPTERA			
Rhagovelia	1		
ISOPODA			
Caecidotea	6	2	9
LIMNOPHILA			
Gyraulus	2		
MEGALOPTERA			
Corydalus	1		
MESOGASTROPODA			
Elimia	2	3	
ODONATA			

Aquid Invertebrate Database Bench Sheet Report
Fountain Farm Br [0804106], Station #1, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Argia	5	5	1
Calopteryx		2	4
Enallagma			2
Gomphidae		5	1
Gomphus	3		
Hagenius brevistylus		2	1
Ischnura			2
Stylogomphus albistylus		1	
PLECOPTERA			
Acroneuria	2		
TRICHOPTERA			
Cheumatopsyche	15		
Chimarra	1		
Helicopsyche	2		
Hydropsyche	2		1
Limnephilidae	1		
Triaenodes			4
TUBIFICIDA			
Enchytraeidae	2	1	
Tubificidae	1		
VENEROIDA			
Pisidiidae	2		

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804107], Station #2, Sample Date: 9/24/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	1	16	1
AMPHIPODA			
Gammarus	4		9
COLEOPTERA			
Dubiraphia	1	13	92
Ectopria nervosa	3	1	
Optioservus sandersoni	1		4
Psephenus herricki	1		
Stenelmis	1		
DECAPODA			
Orconectes medius	2		
Orconectes punctimanus		-99	
Orconectes virilis			-99
DIPTERA			
Ablabesmyia		3	3
Ceratopogoninae		4	2
Chironomidae	2		2
Chrysops			1
Coelotanypus			2
Corynoneura	1	1	
Cricotopus bicinctus		1	1
Cricotopus/Orthocladius	16	2	
Cryptochironomus		1	
Dicrotendipes		1	
Ephydridae		-99	
Epoicocladius	1		
Forcipomyiinae	1		
Hemerodromia	3		23
Labrundinia		2	1
Micropsectra		1	
Microtendipes		6	1
Natarsia	1		
Parakiefferiella	2	8	
Paralauterborniella			1
Parametriocnemus	1		
Paratanytarsus			4
Paratendipes	1		
Phaenopsectra		2	3
Polypedilum aviceps	3		
Polypedilum illinoense grp	2	1	4

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804107], Station #2, Sample Date: 9/24/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum scalaenum grp	1		
Rheotanytarsus	17	1	
Simulium	9		
Stempellinella	20	11	1
Tanytarsus	7	22	4
Thienemanniella	6		1
Thienemannimyia grp.	3	1	4
Tipulidae	3	1	
Tribelos	3	14	1
EPHEMEROPTERA			
Baetis	4		
Caenis anceps	2		
Caenis latipennis	193	171	63
Ephemera simulans	9	1	1
Eurylophella	1	1	4
Heptageniidae	16	4	
Hexagenia limbata			2
Isonychia bicolor	14		
Leptophlebiidae		1	2
Maccaffertium pulchellum	24		
Stenacron	21		
Stenonema femoratum		1	
HEMIPTERA			
Microvelia	1		1
Rhagovelia	-99		2
ISOPODA			
Caecidotea	12	2	15
LEPIDOPTERA			
Petrophila	1		
LUMBRICINA			
Lumbricina	5		
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis	3		
Sialis		-99	1
ODONATA			
Argia	8	1	3
Calopteryx			9
Gomphidae	1		
Hagenius brevistylus		5	2

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804107], Station #2, Sample Date: 9/24/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
TRICHOPTERA			
Cheumatopsyche	24	1	
Hydropsyche	8		
Limnephilidae		1	3
Oecetis			4
Polycentropus	3		2
Triaenodes			11
TUBIFICIDA			
Aulodrilus	1	2	1
Tubificidae	10	18	1
VENEROIDA			
Pisidiidae	1	4	4

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804105], Station #1, Sample Date: 9/24/2008 10:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	15	7	17
AMPHIPODA			
Gammarus		-99	1
Hyalella azteca			24
BRANCHIOBDELLIDA			
Branchiobdellida	6		3
COLEOPTERA			
Dubiraphia		80	30
Ectopria nervosa	1		1
Helichus lithophilus			2
Heterosternuta			1
Microcylloepus pusillus			5
Optioservus sandersoni	35	1	1
Psephenus herricki	15	7	
Stenelmis	9	1	18
DECAPODA			
Orconectes		1	
Orconectes hylas	1		2
Orconectes luteus	1		
Orconectes medius	5	1	
Orconectes punctimanus			1
DIPTERA			
Ablabesmyia		2	2
Caloparyphus		1	
Ceratopogoninae		2	6
Cladotanytarsus		1	
Corynoneura	2		2
Cricotopus bicinctus	1		2
Cricotopus/Orthocladius	9	1	2
Cryptochironomus		2	
Hemerodromia	4		2
Labrundinia		2	6
Nanocladius		1	
Natarsia		3	
Parakiefferiella		9	
Parametriocnemus	2		2
Paratanytarsus			6
Phaenopsectra			1
Polypedilum convictum	3		

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804105], Station #1, Sample Date: 9/24/2008 10:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum illinoense grp			6
Pseudochironomus		2	
Rheocricotopus			2
Rheotanytarsus	14		6
Simulium	28		8
Stempellina		1	
Stempellinella	1	14	
Stenochironomus	1		
Tabanus	3	1	
Tanytarsus	2	8	2
Thienemanniella	3		
Thienemannimyia grp.		1	2
Tipula	1		
Tipulidae			2
Tribelos		3	
EPHEMEROPTERA			
Acentrella	4		
Baetis	17		
Baetisca lacustris		1	
Caenis anceps	17	52	3
Caenis latipennis	20	30	24
Centroptilum		3	2
Ephemera		1	
Eurylophella	17	23	39
Heptageniidae	56	1	1
Isonychia bicolor	68		1
Leptophlebiidae		8	3
Maccaffertium mediopunctatum	15		
Maccaffertium pulchellum	47		1
Procloeon			2
Stenacron	8	9	
Stenonema femoratum		16	1
Tricorythodes	5		
HEMIPTERA			
Metrobates			2
Microvelia			2
ISOPODA			
Caecidotea	1	1	8
LEPIDOPTERA			
Petrophila	1	1	
LIMNOPHILA			

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804105], Station #1, Sample Date: 9/24/2008 10:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Fossaria		1	
Laevapex	1		
Menetus			1
LUMBRICINA			
Lumbricina	8		1
MEGALOPTERA			
Corydalus	5		1
Nigronia serricornis	6	1	
Sialis		1	
MESOGASTROPODA			
Elimia	6		1
ODONATA			
Argia	6	6	12
Calopteryx			3
Enallagma			8
Gomphus			2
Hagenius brevistylus		1	
Hetaerina			1
Macromia		-99	-99
Stylogomphus albistylus	71	3	1
PLECOPTERA			
Acroneuria	2		
Chloroperlidae	1		
Leuctra	2		
TRICHOPTERA			
Ceratopsyche morosa grp	6		
Cheumatopsyche	54		11
Chimarra	7		7
Helicopsyche	2	2	1
Hydropsyche			2
Leptoceridae		1	
Limnephilidae		1	
Oecetis		1	2
Polycentropus	4		4
Psychomyia	1		
Triaenodes			3
TRICLADIDA			
Planariidae	9		
TUBIFICIDA			
Aulodrilus		2	

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0804105], Station #1, Sample Date: 9/24/2008 10:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Enchytraeidae	1		
Tubificidae		5	
VENEROIDA			
Pisidiidae		4	

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804109], Station #2, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	6	9	8
COLEOPTERA			
Dubiraphia		14	24
Ectopria nervosa	1		
Lutrochus	1		
Macronychus glabratus			6
Microcylloepus pusillus	5		
Optioservus sandersoni	15	1	2
Psephenus herricki	1		
Stenelmis	6		15
DECAPODA			
Orconectes		1	
Orconectes harrisonii	-99	-99	
Orconectes luteus		-99	
Orconectes medius	-99	-99	
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia			1
Cardiocladius	4		
Ceratopogoninae	1	3	2
Chironomidae	2		
Cladotanytarsus			1
Clinotanypus			2
Corynoneura	1		1
Cricotopus bicinctus			5
Cricotopus/Orthocladius	19	3	
Dicrotendipes			1
Eukiefferiella	4		
Hemerodromia	7	2	4
Labrundinia			2
Microtendipes		1	1
Parakiefferiella		1	4
Parametriocnemus	9		
Paraphaenocladius		1	
Paratanytarsus		1	9
Phaenopsectra		5	2
Polypedilum convictum	14	1	
Polypedilum halterale grp			1
Polypedilum illinoense grp		4	3

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804109], Station #2, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Rheocricotopus	8		
Rheotanytarsus	10		4
Simulium	79		2
Stempellinella	23	24	6
Stenochironomus			1
Tanytarsus	5	10	10
Thienemanniella	1	8	2
Thienemannimyia grp.	2		1
Tipulidae	1		
Zavrelimyia		1	2
EPHEMEROPTERA			
Acentrella	1		
Baetis	21		1
Caenis anceps	16	9	1
Caenis latipennis	58	142	54
Callibaetis			1
Ephemera	2	3	
Eurylophella	3	2	5
Heptageniidae	8	5	1
Hexagenia			5
Isonychia bicolor	93		
Leptophlebiidae	1	1	4
Maccaffertium mediopunctatum	3		
Maccaffertium pulchellum	27	4	
Stenacron	6	13	
Stenonema femoratum		7	
Tricorythodes			2
ISOPODA			
Caecidotea	108	9	41
LEPIDOPTERA			
Petrophila	1		
LIMNOPHILA			
Ancylidae	1		
Fossaria		1	
Menetus			4
LUMBRICINA			
Lumbricina	2		
MEGALOPTERA			
Corydalus	2		
Nigronia serricornis	4		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804109], Station #2, Sample Date: 9/24/2008 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Sialis		-99	
ODONATA			
Argia	4	3	6
Calopteryx	1	-99	3
Enallagma			7
Gomphus			-99
Hagenius brevistylus		2	3
Macromia		-99	
Stylogomphus albistylus	2	2	
PLECOPTERA			
Acroneuria	1		
TRICHOPTERA			
Ceratopsyche morosa grp	1		
Cheumatopsyche	40		2
Chimarra	59		
Limnephilidae			9
Oecetis			6
Polycentropus			3
Pycnopsyche			1
Triaenodes		1	11
TRICLADIDA			
Planariidae	4		1
TUBIFICIDA			
Branchiura sowerbyi		1	
Tubificidae		8	
VENEROIDA			
Pisidiidae	2		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804108], Station #1, Sample Date: 9/25/2008 11:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	6		1
AMPHIPODA			
Hyalella azteca	1	2	11
COLEOPTERA			
Dubiraphia	2	12	34
Ectopria nervosa	1	1	1
Helichus basalis			2
Optioservus sandersoni	4	1	2
Psephenus herricki	3	3	
Stenelmis	25	2	12
DECAPODA			
Orconectes harrisonii			1
Orconectes hylas	1		
Orconectes luteus	-99		
Orconectes medius	-99	-99	
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		6	1
Antocha	1		
Ceratopogoninae	1	3	
Chironomus		1	
Cladotanytarsus		2	
Corynoneura		1	1
Cricotopus/Orthocladius	1		
Dicrotendipes	1		
Epoicocladius	1		
Hemerodromia	5	1	
Labrundinia		1	6
Mesosmittia			1
Nanocladius			1
Natarsia		10	
Nilotanypus	1		
Parakiefferiella	2		
Parametriocnemus	8		
Paratanytarsus		1	1
Phaenopsectra		3	1
Polypedilum convictum	1		
Pseudochironomus		2	
Rheotanytarsus	4		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804108], Station #1, Sample Date: 9/25/2008 11:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Simulium	25		
Stempellinella	12	6	2
Stictochironomus		2	
Stratiomys	-99		
Tabanus	-99		
Tanytarsus	11	6	10
Thienemanniella	7		1
Thienemannimyia grp.	1	1	2
Tribelos		1	
EPHEMEROPTERA			
Baetis	26		
Caenis anceps	21	8	
Caenis latipennis	212	90	93
Ephemera simulans	5	3	
Ephemeridae		3	3
Eurylophella	9	1	4
Heptageniidae	32	3	
Isonychia bicolor	32		-99
Leptophlebiidae	1		13
Maccaffertium mediopunctatum	5		
Maccaffertium pulchellum	30		
Procloeon		4	
Stenacron	7	13	2
Stenonema femoratum	2	3	1
Tricorythodes	13		
HEMIPTERA			
Microvelia			2
Rhagovelia	7		2
Trepobates		1	
ISOPODA			
Caecidotea	54	15	44
Caecidotea (Blind & Unpigmented)		2	
LEPIDOPTERA			
Parapoynx	-99	1	
LIMNOPHILA			
Menetus			1
LUMBRICINA			
Lumbricina	1		
MEGALOPTERA			
Nigronia serricornis	-99		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0804108], Station #1, Sample Date: 9/25/2008 11:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Sialis		1	
ODONATA			
Argia	5	7	6
Enallagma			11
Gomphidae		4	
Hagenius brevistylus			-99
Macromia		1	
Stylogomphus albistylus		1	
PLECOPTERA			
Acroneuria	2		
RHYNCHOBDELLIDA			
Glossiphoniidae	1		
TRICHOPTERA			
Cheumatopsyche	19		
Chimarra	2		
Helicopsyche	4		
Hydropsyche	1		
Limnephilidae			1
Oecetis			4
Polycentropus	4	2	
Triaenodes			13
TRICLADIDA			
Planariidae	1		
TUBIFICIDA			
Branchiura sowerbyi	2	15	
Tubificidae		13	2
VENEROIDA			
Corbicula	1	2	
Pisidiidae	4	1	

Aquid Invertebrate Database Bench Sheet Report
Salt Pines Cr [0804103], Station #1, Sample Date: 9/23/2008 11:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	2	4	1
BRANCHIOBDELLIDA			
Branchiobdellida	2		3
COLEOPTERA			
Dubiraphia	1	13	58
Ectopria nervosa	1	3	
Heterosternuta	2		
Optioservus sandersoni	5		1
Psephenus herricki	5		1
Stenelmis	8	1	1
DECAPODA			
Orconectes hylas	7	2	
Orconectes medius	2		
Orconectes punctimanus	-99		
DIPTERA			
Chironomidae	1		2
Corynoneura		6	9
Cricotopus/Orthocladius	2		1
Diptera			1
Eukiefferiella	3		1
Labrundinia		1	
Nilotanypus			1
Parametriocnemus	7		
Paratanytarsus			1
Phaenopsectra			1
Polypedilum convictum	3		
Polypedilum illinoense grp	2	1	2
Polypedilum scalaenum grp			1
Rheocricotopus			2
Rheotanytarsus	5	1	10
Simulium	9		6
Stempellinella	5		1
Tabanus	1		
Tanytarsus	3		1
Thienemanniella	6		7
Thienemannimyia grp.	2		1
Tipulidae		1	
Zavrelimyia		3	
EPHEMEROPTERA			

Aquid Invertebrate Database Bench Sheet Report
Salt Pines Cr [0804103], Station #1, Sample Date: 9/23/2008 11:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Baetis	17		1
Caenis anceps		1	
Caenis latipennis	47	130	72
Choroterpes		1	
Ephemeridae		1	
Eurylophella	1	5	51
Heptageniidae	22	2	2
Isonychia bicolor	10		
Leptophlebiidae	1	5	8
Maccaffertium pulchellum	10		
Procloeon		1	
Stenacron	8	14	1
Stenonema femoratum	3	13	
HEMIPTERA			
Microvelia			1
Ranatra kirkaldyi			1
Rhagovelia			1
ISOPODA			
Caecidotea	386	77	58
LIMNOPHILA			
Physella			1
LUMBRICINA			
Lumbricina	-99		
MEGALOPTERA			
Chauliodes			1
ODONATA			
Argia		1	
Calopteryx	1	3	3
Enallagma		1	5
Gomphidae	3		
Stylogomphus albistylus		1	
PLECOPTERA			
Acroneuria	7	2	
TRICHOPTERA			
Cheumatopsyche	8		1
Chimarra	8		2
Helicopsyche		1	
Hydropsyche	1		
Polycentropodidae	1		
Triaenodes			2

Aquid Invertebrate Database Bench Sheet Report
Salt Pines Cr [0804103], Station #1, Sample Date: 9/23/2008 11:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
TRICLADIDA			
Planariidae	2		
TUBIFICIDA			
Spirosperma	1		
Tubificidae	4	2	

Aquid Invertebrate Database Bench Sheet Report
Trib. Old Mines Cr [0804102], Station #1, Sample Date: 9/23/2008 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	2	13	
AMPHIPODA			
Gammarus	10	3	11
COLEOPTERA			
Dubiraphia		1	41
Dytiscidae		1	
Ectopria nervosa	11	5	
Hydrobius	1		
Scirtidae			2
Stenelmis	8	9	1
DECAPODA			
Orconectes medius	-99		
DIPTERA			
Ablabesmyia		5	1
Ceratopogoninae		1	1
Cricotopus/Orthocladius	1		
Dicrotendipes			1
Diptera	1	1	
Eukiefferiella	1		
Forcipomyiinae		1	
Hemerodromia	11		2
Hexatoma		1	1
Labrundinia		1	
Natarsia		4	
Nemotelus	1		
Nilotanypus			1
Parametriocnemus	12		
Paratanytarsus			2
Polypedilum convictum	16		
Pseudolimnophila		1	
Rheocricotopus	5		
Rheotanytarsus	6		
Simulium	30	1	
Stempellinella		5	
Tanytarsus	2	4	5
Thienemanniella	4		
Thienemannimyia grp.	2		1
Tipulidae	5		
Zavrelimyia		2	1

Aquid Invertebrate Database Bench Sheet Report
Trib. Old Mines Cr [0804102], Station #1, Sample Date: 9/23/2008 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
EPHEMEROPTERA			
Acerpenna			1
Baetis	19		
Caenis latipennis	15	129	51
Eurylophella	2	2	
Heptageniidae	11		
Isonychia bicolor	3		
Leptophlebiidae	1	2	1
Maccaffertium pulchellum	12		
Procloeon		3	
Stenacron	5	5	
Stenonema femoratum	5	27	1
Tricorythodes	2		
HEMIPTERA			
Microvelia	1		
ISOPODA			
Caecidotea	102	29	141
LIMNOPHILA			
Lymnaeidae		-99	
LUMBRICINA			
Lumbricina	1		
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis	18		1
MESOGASTROPODA			
Elimia	12	4	2
Pomatiopsis lapidaria	1		
ODONATA			
Argia	8		1
Calopteryx	1	2	15
Gomphidae	35	1	
PLECOPTERA			
Acroneuria	-99		
Leuctridae	1	1	
TRICHOPTERA			
Cheumatopsyche	111		
Chimarra	130		
Polycentropus	4	1	1
TUBIFICIDA			
Enchytraeidae	2		

Aquid Invertebrate Database Bench Sheet Report
Trib. Old Mines Cr [0804102], Station #1, Sample Date: 9/23/2008 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
VENEROIDA			
Pisidiidae		2	

Aquid Invertebrate Database Bench Sheet Report
Brazil Cr [0804104], Station #1, Sample Date: 9/23/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	6	24	1
COLEOPTERA			
Dubiraphia		4	14
Ectopria nervosa	1		
Hydrobius			1
Optioservus sandersoni	108	10	
Psephenus herricki	23	5	
Stenelmis	5	3	2
DECAPODA			
Orconectes luteus			-99
Orconectes medius	-99		-99
Orconectes punctimanus			-99
Orconectes virilis			-99
DIPTERA			
Ablabesmyia		1	3
Antocha	1		
Atherix	-99		
Ceratopogoninae		2	
Chironomidae	1		
Cricotopus/Orthocladius	2		
Eukiefferiella	4		
Hemerodromia	1		3
Micropsectra		4	1
Microtendipes		1	4
Parametriocnemus	7	1	1
Paraphaenocladius			1
Paratanytarsus			9
Polypedilum aviceps	5	1	
Rheocricotopus		1	
Rheotanytarsus	3		3
Simulium	4		
Stempellinella	1	3	4
Tabanus	1		
Tanytarsus	2	4	
Thienemannimyia grp.	3		14
Tipula	1		
Zavrelimyia		2	1
EPHEMEROPTERA			
Baetis	2		

Aquid Invertebrate Database Bench Sheet Report
Brazil Cr [0804104], Station #1, Sample Date: 9/23/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Caenis anceps	4	1	
Caenis latipennis	4	29	25
Ephemerella	1		
Eurylophella	274	148	49
Heptageniidae	25		
Isonychia bicolor	22		
Leptophlebiidae	4	57	72
Maccaffertium pulchellum	80	1	
Stenacron	8	44	
Stenonema femoratum	-99	1	
Tricorythodes		1	
HEMIPTERA			
Microvelia			1
Rhagovelia	1		
ISOPODA			
Caecidotea			45
LIMNOPHILA			
Menetus			7
Physella			1
LUMBRICINA			
Lumbricina	-99	1	
MEGALOPTERA			
Nigronia serricornis	2		
MESOGASTROPODA			
Elimia	4	1	3
ODONATA			
Calopteryx			3
Hagenius brevistylus		1	
Hetaerina			1
Stylogomphus albistylus	10	2	4
PLECOPTERA			
Leuctra	1	1	2
TRICHOPTERA			
Cheumatopsyche	104		
Chimarra	4		
Polycentropus	1		1
Triaenodes		1	4
TRICLADIDA			
Planariidae	1		

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804111], Station #1a, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	7	9	1
AMPHIPODA			
Gammarus	19	3	6
Stygobromus		3	
BRANCHIOBDELLIDA			
Branchiobdellida	1		
COLEOPTERA			
Desmopachria			1
Dubiraphia			4
Ectopria nervosa	1	1	1
Optioservus sandersoni	126	40	4
Psephenus herricki	26	24	-99
Sperchopsis			1
Stenelmis	11	1	
DECAPODA			
Orconectes luteus	-99	-99	
Orconectes medius	1		-99
Orconectes punctimanus			-99
DIPTERA			
Antocha	1		
Ceratopogoninae		1	
Cladotanytarsus		1	
Cricotopus/Orthocladius	9	2	4
Cryptochironomus		1	
Dicrotendipes		1	
Eukiefferiella	5		1
Hemerodromia	1		1
Labrundinia			1
Micropsectra			1
Microtendipes			1
Natarsia		3	1
Nilotanypus		1	
Parakiefferiella	1	1	
Parametriocnemus	8		
Paratanytarsus			1
Polypedilum aviceps	3		
Polypedilum convictum	1		
Potthastia	4		
Rheocricotopus	3		

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804111], Station #1a, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Rheotanytarsus	3		3
Simulium	30		
Stempellinella		1	1
Tabanus	-99	-99	
Tanytarsus	2	1	
Thienemanniella		1	
Thienemannimyia grp.	1	2	1
Tipula	1		
Tribelos		2	
Zavrelimyia		1	
EPHEMEROPTERA			
Acentrella	21		
Baetis	34		
Caenis latipennis	3	10	13
Ephemerella	1		
Eurylophella	73	103	61
Heptageniidae	13	14	
Isonychia bicolor	20		
Leptophlebiidae		10	
Maccaffertium pulchellum	8	1	
Stenacron	6	18	1
Stenonema femoratum			1
HEMIPTERA			
Microvelia			1
LIMNOPHILA			
Ancylidae			1
Physella		-99	4
LUMBRICINA			
Lumbricina	1	1	
LUMBRICULIDA			
Lumbriculidae	1		
MEGALOPTERA			
Corydalus	-99		
Nigronia serricornis	4	1	
MESOGASTROPODA			
Elimia	5	18	147
ODONATA			
Calopteryx			5
Gomphidae	6	3	
PLECOPTERA			

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804111], Station #1a, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Acroneuria	-99		
Chloroperlidae		3	
Zealeuctra	1		
TRICHOPTERA			
Cheumatopsyche	78		
Chimarra	5		
Helicopsyche	10	11	9
Mystacides		3	1
Oecetis			1
Polycentropus	8	6	3
Triaenodes			7
TRICLADIDA			
Planariidae	4		1
VENEROIDA			
Pisidiidae		2	

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804112], Station #1b, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	17	4	2
AMPHIPODA			
Gammarus	11	3	4
BRANCHIOBDELLIDA			
Branchiobdellida	5		
COLEOPTERA			
Dubiraphia			6
Ectopria nervosa		3	-99
Helichus striatus			-99
Optioservus sandersoni	176	51	2
Psephenus herricki	24	10	-99
Stenelmis	17	2	
DECAPODA			
Orconectes luteus			1
Orconectes medius	3		-99
Orconectes punctimanus		-99	1
DIPTERA			
Ablabesmyia			2
Ceratopogoninae		1	
Chironomidae	2	1	2
Cricotopus/Orthocladius	21		6
Eukiefferiella	8		1
Forcipomyiinae			1
Hemerodromia	3		1
Hexatoma	1		
Labrundinia			2
Micropsectra			1
Microtendipes			3
Natarsia			2
Nilotanypus	1		
Parametriocnemus	6	1	
Polypedilum aviceps	6		
Polypedilum convictum	1		
Potthastia	1		
Rheocricotopus	2		
Rheotanytarsus	8		3
Simulium	35	1	
Stempellinella		2	
Sublettea	1		

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804112], Station #1b, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Tabanus	1	1	
Tanytarsus	1	1	2
Thienemanniella	2		1
Thienemannimyia grp.		3	5
Tipula	1		
Tribelos			1
Tvetenia bavarica grp	6		
Tvetenia discoloripes grp	1		
EPHEMEROPTERA			
Acentrella	17		
Baetis	22		
Caenis anceps	3	4	
Caenis latipennis		11	27
Ephemerella	2		
Eurylophella	84	130	53
Heptageniidae	10	2	
Isonychia bicolor	19		
Leptophlebiidae	1	4	6
Maccaffertium pulchellum	5	1	-99
Stenacron	4	25	1
Stenonema femoratum		1	
Tricorythodes		1	
LIMNOPHILA			
Ancylidae		2	1
Menetus		1	2
Physella			1
LUMBRICINA			
Lumbricina	2	1	
MEGALOPTERA			
Nigronia serricornis	4	1	-99
MESOGASTROPODA			
Elimia	12	-99	107
ODONATA			
Argia	1		
Calopteryx			2
Gomphidae		2	
Hetaerina	1		4
Stylogomphus albistylus	9		4
PLECOPTERA			
Chloroperlidae	2	1	

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0804112], Station #1b, Sample Date: 9/30/2008 11:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Zealeuctra	2		
TRICHOPTERA			
Ceratopsyche morosa grp	3		
Cheumatopsyche	58	1	1
Chimarra	5		
Helicopsyche	3	3	9
Mystacides		1	1
Polycentropus	7	6	
Triaenodes			1

Aquid Invertebrate Database Bench Sheet Report
East Fk Huzzah Cr [0804113], Station #1, Sample Date: 9/30/2008 2:25:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	8	17	
AMPHIPODA			
Hyalella azteca			94
Stygobromus	3	7	
BRANCHIOBDELLIDA			
Branchiobdellida	14		
COLEOPTERA			
Dubiraphia		1	17
Ectopria nervosa	2	4	
Hydraena			1
Macronychus glabratus			2
Optioservus sandersoni	91	19	1
Psephenus herricki	44	44	2
Stenelmis	4	4	1
Tropisternus			1
DECAPODA			
Orconectes luteus			-99
Orconectes medius	4	-99	
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		1	
Brillia	1		
Cardiocladius	1		
Chironomidae		3	4
Corynoneura			1
Cricotopus bicinctus	1		4
Cricotopus/Orthocladius	76	5	24
Eukiefferiella	5		
Hemerodromia	1		2
Hexatoma	15	8	
Labrundinia		2	3
Micropsectra			1
Microtendipes		3	
Nilotanypus	1	1	9
Parachaetocladius	1		
Parametriocnemus	3	2	
Paratanytarsus			2
Polypedilum convictum	3		
Potthastia	14	1	

Aquid Invertebrate Database Bench Sheet Report
East Fk Huzzah Cr [0804113], Station #1, Sample Date: 9/30/2008 2:25:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Rheocricotopus	2		1
Rheotanytarsus	15		6
Simulium	8		2
Stempellinella	5	5	
Tabanus	6	1	
Tanytarsus	1	1	1
Thienemanniella	2	1	
Thienemannimyia grp.	2	1	
Tipula			1
EPHEMEROPTERA			
Acentrella	18		
Baetis	32		
Caenis anceps	13	17	4
Caenis latipennis	3	26	60
Choroterpes		2	
Ephemerella			2
Eurylophella	30	60	49
Isonychia bicolor	61		2
Leptophlebiidae	1	53	24
Maccaffertium bednariki	7		
Maccaffertium mediopunctatum	3		
Maccaffertium pulchellum	37		
Stenacron	5	40	
Stenonema femoratum	1	29	
Tricorythodes		2	
HEMIPTERA			
Microvelia			1
Ranatra kirkaldyi			-99
LIMNOPHILA			
Ancylidae		1	7
Physella	2	2	10
LUMBRICINA			
Lumbricina	1	1	
MEGALOPTERA			
Corydalus	-99		
Nigronia serricornis	1	-99	1
Sialis		-99	
MESOGASTROPODA			
Elimia	9	1	2
ODONATA			
Argia		9	2

Aquid Invertebrate Database Bench Sheet Report
East Fk Huzzah Cr [0804113], Station #1, Sample Date: 9/30/2008 2:25:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Boyeria			1
Calopteryx		1	5
Enallagma			3
Gomphidae	5		1
Gomphus		-99	
PLECOPTERA			
Leuctridae		1	
TRICHOPTERA			
Agapetus	2		
Ceratopsyche morosa grp	4		
Cheumatopsyche	46		2
Chimarra	2		
Helicopsyche	7		
Oecetis			2
Phryganeidae			1
Polycentropus	1	10	
Triaenodes			10
TRICLADIDA			
Planariidae	2	1	

Aquid Invertebrate Database Bench Sheet Report
West Fk Huzzah Cr [0804116], Station #1, Sample Date: 10/1/2008 2:10:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	13	16	2
AMPHIPODA			
Gammarus		3	20
Hyalella azteca		4	7
Stygobromus		1	
BRANCHIOBDELLIDA			
Branchiobdellida		8	
COLEOPTERA			
Dubiraphia		1	4
Ectopria nervosa	4		
Hydraena	1		
Optioservus sandersoni	49	16	7
Peltodytes			2
Psephenus herricki	13	8	1
Stenelmis	3	3	
DECAPODA			
Orconectes luteus	-99		
Orconectes medius		-99	-99
Orconectes punctimanus		-99	1
DIPTERA			
Ablabesmyia		20	4
Atherix	2		
Cardiocladius	1		
Ceratopogoninae		1	
Chironomidae	1	1	1
Cladotanytarsus		2	
Corynoneura		1	1
Cricotopus bicinctus			1
Cricotopus/Orthocladius	43	7	14
Dicrotendipes		3	4
Eukiefferiella	2		2
Hemerodromia	3	1	2
Labrundinia		1	5
Microtendipes	1	13	3
Parakiefferiella		5	2
Paramerina			1
Parametriocnemus	2		
Paratanytarsus		2	27
Phaenopsectra		9	

Aquid Invertebrate Database Bench Sheet Report
West Fk Huzzah Cr [0804116], Station #1, Sample Date: 10/1/2008 2:10:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum convictum	18		1
Polypedilum fallax grp		1	
Rheocricotopus	5	4	3
Rheotanytarsus	32		10
Simulium	125	1	13
Stempellina		1	
Stempellinella	5	7	
Stictochironomus		1	1
Tabanus	1		
Tanytarsus	8	34	19
Thienemanniella	2	2	
Thienemannimyia grp.	1		7
EPHEMEROPTERA			
Acentrella	28		2
Baetis	35		
Caenis anceps	3		
Caenis latipennis	2	41	13
Callibaetis			2
Centroptilum			1
Eurylophella	3	23	12
Isonychia bicolor	41		
Leptophlebiidae	4	18	80
Maccaffertium pulchellum	56		
Stenacron	14	20	2
Stenonema femoratum		15	1
ISOPODA			
Caecidotea		1	
LIMNOPHILA			
Menetus			1
Physella		3	18
Planorbella			1
MEGALOPTERA			
Corydalus	1		
MESOGASTROPODA			
Elimia	1		2
ODONATA			
Argia	3	2	
Basiaeschna janata			-99
Calopteryx			6
Enallagma			2

Aquid Invertebrate Database Bench Sheet Report
West Fk Huzzah Cr [0804116], Station #1, Sample Date: 10/1/2008 2:10:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Gomphidae	1	1	
PLECOPTERA			
Leuctridae	2	1	
TRICHOPTERA			
Ceratopsyche morosa grp	1		
Cheumatopsyche	61		1
Chimarra	41		1
Helicopsyche	5	2	2
Hydroptila			1
Limnephilidae	1	2	4
Nectopsyche	1		
Oecetis			1
Oxyethira			1
Polycentropus	2	1	
Triaenodes		1	6
TRICLADIDA			
Planariidae	9	2	3

Aquid Invertebrate Database Bench Sheet Report
Shoal Cr [0804110], Station #1, Sample Date: 9/25/2008 2:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	11	12	3
AMPHIPODA			
Hyalella azteca		3	22
COLEOPTERA			
Dubiraphia		25	25
Ectopria nervosa	9	11	1
Microcylloepus pusillus			24
Optioservus sandersoni	17	1	1
Psephenus herricki	13		
Stenelmis	86	4	5
DECAPODA			
Orconectes luteus	2	-99	
Orconectes medius	-99		
Orconectes punctimanus			1
DIPTERA			
Ablabesmyia		8	
Atherix	2		
Caloparyphus	1		
Cardiocladius	1		
Ceratopogoninae	1		
Chironomidae	1		1
Chrysops		2	
Cricotopus/Orthocladius	2		
Cryptochironomus		1	
Hemerodromia			1
Labrundinia			4
Microtendipes		1	1
Nemotelus		1	
Nilothauma		1	
Parametriocnemus	1		
Paratanytarsus		1	3
Polypedilum convictum	1		
Polypedilum scalaenum grp	1		
Rheotanytarsus	2		1
Simulium	31		
Stempellinella	2	2	
Tabanus	-99		
Tanytarsus	1		
Thienemanniella	2		1

Aquid Invertebrate Database Bench Sheet Report
Shoal Cr [0804110], Station #1, Sample Date: 9/25/2008 2:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Thienemannimyia grp.	8	4	8
Zavrelimyia		14	1
EPHEMEROPTERA			
Acentrella	6		
Baetis	15		
Caenis anceps	124	131	11
Caenis latipennis	50	71	76
Centroptilum			3
Eurylophella	25	3	10
Isonychia bicolor	18		
Leptophlebiidae	4	4	30
Maccaffertium pulchellum	57		
Stenacron	22	1	
Stenonema femoratum	5	5	2
Tricorythodes	5		
HEMIPTERA			
Belostoma			1
Microvelia			3
Rhagovelia	1		
ISOPODA			
Caecidotea	2		2
LEPIDOPTERA			
Crambidae	1		
Petrophila	1		
LIMNOPHILA			
Menetus			2
Physella		-99	6
LUMBRICINA			
Lumbricina	2		
MEGALOPTERA			
Corydalus	1	-99	
Nigronia serricornis	2		
Sialis	1	-99	
MESOGASTROPODA			
Elimia		-99	1
ODONATA			
Argia	7		11
Boyeria			-99
Enallagma			6
Gomphidae	7		

Aquid Invertebrate Database Bench Sheet Report
Shoal Cr [0804110], Station #1, Sample Date: 9/25/2008 2:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Hagenius brevistylus		-99	
Stylogomphus albistylus		2	
PLECOPTERA			
Leuctridae	2		
Neoperla	1		
TRICHOPTERA			
Ceratopsyche morosa grp	2		
Cheumatopsyche	12		
Chimarra	5		
Helicopsyche	28	2	1
Nectopsyche		1	
Oecetis	5	2	1
Polycentropus	4		
Triaenodes			5
TRICLADIDA			
Planariidae	7		
TUBIFICIDA			
Enchytraeidae		1	
Tubificidae		4	
VENEROIDA			
Pisidiidae		2	

Aquid Invertebrate Database Bench Sheet Report
Fountain Farm Br [0930001], Station #1, Sample Date: 3/23/2009 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	15	16	14
AMPHIPODA			
Hyalella azteca		1	8
BRANCHIOBDELLIDA			
Branchiobdellida		1	2
COLEOPTERA			
Ancyronyx variegatus		1	
Dubiraphia	1	5	17
Ectopria nervosa		3	
Lutrochus	1		
Macronychus glabratus			1
Optioservus sandersoni	4		1
Peltodytes			1
Stenelmis	6	6	3
DECAPODA			
Orconectes hylas		-99	1
Orconectes luteus		-99	-99
DIPTERA			
Ablabesmyia		6	
Atherix	-99		
Ceratopogoninae		7	
Chironomidae	7	3	6
Cladotanytarsus		2	
Clinocera	9	2	
Corynoneura	3	7	15
Cricotopus bicinctus	5	1	15
Cricotopus/Orthocladius	60	22	50
Cryptochironomus		8	
Diamesa	1		
Dicrotendipes		2	
Eukiefferiella	6		
Eukiefferiella brevicalcar grp	22		2
Hemerodromia		2	4
Hydrobaenus		3	
Labrundinia		1	2
Micropsectra		1	
Microtendipes		1	
Natarsia			1
Nilotanypus	2		

Aquid Invertebrate Database Bench Sheet Report
Fountain Farm Br [0930001], Station #1, Sample Date: 3/23/2009 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Parakiefferiella	1	23	3
Parametriocnemus	17	1	4
Paratanytarsus	1	1	21
Paratendipes		2	
Polypedilum aviceps	74	3	7
Polypedilum convictum			1
Polypedilum fallax grp		1	
Polypedilum illinoense grp	2	1	4
Procladius		1	
Prosimulium	17		5
Rheocricotopus	12		5
Rheotanytarsus	38		19
Simulium	186		35
Stempellinella	7	75	10
Stictochironomus		1	
Tanytarsus	1	34	7
Thienemanniella	26	1	17
Thienemannimyia grp.	6	5	10
Tipula	1		-99
Tribelos		8	
Tvetenia bavarica grp	25		
Zavrelimyia		2	
EPHEMEROPTERA			
Acentrella	1	1	
Acerpenna	1		1
Baetis			1
Baetisca lacustris		-99	
Caenis anceps	1	20	6
Caenis latipennis	5	18	51
Centroptilum			1
Eurylophella	1		
Eurylophella bicolor		1	
Eurylophella enoensis		2	21
Isonychia			1
Leptophlebia			1
Maccaffertium mediopunctatum	1		
Maccaffertium pulchellum	1		4
Stenacron	1	5	
Stenonema femoratum		11	1
Tricorythodes			1
ISOPODA			

Aquid Invertebrate Database Bench Sheet Report
Fountain Farm Br [0930001], Station #1, Sample Date: 3/23/2009 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Caecidotea	2	1	3
LUMBRICINA			
Lumbricina		-99	
MEGALOPTERA			
Corydalus	-99		
MESOGASTROPODA			
Elimia	1		2
ODONATA			
Argia			1
Gomphidae			2
Hagenius brevistylus		-99	
Stylogomphus albistylus		-99	-99
PLECOPTERA			
Acroneuria	2		
Amphinemura	14		2
Isoperla	7		
Leuctridae	17	3	4
Perlesta	24		8
Strophopteryx	1		
RHYNCHOBDELLIDA			
Piscicolidae			1
TRICHOPTERA			
Cernotina			2
Cheumatopsyche	5	1	2
Helicopsyche	1		2
Neophylax	4		
Polycentropus	1		
Psychomyia	2		
Pycnopsyche			1
Rhyacophila	4		
TRICLADIDA			
Planariidae	8		3
TUBIFICIDA			
Limnodrilus hoffmeisteri			1
Tubificidae		1	
UNIONIDA			
Unionidae	-99		

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930003], Station #2, Sample Date: 3/23/2009 1:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	13	16	1
AMPHIPODA			
Gammarus	8	6	29
BRANCHIOBDELLIDA			
Branchiobdellida	2		
COLEOPTERA			
Dubiraphia		4	22
Dytiscidae		1	1
Ectopria nervosa			1
Macronychus glabratus			1
Microcylloepus pusillus		2	7
Optioservus sandersoni	4	2	1
Stenelmis	2		1
DECAPODA			
Orconectes medius	1	-99	
DIPTERA			
Ablabesmyia	2		
Antocha	4		
Ceratopogoninae	6	7	13
Chironomidae	1	1	4
Chrysops		1	
Cladotanytarsus	2		
Clinocera		2	
Corynoneura			1
Cricotopus bicinctus	2	1	4
Cricotopus/Orthocladius	119	26	26
Cryptochironomus	2	1	1
Dixa			1
Dixella			1
Epoicocladius	1		
Eukiefferiella	20	1	1
Hemerodromia	47	7	16
Micropsectra	1	1	5
Natarsia		1	1
Neozavrelia	1		
Parakiefferiella	17	36	2
Parametriocnemus	3		2
Paratanytarsus			5
Phaenopsectra		2	

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930003], Station #2, Sample Date: 3/23/2009 1:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum aviceps	7		1
Polypedilum convictum	3		
Polypedilum halterale grp		1	
Polypedilum illinoense grp			3
Prosimulium	5		
Psectrocladius			1
Rheocricotopus	8		4
Rheotanytarsus	20	1	3
Simulium	39		1
Stempellinella	13	9	8
Stenochironomus	1		
Tabanus			-99
Tanytarsus	12	28	11
Thienemanniella	3	3	1
Thienemannimyia grp.	8		5
Tipula	-99		-99
Tvetenia	4		2
undescribed Empididae			1
EPHEMEROPTERA			
Acentrella	6		1
Caenis latipennis	96	164	65
Diphetor	1	1	
Eurylophella bicolor		2	
Eurylophella enoensis	1		1
Heptageniidae	1		
Isonychia bicolor	9		
Maccaffertium pulchellum	18	1	
Stenacron	49	13	-99
Stenonema femoratum	1	1	
ISOPODA			
Caecidotea	4		4
LEPIDOPTERA			
Petrophila		-99	
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis	1	-99	1
Sialis		-99	
ODONATA			
Argia		1	1
Basiaeschna janata	1		
Calopteryx	1		

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930003], Station #2, Sample Date: 3/23/2009 1:35:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Gomphus	1	1	
Hagenius brevistylus			2
PLECOPTERA			
Amphinemura	11		1
Leuctridae	25		2
Perlesta	17	2	3
TRICHOPTERA			
Cheumatopsyche	8	2	5
Chimarra	1		
Hydropsyche	2		1
Hydroptila		2	1
Ironoquia			1
Mystacides		2	
Oecetis			2
Polycentropodidae	1		
Polycentropus			4
Pycnopsyche			2
Triaenodes			4
TRICLADIDA			
Planariidae	1		3
TUBIFICIDA			
Enchytraeidae			1
Tubificidae	3	9	1
VENEROIDA			
Pisidiidae		1	1

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930002], Station #1, Sample Date: 3/23/2009 12:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	1	18	
AMPHIPODA			
Hyalella azteca			17
BRANCHIOBDELLIDA			
Branchiobdellida	1		
COLEOPTERA			
Dubiraphia		19	15
Microcylloepus pusillus			3
Optioservus sandersoni	12	1	
Paracymus			1
Psephenus herricki		1	
Stenelmis		1	8
DECAPODA			
Orconectes luteus	-99	-99	
Orconectes medius	2		
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		3	
Antocha	1	1	
Ceratopogoninae		26	
Chironomidae	2	5	5
Cladotanytarsus		8	
Clinocera	10	11	1
Corynoneura	5	3	1
Cricotopus bicinctus	2		4
Cricotopus/Orthocladius	37	14	59
Cryptochironomus		3	
Dicrotendipes		1	
Eukiefferiella	46	2	3
Hemerodromia	6	6	1
Labrundinia			12
Micropsectra		2	1
Microtendipes		1	
Natarsia		5	
Orthocladius (Euorthocladius)	3		
Parakiefferiella	2	23	9
Parametriocnemus	7		
Paratanytarsus	1		55
Phaenopsectra		1	1

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930002], Station #1, Sample Date: 3/23/2009 12:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum aviceps	8		1
Polypedilum halterale grp		1	
Polypedilum illinoense grp			1
Prosimulium	18		
Rheocricotopus	22		
Rheotanytarsus	8		6
Simulium	102		
Stempellina		3	
Stempellinella	4	21	2
Tabanus	1		
Tanytarsus	4	34	8
Thienemanniella	19	4	4
Thienemannimyia grp.	3	2	8
Tipula	1		
Tvetenia	14		
EPHEMEROPTERA			
Acentrella	15		
Baetisca lacustris		2	
Caenis latipennis	5	26	31
Diphetor	2		
Ephemera simulans		-99	
Eurylophella bicolor		35	20
Eurylophella enoensis			21
Isonychia bicolor	15		
Leptophlebia		1	
Maccaffertium mediopunctatum	1		
Maccaffertium pulchellum	20		3
Paraleptophlebia			1
Stenacron	3	5	
Stenonema femoratum	-99	6	1
GORDIOIDEA			
Gordiidae	-99		
LEPIDOPTERA			
Petrophila	2		
LUMBRICINA			
Lumbricina	2	-99	
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis	4		
MESOGASTROPODA			

Aquid Invertebrate Database Bench Sheet Report
Pond Cr [0930002], Station #1, Sample Date: 3/23/2009 12:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Elimia	1		
ODONATA			
Argia			6
Calopteryx			2
Enallagma			8
Gomphidae	2	-99	1
Helocordulia		-99	
Stylogomphus albistylus		-99	1
PLECOPTERA			
Acroneuria	1		
Amphinemura	12		1
Leuctridae	31	4	2
Perlesta	1		
Strophopteryx	4		
TRICHOPTERA			
Cheumatopsyche	11		
Chimarra	3		
Helicopsyche	1		
Polycentropus			2
Pycnopsyche			-99
Rhyacophila	2	1	4
Triaenodes			1
TRICLADIDA			
Planariidae	3		3
TUBIFICIDA			
Tubificidae		5	
VENEROIDA			
Corbicula		3	

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930012], Station #3, Sample Date: 4/1/2009 11:20:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	4	20	4
COLEOPTERA			
Dubiraphia		3	19
Ectopria nervosa	1		
Hydroporus		6	
Macronychus glabratus	1		2
Microcylloepus pusillus	2		
Optioservus sandersoni	9		1
DECAPODA			
Orconectes medius	-99		
Procambarus acutus			-99
DIPTERA			
Ablabesmyia		4	2
Ceratopogoninae	1	13	5
Chironomidae	4	4	5
Clinocera	3	2	
Corynoneura			4
Cricotopus bicinctus	2		4
Cricotopus/Orthocladius	12	6	23
Cryptochironomus		1	
Diptera	2	1	
Hemerodromia	15	9	11
Labrundinia			2
Natarsia			1
Nilotanypus	6	1	1
Parakiefferiella	1	4	
Parametriocnemus	20	3	5
Paratanytarsus	1		4
Polypedilum aviceps	63	6	13
Polypedilum illinoense grp	1		5
Procladius			1
Rheocricotopus	34	13	15
Rheotanytarsus	5	2	7
Simulium	50		25
Stempellinella	6	18	5
Tabanus	-99		
Tanypus		1	
Tanytarsus	28	57	19
Thienemanniella	1	3	9

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930012], Station #3, Sample Date: 4/1/2009 11:20:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Thienemannimyia grp.	10	3	5
Tipula	2		
Zavrelimyia		6	1
EPHEMEROPTERA			
Acentrella	4		
Caenis latipennis	5	11	11
Eurylophella bicolor		1	3
Isonychia bicolor	27		1
Leptophlebiidae	1		
Maccaffertium pulchellum	44	4	4
Stenacron	11	10	1
ISOPODA			
Caecidotea	7	2	9
LIMNOPHILA			
Lymnaeidae	2		
LUMBRICINA			
Lumbricina			1
MEGALOPTERA			
Nigronia serricornis	2	-99	
ODONATA			
Argia		2	
Calopteryx			6
Gomphidae	2	3	
Gomphus	1		
Stylogomphus albistylus	1	-99	
PLECOPTERA			
Amphinemura	10		3
Leuctridae	163	76	44
Perlesta	10		1
TRICHOPTERA			
Cheumatopsyche	48		
Chimarra	12		
Oecetis	1		1
Oxyethira			5
Polycentropus	3	3	6
Pycnopsyche		-99	1
Rhyacophila	8	1	1
Triaenodes		1	
TRICLADIDA			
Planariidae	5	1	2

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930012], Station #3, Sample Date: 4/1/2009 11:20:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
TUBIFICIDA			
Tubificidae			1
VENEROIDA			
Pisidiidae	2	1	

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930006], Station #2, Sample Date: 3/25/2009 11:50:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	8	3	1
COLEOPTERA			
Dubiraphia		20	12
Macronychus glabratus			3
Microcylloepus pusillus	13		
Optioservus sandersoni	6		3
Psephenus herricki	1		
Stenelmis	3		3
DECAPODA			
Cambarus maculatus	-99		
Orconectes harrisonii		-99	
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		5	5
Brillia			1
Cardiocladius	8		
Ceratopogoninae		1	1
Chironomidae	3	4	2
Clinocera	1		
Clinotanypus			2
Corynoneura			1
Cricotopus bicinctus			8
Cricotopus trifascia	2		
Cricotopus/Orthocladius	39	25	29
Dasyheleinae	1		
Dixella			6
Eukiefferiella	1		
Forcipomyiinae			1
Hemerodromia	16	5	7
Labrundinia			2
Microtendipes		1	
Nanocladius		1	
Natarsia		4	
Nilotanypus	1		
Parakiefferiella		9	4
Parametriocnemus	5	1	1
Paratanytarsus	1	1	37
Polypedilum aviceps	51	2	9
Polypedilum illinoense grp	1		23

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930006], Station #2, Sample Date: 3/25/2009 11:50:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Prosimulium	1		
Rheocricotopus	21		6
Rheotanytarsus	20	2	4
Simulium	105		1
Stempellinella	4	24	10
Stenochironomus		1	
Tanytarsus	2	52	16
Thienemanniella	2	5	2
Thienemannimyia grp.	16		2
Tipula	-99		
Tribelos		4	
Tvetenia	63		2
Zavrelimyia			2
EPHEMEROPTERA			
Acentrella	5		
Caenis latipennis	6	85	45
Diphetor	1		
Ephemera simulans		2	
Eurylophella enoensis	4	3	11
Heptageniidae	6	1	
Hexagenia limbata		-99	
Isonychia bicolor	34		1
Maccaffertium mediopunctatum	3		
Maccaffertium pulchellum	23		1
Paraleptophlebia	2		
Stenacron		2	
Stenonema femoratum		2	
Tricorythodes	1		
ISOPODA			
Caecidotea	81	34	67
LIMNOPHILA			
Menetus		1	
LUMBRICINA			
Lumbricina	-99		
LUMBRICULIDA			
Lumbriculidae			1
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis			2
ODONATA			
Argia	1		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930006], Station #2, Sample Date: 3/25/2009 11:50:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Calopteryx			-99
Dromogomphus			-99
Enallagma			3
Hagenius brevistylus		1	
Macromia			-99
Stylogomphus albistylus			-99
PLECOPTERA			
Acroneuria	1		
Amphinemura	27		
Clioperla clio	-99		
Isoperla	1		
Leuctridae	50	1	2
Perlesta	13		3
TRICHOPTERA			
Ceratopsyche morosa grp	2		
Cheumatopsyche	10		1
Chimarra	25		
Hydroptila	1		
Oecetis		1	6
Oxyethira		1	
Polycentropus	3		13
Pycnopsyche	-99	-99	1
Rhyacophila	5		-99
Triaenodes			3
TRICLADIDA			
Planariidae	7		1
TUBIFICIDA			
Branchiura sowerbyi		1	
Quistradrilus multisetosus			1
Tubificidae	1	4	4
VENEROIDA			
Pisidiidae		1	6

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930005], Station #1, Sample Date: 3/25/2009 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	12		7
AMPHIPODA			
Hyalella azteca			2
BRANCHIOBDELLIDA			
Branchiobdellida			1
COLEOPTERA			
Dubiraphia	4	31	24
Macronychus glabratus			2
Microcylloepus pusillus	1		
Optioservus sandersoni	3		
Stenelmis	18	1	1
DECAPODA			
Orconectes harrisonii	1		
Orconectes luteus	-99		
Orconectes medius	-99		
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		13	13
Antocha			1
Atherix	-99		
Brillia			2
Ceratopogoninae	1		3
Chironomidae	3	5	5
Chrysops			1
Cladotanytarsus	1	15	
Cricotopus bicinctus	1		7
Cricotopus/Orthocladius	40	10	36
Cryptochironomus		2	
Cryptotendipes		2	
Diptera		5	
Dixa			4
Epoicocladius	1		
Eukiefferiella	1		
Hemerodromia	26	3	4
Labrundinia			9
Microtendipes	2	13	
Nanocladius		1	
Natarsia			4
Nilotanypus	3		

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930005], Station #1, Sample Date: 3/25/2009 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Parakiefferiella		15	14
Paralauterborniella		1	
Parametriocnemus	19	1	
Paratanytarsus	3	6	21
Paratendipes		2	
Phaenopsectra		11	1
Polypedilum aviceps	22		1
Polypedilum convictum	3		
Polypedilum halterale grp		2	
Polypedilum illinoense grp	1	2	16
Procladius		1	
Rheocricotopus	45		5
Rheotanytarsus	23		9
Simulium	10		
Stempellinella	25	31	7
Stictochironomus		1	
Tanytarsus	24	48	19
Thienemanniella	7	1	1
Thienemannimyia grp.	13	1	6
Tribelos		7	
Tvetenia	32		
Zavrelimyia		1	
EPHEMEROPTERA			
Acentrella	2		
Caenis anceps	11	3	
Caenis latipennis	59	65	19
Centroptilum			3
Diphetor	3		
Ephemera	-99	-99	
Eurylophella	12		7
Eurylophella bicolor	1	3	3
Eurylophella enoensis		4	6
Heptageniidae	36		
Hexagenia			1
Isonychia bicolor	22		
Leptophlebia		1	
Maccaffertium mediopunctatum	10		
Maccaffertium pulchellum	21		
Paraleptophlebia	3		
Stenacron	4	1	3
Stenonema femoratum		5	1

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930005], Station #1, Sample Date: 3/25/2009 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Tricorythodes	10		
ISOPODA			
Caecidotea	72	5	12
LIMNOPHILA			
Ferrissia			1
Helisoma			1
LUMBRICINA			
Lumbricina	1		-99
MEGALOPTERA			
Corydalus	-99		
Nigronia serricornis	-99		-99
Sialis		-99	
MESOGASTROPODA			
Elimia			-99
ODONATA			
Argia		1	2
Calopteryx			1
Enallagma			1
Hetaerina			1
Macromia			1
PLECOPTERA			
Acroneuria	-99		
Amphinemura	15		1
Leuctridae	39		1
Perlesta	16		2
RHYNCHOBDELLIDA			
Glossiphoniidae		1	
TRICHOPTERA			
Cheumatopsyche	14		1
Chimarra	4		
Helicopsyche	4		
Mystacides		1	
Oecetis		1	3
Oxyethira			2
Polycentropus	1		1
Pycnopsyche	-99		5
Rhyacophila	6		
Triaenodes			6
TRICLADIDA			
Planariidae	3		2

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0930005], Station #1, Sample Date: 3/25/2009 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
TUBIFICIDA			
Branchiura sowerbyi		2	3
Enchytraeidae		1	
Limnodrilus claparedianus		1	
Limnodrilus hoffmeisteri			1
Quistradrilus multisetosus			2
Tubificidae	1	3	1
VENEROIDA			
Corbicula	1		
Pisidiidae		1	1

Aquid Invertebrate Database Bench Sheet Report
Salt Pines Cr [0930004], Station #1, Sample Date: 3/23/2009 3:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	3	1	
BRANCHIOBDELLIDA			
Branchiobdellida	1	6	
COLEOPTERA			
Dubiraphia		4	6
Ectopria nervosa		1	1
Microcylloepus pusillus			1
Optioservus sandersoni	3		
Stenelmis	5		
DECAPODA			
Orconectes hylas			-99
Orconectes medius	2		
Orconectes punctimanus		3	1
DIPTERA			
Ablabesmyia		5	
Antocha	1		
Chelifera			1
Chironomidae	4	4	8
Clinocera	5	2	
Corynoneura	4	6	4
Cricotopus bicinctus	8	3	33
Cricotopus/Orthocladius	66	16	71
Cryptochironomus		2	
Diptera	3	2	1
Eukiefferiella	4		5
Eukiefferiella brevicalcar grp	3		
Hemerodromia	5		
Natarsia		6	
Parakiefferiella		6	2
Parametriocnemus	32		4
Paratanytarsus	1	1	5
Polypedilum aviceps	36		8
Polypedilum convictum	12		
Polypedilum illinoense grp			2
Polypedilum scalaenum grp		1	
Prosimulium	13		
Rheocricotopus	32	1	39
Rheotanytarsus	3	1	21
Simulium	19		
Stempellinella	9	33	2

Aquid Invertebrate Database Bench Sheet Report
Salt Pines Cr [0930004], Station #1, Sample Date: 3/23/2009 3:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Tanytarsus	1	20	5
Thienemanniella	30	11	49
Thienemannimyia grp.	14	8	5
Tipula	-99		
Tvetenia bavarica grp	24		10
EPHEMEROPTERA			
Acentrella	1		
Acerpenna	4		1
Caenis anceps		1	
Caenis latipennis	4	54	3
Diphetor	1		
Eurylophella enoensis		2	8
Leptophlebia		1	
Maccaffertium pulchellum	9	3	
Stenacron	1	4	1
Stenonema femoratum		9	
ISOPODA			
Caecidotea	170	63	21
LUMBRICINA			
Lumbricina	-99		
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis	-99		
MESOGASTROPODA			
Elimia	2		
ODONATA			
Calopteryx			-99
PLECOPTERA			
Acroneuria	2	1	
Allocapnia	2	1	
Amphinemura	11		3
Isoperla	6		
Leuctridae	16	3	
Perlesta	5		
Strophopteryx	1		
RHYNCHOBDELLIDA			
Piscicolidae			1
TRICHOPTERA			
Cheumatopsyche	22		12
Chimarra	12		1

Aquid Invertebrate Database Bench Sheet Report
Salt Pines Cr [0930004], Station #1, Sample Date: 3/23/2009 3:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Pycnopsyche			1
Rhyacophila	9		
TRICLADIDA			
Planariidae	74	23	7
TUBIFICIDA			
Tubificidae	1	4	

Aquid Invertebrate Database Bench Sheet Report
Trib. Old Mines Cr [0930007], Station #1, Sample Date: 3/25/2009 1:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	7	2	1
AMPHIPODA			
Gammarus	7		1
BRANCHIOBDELLIDA			
Branchiobdellida	1		
COLEOPTERA			
Dubiraphia		1	7
Dytiscidae		1	
Ectopria nervosa		2	
Optioservus sandersoni	2		
Scirtidae			1
Stenelmis	1	2	1
DECAPODA			
Orconectes hylas	-99		
Orconectes medius			-99
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia	1	24	2
Antocha	1		
Ceratopogoninae	1	5	1
Chaetocladius	1		
Chelifera	1		
Chironomidae		1	2
Clinocera	3	1	1
Corynoneura	1	6	2
Cricotopus bicinctus	6	4	13
Cricotopus/Orthocladius	118	63	64
Cryptochironomus		4	
Dicrotendipes		1	
Eukiefferiella	9		1
Hemerodromia	4	12	2
Labrundinia			1
Natarsia		4	1
Nilotanypus	1		
Parakiefferiella	3	3	2
Parametriocnemus	12		
Paratanytarsus		1	13
Paratendipes		1	
Phaenopsectra			3
Polypedilum aviceps	3		

Aquid Invertebrate Database Bench Sheet Report
Trib. Old Mines Cr [0930007], Station #1, Sample Date: 3/25/2009 1:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum convictum	4		
Polypedilum illinoense grp		4	8
Prosimulium			1
Pseudolimnophila			1
Rheocricotopus	14	1	2
Rheotanytarsus	4	1	2
Simulium	3		
Stempellinella	20	18	12
Tanytarsus	10	12	4
Thienemanniella	7	7	6
Thienemannimyia grp.	24	11	7
Tipula			-99
Tribelos		1	
Tvetenia bavarica grp	3		1
Zavrelimyia	1	2	
EPHEMEROPTERA			
Acerpenna	26		17
Caenis latipennis	21	52	39
Centroptilum			1
Diphetor	16	1	
Eurylophella	3	1	
Eurylophella enoensis		1	3
Maccaffertium pulchellum	2		
Stenacron	3	4	
Stenonema femoratum	3	3	
HEMIPTERA			
Microvelia			1
ISOPODA			
Caecidotea	26	14	23
LIMNOPHILA			
Ferrissia	1		
Physella			1
MEGALOPTERA			
Nigronia serricornis	1		
MESOGASTROPODA			
Elimia	1	-99	4
ODONATA			
Argia		1	2
Calopteryx			2
Gomphidae		1	1

Aquid Invertebrate Database Bench Sheet Report
Trib. Old Mines Cr [0930007], Station #1, Sample Date: 3/25/2009 1:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Stylogomphus albistylus	3	1	2
PLECOPTERA			
Amphinemura	12		3
Isoperla	2		
Leuctridae	137	15	9
Perlesta	5		
Zealeuctra	3	2	
RHYNCHOBDELLIDA			
Piscicolidae		1	
TRICHOPTERA			
Cheumatopsyche	6	1	1
Chimarra	3		
Helicopsyche			1
Neophylax	2		
Oecetis			1
Polycentropus	2		
Pycnopsyche			3
Rhyacophila	7		
Triaenodes			4
TRICLADIDA			
Planariidae	4		2
TUBIFICIDA			
Enchytraeidae	1	1	1
Limnodrilus hoffmeisteri			2
Tasserkidrilus superiorensis			1
Tubificidae		1	4
VENEROIDA			
Pisidiidae		1	1

Aquid Invertebrate Database Bench Sheet Report
Brazil Cr [0930009], Station #1a, Sample Date: 3/26/2009 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	16	15	2
COLEOPTERA			
Dubiraphia			25
Dytiscidae	1		
Helichus basalis			2
Microcylloepus pusillus	2		
Optioservus sandersoni	57	19	3
Psephenus herricki		2	
Stenelmis			1
DECAPODA			
Orconectes		-99	
Orconectes medius		-99	1
DIPTERA			
Ablabesmyia			1
Antocha	1		
Atherix		-99	
Brillia	1		1
Ceratopogoninae	9	3	2
Chaetocladius		1	
Chironomidae	3		1
Cladotanytarsus		2	
Corynoneura	1		
Cricotopus bicinctus	5		9
Cricotopus/Orthocladius	123	72	41
Diamesa	1		
Dicrotendipes		1	1
Diptera		1	1
Dixa			1
Eukiefferiella	4		1
Hemerodromia			3
Labrundinia			6
Micropsectra	5	1	5
Nilotanypus	1	1	
Parakiefferiella		1	
Parametriocnemus	6	1	1
Paratanytarsus			9
Polypedilum aviceps	67	1	2
Polypedilum fallax grp		1	
Polypedilum illinoense grp			1
Prosimulium	1		1

Aquid Invertebrate Database Bench Sheet Report
Brazil Cr [0930009], Station #1a, Sample Date: 3/26/2009 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Rheocricotopus	2	1	5
Rheotanytarsus	2	1	8
Simulium	25		6
Stempellinella	2		
Stenochironomus			1
Tanytarsus	6	9	13
Thienemannimyia grp.	24	23	8
Tipula	1		
Tvetenia	4		1
EPHEMEROPTERA			
Acentrella	94		17
Acerpenna	1	1	1
Caenis latipennis	1	5	9
Diphetor	2		1
Eurylophella bicolor	19	45	37
Eurylophella enoensis		2	29
Heptageniidae	10	1	
Isonychia bicolor	3		
Leptophlebia		2	8
Maccaffertium pulchellum	6	1	1
Paraleptophlebia			4
Stenacron	1	3	3
Stenonema femoratum		2	
ISOPODA			
Caecidotea		1	21
LIMNOPHILA			
Physella			1
LUMBRICINA			
Lumbricina		2	
MEGALOPTERA			
Nigronia serricornis	-99		1
MESOGASTROPODA			
Elimia	1		18
ODONATA			
Boyeria			-99
Calopteryx			-99
Gomphidae		2	
PLECOPTERA			
Amphinemura	55	1	3
Haploperla	1		

Aquid Invertebrate Database Bench Sheet Report
Brazil Cr [0930009], Station #1a, Sample Date: 3/26/2009 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Isoperla	14		1
Leuctridae	222	105	13
Perlesta	2		
TRICHOPTERA			
Agapetus	7		
Cheumatopsyche	7		
Chimarra	2		
Helicopsyche			1
Lepidostoma			1
Polycentropus	2		1
Pycnopsyche		-99	2
Rhyacophila	4		
Triaenodes			9
TUBIFICIDA			
Tubificidae			1

Aquid Invertebrate Database Bench Sheet Report
Brazil Cr [0930010], Station #1b, Sample Date: 3/26/2009 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	8	7	4
AMPHIPODA			
Stygobromus	1		
COLEOPTERA			
Dubiraphia		1	7
Ectopria nervosa		-99	
Optioservus sandersoni	45	12	6
Psephenus herricki	-99	1	
DECAPODA			
Orconectes medius	-99	-99	-99
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		1	1
Atherix	-99	-99	
Ceratopogoninae	4	2	
Chironomidae	7		
Chrysops	-99		
Cladotanytarsus		1	
Corynoneura			1
Cricotopus bicinctus	1	1	1
Cricotopus/Orthocladius	100	66	8
Diamesa	2		
Dicrotendipes		2	
Diptera	1	1	
Eukiefferiella brevicalcar grp	2		2
Hemerodromia	3	1	1
Hexatoma	2	1	
Labrundinia			4
Micropsectra	4		1
Nanocladius			1
Nilotanypus			1
Odontomyia			1
Parakiefferiella		2	
Parametriocnemus	4	1	
Paratanytarsus			5
Polypedilum aviceps	62	4	22
Polypedilum convictum	2		
Polypedilum illinoense grp	1		2
Prosimulium	7		

Aquid Invertebrate Database Bench Sheet Report
Brazil Cr [0930010], Station #1b, Sample Date: 3/26/2009 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Pseudolimnophila			1
Rheocricotopus	3	2	8
Rheotanytarsus	1		4
Simulium	43		3
Stempellinella		1	1
Sympotthastia		2	
Tanytarsus	10	8	5
Thienemannimyia grp.	21	27	5
Tipula	-99		-99
Tvetenia bavarica grp	2	1	1
Zavrelimyia		2	
EPHEMEROPTERA			
Acentrella	91	1	19
Caenis latipennis		5	1
Diphetor	7		2
Ephemerella subvaria	-99		
Eurylophella bicolor	18	52	10
Eurylophella enoensis		1	12
Heptageniidae	7		2
Isonychia bicolor	5		
Leptophlebia		-99	4
Maccaffertium pulchellum	8	1	5
Paraleptophlebia	3		2
Stenacron		1	
Stenonema femoratum		-99	
HEMIPTERA			
Microvelia			1
ISOPODA			
Caecidotea			12
LIMNOPHILA			
Menetus			2
LUMBRICINA			
Lumbricina		-99	
MEGALOPTERA			
Nigronia serricornis	-99	1	
MESOGASTROPODA			
Elimia	-99		10
ODONATA			
Basiaeschna janata			-99
Stylogomphus albistylus	5		

Aquid Invertebrate Database Bench Sheet Report
Brazil Cr [0930010], Station #1b, Sample Date: 3/26/2009 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
PLECOPTERA			
Amphinemura	42		29
Haploperla	1		
Isoperla	14		3
Leuctridae	242	137	24
Perlesta	2		1
TRICHOPTERA			
Agapetus	3		
Ceratopsyche slossonae	-99		
Cheumatopsyche	7		4
Chimarra	1	-99	2
Neophylax	-99		
Pycnopsyche		-99	4
Rhyacophila	3		
Triaenodes			2
TUBIFICIDA			
Enchytraeidae	1	1	

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0930011], Station #1, Sample Date: 3/26/2009 1:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	5	3	1
AMPHIPODA			
Gammarus	18	2	10
Stygobromus		1	
BRANCHIOBDELLIDA			
Branchiobdellida	1		
COLEOPTERA			
Dubiraphia			1
Helichus			1
Optioservus sandersoni	41	34	10
Stenelmis	2	2	
DECAPODA			
Orconectes medius	-99	-99	-99
Orconectes punctimanus		1	
DIPTERA			
Ablabesmyia		2	
Antocha	1		
Cardiocladius	2	1	
Ceratopogoninae	2	2	
Chelifera	1		1
Chironomidae	5	2	1
Clinocera	2		1
Corynoneura		1	
Cricotopus bicinctus	1	1	7
Cricotopus/Orthocladius	57	13	19
Diptera		1	
Eukiefferiella	1		1
Hemerodromia	1		1
Labrundinia			2
Micropsectra	3	2	3
Natarsia		1	
Nilotanypus			1
Parakiefferiella	2		1
Paratanytarsus			1
Polypedilum aviceps	17	1	5
Polypedilum convictum	1		
Polypedilum fallax grp		1	
Polypedilum illinoense grp			1
Polypedilum scalaenum grp		1	

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0930011], Station #1, Sample Date: 3/26/2009 1:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Potthastia	82	31	43
Prosimulium	6		1
Psectrocladius			1
Rheocricotopus	9	2	2
Rheotanytarsus	2		
Simulium	6		1
Stempellinella	2	4	4
Stilocladius		1	4
Sympotthastia		1	1
Synorthocladius	1		
Tabanus	-99		
Tanytarsus	6	4	2
Thienemanniella	1		3
Thienemannimyia grp.	28	32	11
Tipula	1		
Tvetenia	5		2
Zavrelimyia		1	
EPHEMEROPTERA			
Acentrella	3		1
Caenis latipennis	1	11	4
Eurylophella bicolor	13	36	21
Eurylophella enoensis			16
Heptageniidae	5		1
Isonychia bicolor	2		
Leptophlebia		2	4
Maccaffertium mediopunctatum	1		
Maccaffertium pulchellum	6		2
Maccaffertium vicarium		-99	
Paraleptophlebia	2		
Stenacron	1	2	
LIMNOPHILA			
Ancylidae		2	
Physella	1	-99	2
LUMBRICINA			
Lumbricina	-99	2	
MESOGASTROPODA			
Elimia	1	1	20
ODONATA			
Boyeria			1
Stylogomphus albistylus		1	
PLECOPTERA			

Aquid Invertebrate Database Bench Sheet Report
Courtois Cr [0930011], Station #1, Sample Date: 3/26/2009 1:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Amphinemura	11		11
Isoperla	3		
Leuctridae	136	96	35
Perlesta	1		1
Prostoia			1
TRICHOPTERA			
Agapetus	4		
Cheumatopsyche	7		2
Helicopsyche	5	1	11
Hydroptila			2
Mystacides			1
Polycentropus	4		3
Psychomyia	1		
Pycnopsyche		2	9
Triaenodes			2

Aquid Invertebrate Database Bench Sheet Report
East Fk Huzzah Cr [0930015], Station #1, Sample Date: 4/8/2009 12:10:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	9	5	3
AMPHIPODA			
Hyalella azteca			17
Stygobromus	2	3	
BRANCHIOBDELLIDA			
Branchiobdellida	2		1
COLEOPTERA			
Dubiraphia			5
Macronychus glabratus			1
Optioservus sandersoni	29	8	
Psephenus herricki	1	1	-99
Stenelmis	1		2
DECAPODA			
Orconectes luteus			-99
Orconectes medius	1	-99	1
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		9	2
Ceratopogoninae	1		
Chelifera	1		
Chironomidae	5	3	5
Cladotanytarsus		1	
Clinocera	3	1	
Corynoneura	2	11	13
Cricotopus bicinctus			7
Cricotopus/Orthocladius	165	58	59
Eukiefferiella brevicalcar grp	33		9
Hemerodromia	3	1	
Hexatoma	1		
Labrundinia			4
Micropsectra			1
Nilotanypus	8	3	5
Parametriocnemus	44	3	
Polypedilum aviceps	31		2
Polypedilum convictum	33	1	2
Polypedilum fallax grp			1
Potthastia	8	59	14
Psectrocladius		1	
Rheocricotopus	19		2

Aquid Invertebrate Database Bench Sheet Report
East Fk Huzzah Cr [0930015], Station #1, Sample Date: 4/8/2009 12:10:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Rheotanytarsus	7		16
Simulium	25		2
Stempellinella	7	12	3
Tabanus	-99	1	
Tanytarsus	9	19	7
Thienemanniella	5	2	2
Thienemannimyia grp.	30	28	11
Tipula	-99		
Tvetenia bavarica grp	5		2
EPHEMEROPTERA			
Acentrella	63		12
Acerpenna	1		
Baetis	8		
Caenis anceps		14	3
Caenis latipennis	2	6	10
Ephemerella	1		
Eurylophella bicolor	8	36	28
Eurylophella enoensis			4
Heptageniidae	34	10	2
Isonychia bicolor	8		
Leptophlebia		1	2
Maccaffertium bednariki	4		
Maccaffertium mediopunctatum		1	
Maccaffertium pulchellum	9	1	2
Stenacron	1	9	1
Stenonema femoratum	-99	1	
LIMNOPHILA			
Menetus			1
Physella			1
LUMBRICINA			
Lumbricina	-99	-99	
LUMBRICULIDA			
Lumbriculidae			2
MEGALOPTERA			
Corydalus	1		
MESOGASTROPODA			
Elimia	-99	-99	22
ODONATA			
Enallagma			4
PLECOPTERA			

Aquid Invertebrate Database Bench Sheet Report
East Fk Huzzah Cr [0930015], Station #1, Sample Date: 4/8/2009 12:10:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Amphinemura	13		6
Isoperla	2		
Leuctridae	112	59	43
Perlesta	2	1	
Pteronarcys pictetii	3		
TRICHOPTERA			
Agapetus	1		
Cheumatopsyche	3		-99
Chimarra	1		
Helicopsyche	2		4
Oecetis			1
Polycentropus	2	1	2
Pycnopsyche	-99	-99	3
TRICLADIDA			
Planariidae	2		1
TUBIFICIDA			
Limnodrilus hoffmeisteri			1
Tubificidae			1

Aquid Invertebrate Database Bench Sheet Report
West Fk Huzzah Cr [0930016], Station #1, Sample Date: 4/8/2009 1:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	12	1	2
AMPHIPODA			
Gammarus		37	27
Hyalella azteca			3
Stygobromus		1	
ARHYNCHOBDELLIDA			
Erpobdellidae	-99		
COLEOPTERA			
Dubiraphia			3
Dytiscidae			1
Ectopria nervosa	1		
Optioservus sandersoni	10	16	5
Psephenus herricki	5	2	
DECAPODA			
Orconectes medius	-99	-99	
Orconectes punctimanus			-99
DIPTERA			
Ablabesmyia		10	4
Ceratopogoninae	3		3
Chironomidae	2	3	5
Clinocera	5		
Corynoneura		3	
Cricotopus bicinctus	1		1
Cricotopus/Orthocladius	29	31	44
Dicrotendipes	1	6	6
Diptera		1	
Dixella	1		
Eukiefferiella brevicalcar grp	10		1
Hemerodromia	13		3
Hydrobaenus			1
Labrundinia			1
Micropsectra	56	28	14
Natarsia		1	
Nilotanypus		1	1
Parakiefferiella	3	29	4
Parametriocnemus	4		
Paratanytarsus		1	96
Paratendipes		5	11
Polypedilum aviceps	9		

Aquid Invertebrate Database Bench Sheet Report
West Fk Huzzah Cr [0930016], Station #1, Sample Date: 4/8/2009 1:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum convictum	13		
Polypedilum scalaenum grp		1	
Rheocricotopus	3		
Rheotanytarsus	10	1	4
Simulium	59		
Stempellina		2	
Stempellinella		2	
Tabanus	-99		
Tanytarsus	6	17	9
Thienemanniella	4	4	8
Thienemannimyia grp.	45	16	10
Tipula	-99		
Tvetenia bavarica grp	8		1
Zavrelimyia		2	1
EPHEMEROPTERA			
Acentrella	32		4
Acerpenna	1		1
Baetis	12		1
Caenis latipennis	1	8	11
Centroptilum		3	5
Diphetor	8		
Eurylophella bicolor		5	5
Eurylophella enoensis			7
Heptageniidae	56	8	
Isonychia bicolor	3		
Leptophlebia			2
Maccaffertium pulchellum	7		
Paraleptophlebia	3	2	1
Stenacron	3	5	1
HEMIPTERA			
Ranatra fusca		-99	
ISOPODA			
Caecidotea			4
LIMNOPHILA			
Helisoma		-99	-99
Menetus			2
Physella		4	10
Planorbella			2
LUMBRICINA			
Lumbricina		-99	
MEGALOPTERA			

Aquid Invertebrate Database Bench Sheet Report
West Fk Huzzah Cr [0930016], Station #1, Sample Date: 4/8/2009 1:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Nigronia serricornis			-99
MESOGASTROPODA			
Elimia		-99	3
ODONATA			
Aeshnidae			1
Argia			1
Calopteryx			1
Gomphidae	2		
Hagenius brevistylus			-99
Ischnura			1
PLECOPTERA			
Amphinemura	4		
Isoperla	4		
Leuctridae	161	78	11
Perlesta	9		1
Pteronarcys pictetii	2		
RHYNCHOBDELLIDA			
Glossiphoniidae		-99	
Piscicolidae		1	
TRICHOPTERA			
Agapetus	11		
Cheumatopsyche	5		
Chimarra	2		
Helicopsyche	3		2
Hydroptila	2		4
Neophylax	1		
Oxyethira			2
Polycentropus	-99		
Pycnopsyche	-99	-99	-99
Triaenodes			3
TRICLADIDA			
Planariidae	1		
TUBIFICIDA			
Tubificidae			1

Aquid Invertebrate Database Bench Sheet Report
Shoal Cr [0930008], Station #1, Sample Date: 3/25/2009 4:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	22	3	4
AMPHIPODA			
Hyalella azteca			17
BRANCHIOBDELLIDA			
Branchiobdellida	1		
COLEOPTERA			
Dubiraphia		29	21
Ectopria nervosa	1	4	1
Microcylloepus pusillus	13		
Optioservus sandersoni	10	4	1
Psephenus herricki	2		
Stenelmis	65	2	
DECAPODA			
Orconectes medius	-99		
DIPTERA			
Ablabesmyia		12	
Atherix	3		
Ceratopogoninae	4	19	7
Chironomidae	1	3	
Chrysops		1	1
Cladotanytarsus		11	
Clinocera	24		1
Corynoneura			2
Cricotopus bicinctus	2	1	2
Cricotopus/Orthocladius	51	17	41
Cryptochironomus		3	
Cryptotendipes		2	
Diamesa	1		
Dicrotendipes		4	2
Diptera		1	
Dixella			2
Djalmabatista		2	2
Ephydridae			1
Eukiefferiella	1		
Hemerodromia		2	1
Labrundinia			14
Micropsectra	2		
Microtendipes		5	
Myxosargus			5

Aquid Invertebrate Database Bench Sheet Report
Shoal Cr [0930008], Station #1, Sample Date: 3/25/2009 4:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Natarsia		7	
Nilotanypus	2		
Orthocladius (Euorthocladius)	3		
Parakiefferiella		4	1
Paralauterborniella		2	3
Parametriocnemus	23		
Paratanytarsus			7
Polypedilum aviceps	11		
Polypedilum convictum	1		
Polypedilum illinoense grp	1		19
Potthastia	6	2	3
Psectrocladius		1	1
Pseudochironomus			1
Rheocricotopus	18		
Rheotanytarsus	25		2
Simulium	73		
Stempellinella	2	13	2
Synorthocladius			1
Tanytarsus	1	13	5
Thienemanniella	3		1
Thienemannimyia grp.	4	9	15
Tipula	-99		
Zavrelimyia			1
EPHEMEROPTERA			
Acentrella	70		
Caenis anceps		79	1
Caenis latipennis	12	43	2
Centroptilum			5
Diphetor	1		
Eurylophella bicolor	15	5	9
Eurylophella enoensis		1	20
Isonychia bicolor	11		
Maccaffertium pulchellum	24		
Serratella	2		
Stenacron	1	1	
Stenonema femoratum	1		
HAPLOTAXIDA			
Haplotaxis		2	
ISOPODA			
Caecidotea			1
LIMNOPHILA			

Aquid Invertebrate Database Bench Sheet Report
Shoal Cr [0930008], Station #1, Sample Date: 3/25/2009 4:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Lymnaeidae			2
Physella			1
LUMBRICINA			
Lumbricina		-99	
MEGALOPTERA			
Corydalus	1		
Nigronia			1
MESOGASTROPODA			
Elimia		1	1
ODONATA			
Argia			1
Calopteryx			1
Enallagma			2
Gomphidae		1	1
PLECOPTERA			
Amphinemura	27		
Leuctridae	27	8	
Perlesta	9		
TRICHOPTERA			
Cheumatopsyche	5		
Chimarra	6		
Helicopsyche	3		
Hydroptila	9	2	
Neophylax	1		
Polycentropus		1	1
Psychomyia	2		
Rhyacophila	2		
TRICLADIDA			
Planariidae	4		2
TUBIFICIDA			
Branchiura sowerbyi			1
Enchytraeidae			2
Limnodrilus hoffmeisteri		2	3
Spirosperma		1	
Tubificidae		8	10
VENEROIDA			
Pisidiidae			6

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0918402], Station #3, Sample Date: 9/15/2009 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	6	1	
BRANCHIOBDELLIDA			
Branchiobdellida	1		1
COLEOPTERA			
Dubiraphia		14	15
Macronychus glabratus			3
Optioservus sandersoni	30		1
Psephenus herricki	1		
Stenelmis	1		
DECAPODA			
Orconectes medius	1	2	
DIPTERA			
Ablabesmyia		3	6
Ceratopogoninae			1
Chironomidae	1	3	
Corynoneura		3	
Cricotopus/Orthocladius			1
Dicrotendipes			1
Diptera		1	
Dixa			3
Dixella		1	1
Forcipomyiinae	2		
Hemerodromia	27	2	11
Larsia		1	
Microtendipes		4	1
Myxosargus			1
Nanocladius		1	
Parakiefferiella		2	
Parametriocnemus	5	1	3
Paratanytarsus		5	32
Paratendipes		2	2
Phaenopsectra		1	
Polypedilum aviceps	4	1	
Polypedilum illinoense grp	1		
Pseudosmittia		1	
Rheocricotopus	5		
Rheotanytarsus	7	1	7
Simulium	5		1
Stempellinella	127	168	126

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0918402], Station #3, Sample Date: 9/15/2009 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Stenochironomus		2	2
Tanytarsus	11	80	45
Thienemanniella	1	2	
Thienemannimyia grp.	7		2
Tipula			2
Tribelos		1	
Zavrelimyia	1		
EPHEMEROPTERA			
Acentrella	2		
Baetis	61		
Caenis latipennis		2	
Eurylophella bicolor			1
Eurylophella enoensis		1	
Isonychia	71		3
Leptophlebiidae			6
Maccaffertium pulchellum	107	1	1
Stenacron	9	8	3
Stenonema femoratum		3	
HEMIPTERA			
Microvelia	1		
Rhagovelia	1		1
ISOPODA			
Caecidotea	8	5	6
LIMNOPHILA			
Ancylidae	2	1	
LUMBRICULIDA			
Lumbriculidae			2
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis	7	-99	1
ODONATA			
Calopteryx		4	9
Gomphidae	7	1	1
Gomphus		1	1
Hagenius brevistylus		2	
Stylogomphus albistylus		-99	1
PLECOPTERA			
Perlesta			1
Zealeuctra	9		
TRICHOPTERA			

Aquid Invertebrate Database Bench Sheet Report
Shibboleth Br [0918402], Station #3, Sample Date: 9/15/2009 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Cheumatopsyche	59	1	3
Chimarra	23		1
Oxyethira			1
Polycentropodidae	4		7
Ptilostomis			1
Triaenodes			22
TRICLADIDA			
Planariidae	1		
TUBIFICIDA			
Branchiura sowerbyi		2	2
Tubificidae		3	
VENEROIDA			
Pisidiidae	1		1

Appendix C

Fine Sediment Percentage Statistical Analysis:
Kruskal-Wallis One Way Analysis of Variance on Ranks,
Test Stations vs. Controls

Key: Test Stations-PC=Pond Creek; SB=Shibboleth Branch; TOM=Trib. Old Mines Creek; SPC=Salt Pines Creek; FFB=Fountain Farm Branch
Controls-Brazil Creek, Courtois Creek, East Fork Huzzah Creek, West Fork Huzzah Creek, Shoal Creek

One Way Analysis of Variance Thursday, April 02, 2009, 12:52:42 PM

Data source: Data 1 in Tribs 2008 Stats

Dependent Variable: percent

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks Thursday, April 02, 2009, 12:52:42 PM

Data source: Data 1 in Tribs 2008 Stats

Group	N	Missing	Median	25%	75%
PC #2	18	0	95.000	90.000	95.000
PC #1	18	0	27.000	23.000	55.000
SB #3	18	0	15.000	5.000	87.000
SB #2	18	0	35.000	13.000	80.000
SB #1	18	0	36.500	15.000	77.000
TOM	18	0	62.500	20.000	83.000
SPC	18	0	11.000	5.000	33.000
FFB	18	0	45.000	13.000	91.000
Controls	90	0	7.000	3.000	20.000

H = 94.461 with 8 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

Multiple Comparisons versus Control Group (Dunn's Method):

Comparison	Diff of Ranks	Q	P<0.05
PC 2 vs. Control	142.806	8.170	Yes
TOM vs. Control	81.083	4.639	Yes
FFB vs. Control	75.472	4.318	Yes
SB2 vs. Control	67.389	3.856	Yes
SB1 vs. Control	64.694	3.701	Yes
PC 1 vs. Control	62.722	3.589	Yes
SB3 vs. Control	44.806	2.563	No
SPC vs. Control	13.889	0.795	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Appendix D

Photographs of Sediment Bars in Shibboleth Branch #2 and #1 (in order)