



# Missouri Department of Natural Resources

## **Biological Assessment Report**

### **Middle Fork Salt River Macon and Monroe Counties, Missouri**

**September 2007- March 2008**

Prepared for:

Missouri Department of Natural Resources  
Division of Environmental Quality  
Water Protection Program  
Water Pollution Control Branch

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## **1.0 Introduction**

At the request of the Missouri Department of Natural Resources (**MDNR**), Water Protection Program (**WPP**), the Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) conducted a macroinvertebrate bioassessment and habitat study of the Middle Fork Salt River, water body identification number 121 in Macon and Monroe counties in northeast Missouri.

This study assessed approximately 49 miles of the Middle Fork Salt River from sec. 9, T. 54 N., R. 9 W. at the confluence with Mark Twain Lake in Monroe County upstream to the confluence of Narrow Creek at sec. 16, T. 56 N., R. 13 W. in Macon County (Missouri Water Quality Standards (**WQS**) (MDNR 2005a). According to the WQS, Middle Fork Salt River is a class “P” (perennial) stream, with the following designated uses: irrigation, livestock and wildlife watering, protection of warm water aquatic life and human health fish consumption, secondary contact recreation, drinking water supply, and category B whole body contact recreation.

On Missouri’s 2002 303(d) list, the entire 49-mile section of Middle Fork Salt River was listed as impaired for sedimentation from agricultural non-point sources. The watershed is approximately 348 square miles and comprised mostly of grassland, cropland, and forest. In 2006, the Environmental Protection Agency established a Total Maximum Daily Load (**TMDL**) for the Middle Fork Salt River. According to the TMDL, the beneficial use that is impaired is warm water aquatic life. However, at the time the TMDL was established, a biological assessment was not available for this water body.

## **1.1 Purpose**

The purpose of the study was to determine if the biological community of Middle Fork Salt River is impaired.

## **1.2 Objectives**

- 1) Assess the habitat characteristics of Middle Fork Salt River.
- 2) Assess the macroinvertebrate community of Middle Fork Salt River.
- 3) Assess the physicochemical characteristics of Middle Fork Salt River.

## **1.3 Tasks**

- 1) Conduct a habitat assessment of Middle Fork Salt River.
- 2) Conduct a bioassessment of the macroinvertebrate community of Middle Fork Salt River.
- 3) Conduct physicochemical monitoring of Middle Fork Salt River.

## **1.4 Null Hypotheses**

- 1) Habitat will not differ substantially among Middle Fork Salt River stream segments.
- 2) Habitat will not differ between Middle Fork Salt River and biocriteria reference streams in the Central Plains/Cuivre/Salt Ecological Drainage Unit (**EDU**).

- 3) Macroinvertebrate assemblages will not differ substantially among Middle Fork Salt River stream segments.
- 4) Macroinvertebrate assemblages will not differ substantially between Middle Fork Salt River and biocriteria reference streams in the Central Plains/Cuivre/Salt EDU.

## 2.0 Methods

Staff of the MDNR, ESP, WQMS conducted this study. Sampling was conducted during the fall of 2007 and the spring of 2008. Fall sampling was conducted on September 26-27 and October 2-3 2007 and consisted of macroinvertebrate sampling, habitat assessments, and water quality sampling at eight stations on Middle Fork Salt River. During the spring, water quality and macroinvertebrate sampling were conducted on April 1-2, 2008. Excessive spring rainfall disrupted much of the sampling season and high water prevented sampling at stations 1, 2, 4, 5, and 7. Stations 3, 6, and 8 were sampled during the spring sampling season with Station 6 being sampled as a quality control duplicate. Methods are included for biological assessments, stream habitat assessments, and physicochemical water quality collection.

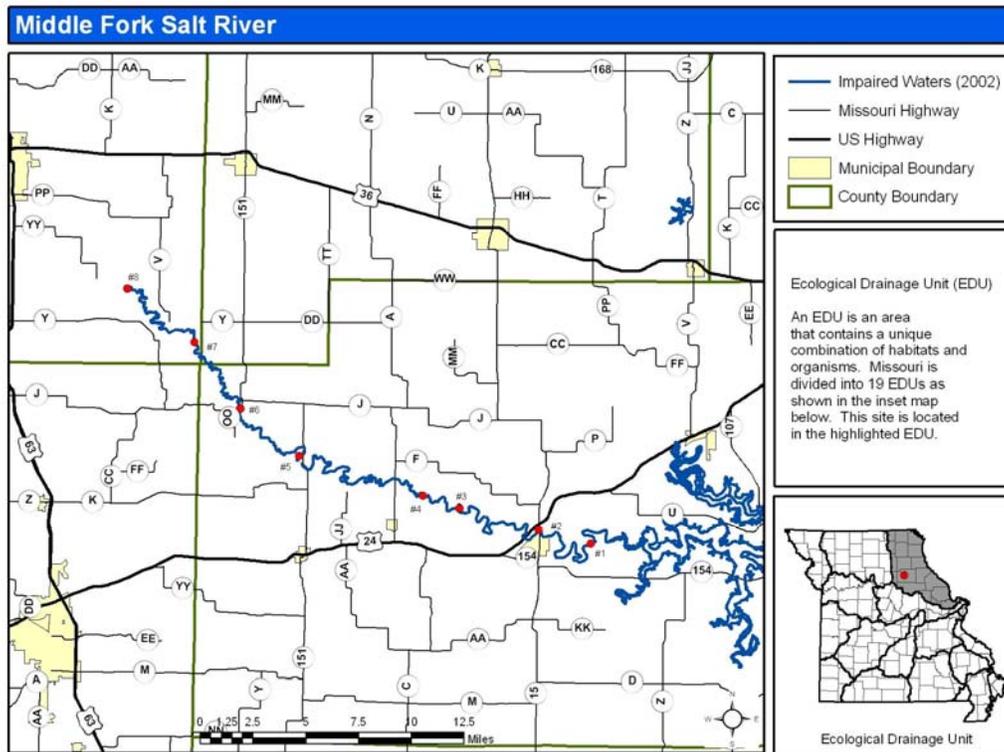
## 2.1 Study Area and Station Descriptions

The study area included approximately 49 miles of Middle Fork Salt River in Monroe and Macon counties (Figure 1). Eight stations were chosen. Station locations and descriptions are listed below in Table 1.

Table 1  
 Descriptive Information for Middle Fork Salt River Stations

Stations	Location - UTM Zone 15	Description	County
Station 1	589879 E 4370425 N	Upstream at the USACE hunting/fishing access 33 on County Road 425	Monroe
Station 2	585919 E 4371506 N	Upstream at MDC's Paris access	Monroe
Station 3	579872 E 4373177 N	End of a farm road off County Road 237	Monroe
Station 4	577077 E 4374142 N	Downstream of County Road 215	Monroe
Station 5	567619 E 4377173 N	Woodland Conservation Area	Monroe
Station 6	563129 E 4380807 N	Upstream of State Route J	Monroe
Station 7	559646 E 4385824 N	Upstream of Owatonna Blvd.	Macon
Station 8	554544 E 4389935 N	Upstream of Nature Ave.	Macon

Figure 1  
Middle Fork Salt River Sampling Stations for Fall 2007 and Spring 2008.



### 2.1.1 Land Use Description

The land use conditions were summarized from land cover GIS files. Percent land cover data were derived from Thematic Mapper (TM) satellite data collected between 2000 and 2004 and interpreted by the Missouri Resource Assessment Partnership (**MoRAP**). See Table 2 for a comparison of land use for the EDU and the 14-digit hydrologic unit codes (**HUC**) that contain Middle Fork Salt River study segments.

Table 2  
 Percent Land Cover in the Middle Fork Salt River  
 Stations and Central Plains/Cuivre/Salt EDU

Stations	14-digit HUC	Urban	Crops	Grass	Forest	Wetland	Open-water
Station 1	07110006010006	2	21	38	24	1	10
Station 2	07110006010006	2	21	38	24	1	10
Station 3	07110006010006	2	21	38	24	1	10
Station 4	07110006010006	2	21	38	24	1	10
Station 5	07110006010004	1	23	43	26	3	0
Station 6	07110006010004	1	23	43	26	3	0
Station 7	07110006010004	1	23	43	26	3	0
Station 8	07110006010002	6	22	45	20	4	0
Central Plains/ Cuivre/Salt EDU	NA	3	42	29	19	0	0

## 2.2 Stream Habitat Assessment Project Procedure

Standardized assessment procedures were followed as described for glide/pool prevalent streams in the Stream Habitat Assessment Project Procedure (SHAPP) (MDNR 2003a). According to the SHAPP, the aquatic community is influenced by the quality of the stream habitat. Stream habitat quality is scored for each station and the scores are compared with SHAPP control (reference) station scores. If the SHAPP score at a test station is  $\geq 75\%$  of the SHAPP control scores, the stream habitat at the test station is considered to be comparable to the reference (control) stream. North River, located in Marion County, is a biocriteria reference site and was chosen as the SHAPP control.

## 2.3 Bioassessment

### 2.3.1 Macroinvertebrate Sampling and Analyses

Macroinvertebrate sampling was conducted according to the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (MDNR 2003b). Middle Fork Salt River is considered a glide/pool dominated system. The three standard habitats of glide/pool streams sampled at all locations were: non-flowing water over depositional substrate, large woody debris substrate, and rootmat substrate. Macroinvertebrates were sub sampled in the laboratory and identified to specific taxonomic levels (MNDR 2005b) in order to develop biological criteria metrics (MDNR 2003b).

Macroinvertebrate data were evaluated by comparing with biological criteria for perennial/wadeable streams of the Central Plains/Cuivre/Salt EDU. An EDU is an ecological area in which the aquatic biological communities and stream habitat can be expected to be similar. See the inset in Figure 1 for general stream location within the Central Plains/Cuivre/Salt EDU.

Biological criteria are calculated separately for the fall (mid-September through mid-October) and spring (mid-March through mid-April) index periods. The Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure provides details on the calculation of metrics and scoring of the multi-metric Macroinvertebrate Stream Condition Index (**MSCI**). The four components of the MSCI are: Taxa Richness (**TR**); Ephemeroptera, Plecoptera, and Trichoptera Taxa (**EPTT**); Biotic Index (**BI**); and the Shannon Diversity Index (**SDI**). An MSCI score of 16-20 is considered as full biological sustainability, 10-14 as partial biological sustainability, and 4-8 as non-biological sustainability.

### **2.3.2 Physicochemical Water Sampling and Analyses**

Physicochemical water samples were handled according to the appropriate MDNR, ESP Standard Operating Procedure (**SOP**) and/or Project Procedure (**PP**). Results for physicochemical water parameters were examined by season and station. All physicochemical water parameters were sampled by field measurements or grab samples. Water samples were collected according to the SOP MDNR-ESP-001 Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2008a). All samples were kept on ice during transport to ESP.

Water quality parameters were measured *in-situ* or collected and returned for analyses at the state environmental laboratory. Temperature (C°) (MDNR2003c), pH (MDNR 2001a), specific conductance (µS) (MDNR 2003d), dissolved oxygen (mg/L) (MDNR 2002a), and discharge (cubic feet per second-cfs) (MDNR 2003e) were measured in the field. Turbidity (NTU) (MDNR 2005c) was measured and recorded in the ESP, WQMS biology laboratory. The ESP, Chemical Analysis Section (**CAS**) in Jefferson City, Missouri conducted the analyses for ammonia-nitrogen (mg/L), nitrate+nitrite-nitrogen (mg/L), total nitrogen (mg/L), chloride (mg/L), and total phosphorus (mg/L).

Physicochemical water parameters were compared between stations as well as with Missouri's WQS (MDNR 2005a). Interpretation of acceptable limits in the WQS may be dependent on a stream's classification and its beneficial-use as designated in the WQS (MDNR 2005a).

### **2.3.3 Discharge**

Stream flow was measured using a SonTek/YSI FlowTracker® flow meter at each station. Velocity and depth measurements were recorded at each station according to SOP MDNR-WQMS-113 Flow Measurement in Open Channels (MDNR 2003e).

## **3.0 Results and Analyses**

### **3.1 Land Use**

The land use data in Table 2 provides a comparison between the 14-digit hydrologic units covered within the study reach of the Middle Fork Salt River with the Central

Plains/Cuivre/Salt EDU. The 49-mile reach of the Middle Fork Salt River contains three separate 14-digit HUC's. The land use coverage is fairly comparable within the three HUC's. The lower portion of the watershed contains more open water while the upper watershed contains slightly more grassland. Overall, the Central Plains/Cuivre/Salt EDU watershed contains more cropland and less grassland than the immediate watershed of the Middle Fork Salt River. General land use is not expected to negatively impact the biological community.

### 3.2 Stream Habitat Assessment

Scoring results of the habitat assessment are found in Table 3. If the study station SHAPP score is  $\geq 75\%$  of the control station score, the stations are considered to contain comparable habitats. Comparable habitats should be able to support comparable biological communities. Station 1 scored  $< 75\%$ . The remaining 7 stations all scored  $> 75\%$ . Although the SHAPP for station 1 scored less than 75% of the control site, the differences in the habitat did not appear to negatively affect the biological community.

Table 3  
 Stream Habitat Assessment Scores and Percentage  
 Comparison for Middle Fork Salt River

Stations	SHAPP Scores	% of Reference
Station 1	83	70
Station 2	119	100
Station 3	134	113
Station 4	104	87
Station 5	106	89
Station 6	120	101
Station 7	120	101
Station 8	101	85
North River (SHAPP Control)	119	----

### 3.3 Biological Assessment and Macroinvertebrate Community Analyses

Tables 4 and 5 provide scoring criteria and results for the fall and spring index periods, respectively. MSCI scores are calculated by scoring station metrics against the appropriate Biological Criteria (BIOREF) scores located in the tables. An MSCI score of 16 - 20 results in an assignment of a fully supported biological community. All Middle Fork Salt River stations except station 5 scored an MSCI of fully supporting during the fall sampling season. The three stations sampled during the spring all scored an MSCI of fully supporting.

Table 4  
 Fall 2007 Biological Criteria (BIOREF) Metric Scores, Biological Support Category, and  
 Stream Condition Index (MSCI) Scores

Stations	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Station 1	0703271	87	20	7.2	3.56	18	Full
Station 2	0703270	82	15	6.7	3.39	20	Full
Station 3	0703269	75	15	6.7	3.55	20	Full
Station 4	0703268	73	14	6.8	3.17	18	Full
Station 5	0703267	66	11	7.1	2.71	14	Partial
Station 6	0703266	63	10	6.9	3.09	16	Full
Station 7	0703265	61	12	7.3	2.98	18	Full
Station 8	0703264	71	13	6.9	3.26	18	Full
BIOREF Score=5		> 59	> 11	< 6.8	> 2.9	20-16	Full
BIOREF Score=3		59-29	11-5	6.8-8.4	2.9-1.45	14-10	Partial
BIOREF Score=1		< 29	< 5	> 8.4	< 1.45	8-4	Non

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

Table 5  
 Spring 2008 Biological Criteria (BIOREF) Metric Scores, Biological Support Category,  
 and Stream Condition Index (MSCI) Scores

Stations	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Station 3	0804029	75	12	7.1	2.98	20	Full
Station 6a	0804027	55	6	8.0	2.61	16	Full
Station 6b	0804028	62	10	7.8	2.67	18	Full
Station 8	0804026	53	7	7.3	2.45	16	Full
BIOREF Score=5		> 49	> 7	< 7.2	> 2.09	20-16	Full
BIOREF Score=3		49-25	7-3	7.2-8.6	2.09-1.05	14-10	Partial
BIOREF Score=1		< 25	< 3	> 8.6	< 1.05	8-4	Non

MSCI Scoring Table (in light gray) developed from BIOREF streams (n = 9). TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

The fall 2007 community analysis is shown in Table 6. Chironomidae was the dominant family at all stations except station 5 in which Caenidae was the dominant family. Elmidae was the second dominant family at the downstream stations and the most upstream station while Caenidae was the second dominant family at stations 6 and 7. Of the EPT taxa, all stations had Ephemeroptera and Trichoptera but lacked Plecoptera.

Table 6  
 Fall 2007 Macroinvertebrate Summary

Station	1	2	3	4	5	6	7	8
% Ephemeroptera	12	6.5	19.3	25	39.7	34.5	18.2	18
% Plecoptera	0	0	0	0	0	0	0	0
% Trichoptera	0.8	1.9	3	3.3	3	1.8	2	1.2
Total EPT %	12.8	8.4	22.3	28.3	42.7	36.3	20.2	19.2
% Diptera	49.5	48.9	28.9	30.9	17.6	26.3	47.3	36
% Dominant Families								
Chironomidae	45.9	45.8	26.1	29.4	16	24.9	45.5	31.6
Elmidae	12.2	18.5	19.1	20.5	14.9	15.4	9.5	15.6
Caenidae	3.4	1.4	4.2	20.3	34.7	21	16.2	9.1
Coenagrionidae	8.8	4.7	3.1	6.4	4.8	5.7	3.9	4.8
Tubificidae	6.1	5.1	6.8	2.5	9.5	7.5	6.1	1.6
Heptageniidae	4.7	3.2	7	1.0	2.1	8.7	0.8	1.7

The spring 2008 macroinvertebrate community analysis is shown in Table 7. Chironomidae was the dominant family at the stations sampled while Caenidae was the second dominant family at stations 3 and 6a and 6b. EPT taxa were present at station 3 and the duplicate station, 6b. Station 6a and station 8 contained Ephemeroptera and Trichoptera but lacked Plecoptera.

Table 7  
 Spring 2008 Macroinvertebrate Summary

Station	3	6a	6b	8
% Ephemeroptera	19.3	25.3	31.2	14.5
% Plecoptera	0.1	0	0.1	0
% Trichoptera	0.8	0.3	0.4	0.6
Total EPT %	20.2	25.6	31.7	15.1
% Diptera	60	58	47.5	69.3
% Dominant Families				
Chironomidae	44.4	52.4	40	46.5
Caenidae	17.7	22.7	28.1	13.5
Simuliidae	13.5	0.6	1.4	20.9
Tubificidae	8.3	5.9	8.2	4.2
Elmidae	3.6	2.7	5.5	1.9
Enchytraeidae	1.3	3.4	0.8	6.5

### 3.4 Physicochemical Water Parameters

Physicochemical results from both sampling seasons can be found in Tables 8 and 9. The dissolved oxygen at stations 5, 6, 7, and 8 failed to meet the minimum requirement of 5.0 mg/L during the fall sampling period. The values for these four stations ranged from 3.78 mg/L to 4.07 mg/L. Although these sites had low dissolved oxygen, this was a grab sample and the stations still exhibited fair values for dissolved oxygen. The lower levels of dissolved oxygen present are not expected to significantly affect the biological community.

During the fall 2007 sampling season, station 8 showed increased levels of chloride, flow, turbidity, and total nitrogen. The area received almost an inch of rain (see elevated flow) the evening previous to sampling. Increased runoff from the surrounding agricultural land likely influenced the water parameters from station 8. Little variation occurred between sites during the spring season. Physicochemical water quality is not expected to impact the biological community during the study seasons.

Table 8  
 Fall 2007 Physicochemical Water Parameters

Stations:	1	2	3	4	5	6	7	8
Parameters:								
Ammonia as N (mg/L)	0.03*	0.03*	0.03*	0.03*	0.03*	0.03*	0.05	0.03*
Chloride (mg/L)	22.0	9.59	18.9	23.1	30.7	32.2	84.5	104
Dissolved Oxygen (mg/L)	5.94	5.25	6.24	5.97	3.97	3.78	4.07	3.9
Flow (cfs)	6.48	3.31	3.49	3.49	2.79	2.25	1.83	18.0
pH (su)	7.9	7.9	7.7	7.9	7.5	7.3	7.9	7.6
Specific Conductance (µS/cm)	338	374	347	379	418	462	733	827
Temperature (°C)	18.5	20.0	19.0	18.5	18.0	18.5	20.0	18.5
Turbidity (NTU)	15.1	11.9	8.6	8.04	25.2	29.7	14.7	64.5
Nitrate+Nitrite as N (mg/L)	0.05	0.01*	0.01*	0.01*	0.06	0.07	0.03	0.68
Total Nitrogen (mg/L)	0.58	0.78	0.47	0.46	0.66	0.81	0.75	1.48
Total Phosphorus (mg/L)	0.14	0.21	0.09	0.08	0.11	0.14	0.09	0.7

\* Below detectable limits

Table 9  
 Spring 2008 Physicochemical Water Parameters

Stations:	3	6a	6b	8
Parameters:				
Ammonia as N (mg/L)	0.03*	0.05	0.08	0.03*
Chloride (mg/L)	18.4	24.3	24.4	32.9
Dissolved Oxygen (mg/L)	13.2	10.5	10.5	9.89
Flow (cfs)	63.6	59.1	59.1	45.1
pH (su)	8.21	7.92	7.92	8.38
Specific Conductance (µS/cm)	396	390	390	442
Temperature (°C)	9.5	8.0	8.0	9.0
Turbidity (NTU)	13.2	18.2	18.4	22.8
Nitrate+Nitrite as N (mg/L)	0.16	0.39	0.39	0.48
Total Nitrogen (mg/L)	0.9	1.11	1.07	1.25
Total Phosphorus (mg/L)	0.03	0.07	0.07	0.18

\* Below detectable limits

#### 4.0 Biological Assessment QA/QC

The goal of the sampling protocol is to collect a majority of the taxa with consistent relative abundance from each of three major habitats in a reach of stream. Within the sampling reach, duplicate samples will be collected and analyzed for quantitative similarity index for taxa (QSIT). The QSIT compares two aquatic communities in terms of presence or absence of taxa, also taking relative abundance (percent composition) of each taxa into account (MDNR 2003b). Duplicate samples are expected to have a 70% or greater taxa similarity (Rabeni et al. 1999, MDNR 2003b). During the spring sampling season, duplicate samples were collected at station 6. The QSIT for these stations was 74.5%.

#### 5.0 Discussion.

According to the SHAPP scores, all stations except station 1 contain comparable habitats to the SHAPP control station on the North River in Marion County. Station 1 was located at a Corps of Engineers hunting/fishing access site. The stream bed received little shade as the banks appeared to have levees and were mowed with a forested corridor set back from the banks. There were areas of rocky substrate but also lots of sand. Little rootmat was present. All other stations appeared to have natural channels with relatively healthy riparian areas and plentiful sampling habitats. Stations 3 and 4 contained many mussels and had more rock substrate than either upstream or downstream of this section.

With the exception of station 5 during the fall sampling season, macroinvertebrate data did not reveal any impairment in the Middle Fork Salt River. Station 5 was located at Missouri Department of Conservation's Woodlawn Access. The banks at this station were fairly steep and dropped off vertically at the water's edge. The stream bottom was fairly consistent throughout the study section. Along the banks, the substrate was silty and became relatively sandy in the middle of the channel. The study reach had little sinuosity but did not appear channelized. This site had a relatively healthy and mature riparian zone along both banks.

In reviewing the data, the EPTT, BI, and SDI values at this station did not score in the optimum range. Of all the stations sampled during the fall season, station 5 was the only station in which Caenidae was the dominant family, comprising almost 35% of the benthic community and approximately 88% of the Ephemeroptera collected at this station. Caenidae is a fairly tolerant mayfly family. *Caenis latipennis* was the only Caenidae identified and has a BI value of 7.6.

There was little variation in the community make up during each sampling season. Dominant families were fairly consistent between the stations. During the fall, Chironomidae and Elmidae were the dominant families. As sampling moved downstream in the watershed, Caenidae became more prevalent. Spring sampling revealed Chironomidae and Caenidae to be the most abundant. Stations 3 and 8 also had fair numbers of Simuliidae. Total EPT taxa ranged from 12.8% to 42.7% during the fall and 15.1% to 31.7% during the spring. Plecoptera were absent during the fall and were rare during the spring.

The physicochemical data does not show any significant trends. During the fall sampling season, chloride and specific conductance were slightly elevated at the two most downstream sites. This could be due to both sites being located adjacent to the town of Paris. The WWTF for Paris discharges into the Middle Fork Salt River between these two stations and septic systems are prevalent in this area.

## **6.0 Conclusion**

Four null hypotheses were stated in the introduction: 1) Habitat will not differ substantially among Middle Fork Salt River stream segments; 2) Habitat will not differ between Middle Fork Salt River and biocriteria reference streams in the Central Plains/Cuivre/Salt EDU; 3) Macroinvertebrate assemblages will not differ substantially among Middle Fork Salt River stream segments; 4) Macroinvertebrate assemblages will not differ substantially between Middle Fork Salt River and biocriteria reference streams in the Central Plains/Cuivre/Salt EDU.

Null hypothesis #1 is accepted. Although the habitat score for station 1 was low during the fall sampling season, overall, land use and SHAPP scores revealed that habitat of the Middle Fork Salt River stations is comparable.

Null hypothesis #2 is accepted for all stations except station 1. The habitat score for station 1 was less than 75% of the control station. However, this did not affect the macroinvertebrate community. The MSCSI score for this station was fully supporting. Overall, land use and SHAPP scores revealed the habitat of the Middle Fork Salt River stations was comparable to BIOREF stations within the Central Plains/Cuivre/Salt EDU.

Null hypothesis #3 is accepted. The macroinvertebrate community of all Middle Fork Salt River stations exhibited similar dominant taxa during each sampling season.

Null hypothesis #4 is accepted for all stations, except station 5, during the fall sampling season. The macroinvertebrate community of the remaining Middle Fork Salt River stations during the fall and all stations during the spring ranked as fully supporting and therefore, did not substantially differ from the MSCSI calculated from biocriteria reference streams within the same EDU.

Overall, the bioassessment for the Middle Fork Salt River suggests no biological impairment due to water quality or habitat parameters. The MSCSI scores of 7 out of the 8 stations during the fall and all 3 stations sampled during the spring are >16, indicating a healthy macroinvertebrate community. The habitat scores for the study stations, with the exception of station 1, which was channelized and maintained, are considered comparable to the control station. The physicochemical results revealed few definitive trends other than typical seasonal differences.

## **7.0 Literature Cited**

Missouri Department of Natural Resources. 2001a. Field Analysis of Water Samples for pH. Field Services Section-100. Environmental Services Program. P.O. Box 176, Jefferson City, Missouri. 10pp.

Missouri Department of Natural Resources. 2002a. Sample Collection and Field Analysis of Dissolved Oxygen Using a Membrane Electrode Meter. Water Quality Monitoring Section-103. Environmental Services Program. P.O. Box 176, Jefferson City, Missouri. 13pp.

Missouri Department of Natural Resources. 2003a. Stream habitat assessment project procedure. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 40 pp.

Missouri Department of Natural Resources. 2003b. Semi-quantitative macroinvertebrate stream bioassessment project procedure. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 24 pp.

Missouri Department of Natural Resources. 2003c. Field Measurement of Water Temperature. Field Services Section-101. Environmental Services Program. P.O. Box 176, Jefferson City, Missouri. 3pp.

Missouri Department of Natural Resources. 2003d. Field Analysis of Specific Conductance. Field Services Section-102. Environmental Services Program. P.O. Box 176, Jefferson City, Missouri. 14pp.

Missouri Department of Natural Resources. 2003e. Flow measurements in open channels. Water Quality Monitoring Section-113. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 9 pp.

Missouri Department of Natural Resources. 2005a. Title 10. Rules of Department of Natural Resources Division 20-Clean Water Commission, Chapter 7-Water Quality. 10 CSR 20-7.031 Water Quality Standards. pp. 10-136.

Missouri Department of Natural Resources. 2005b. Taxonomic levels for macroinvertebrate identifications. Water Quality Monitoring Section-209. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 30 pp.

Missouri Department of Natural Resources. 2005c. Analysis of Turbidity Using the Hach 2100P Portable Turbidimeter. Water Quality Monitoring Section-012. Environmental Services Program. P.O. Box 176, Jefferson City, Missouri. 9pp.

Missouri Department of Natural Resources. 2008a. Required/recommended containers, volumes, preservatives, holding times, and special sampling considerations. Environmental Services Program-001. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 26 pp.

Rabeni, C.F., N. Wang, and R.J. Sarver. 1999. Evaluating adequacy of the representative stream reach used in invertebrate monitoring programs. *J. N. Amer. Bentholical Soc.* 18(2): 284-291.

Submitted by:

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Approved by:

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## **Appendix A**

Invertebrate Database Bench Sheet Report

Middle Fork Salt River

Macon and Monroe Counties

Grouped by Season and Station

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0703264], Station #8, Sample Date: 9/26/2007 10:00:00 AM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	6		
<b>AMPHIPODA</b>			
Hyaella azteca		15	
<b>COLEOPTERA</b>			
Dubiraphia	7	105	
Enochrus			1
Laccobius	1		1
Macronychus glabratus		3	
Scirtidae			7
<b>DECAPODA</b>			
Orconectes immunis		-99	2
Orconectes virilis		-99	
<b>DIPTERA</b>			
Ablabesmyia	4		2
Chironomus	10		
Cladotanytarsus	6		
Cryptochironomus	2	1	
Dicrotendipes	5		17
Diptera	1		
Ephydriidae			1
Forcipomyiinae			15
Gonomyia	6		5
Limonia			1
Paralauterborniella	2		
Paratanytarsus	1	1	1
Polypedilum	2		
Polypedilum halterale grp	9		
Polypedilum illinoense grp	9		3
Procladius	1		
Pseudochironomus			5
Rheotanytarsus	1		
Stelechomyia			1
Stempellinella	13		
Stenochironomus			28
Stratiomyidae		1	
Tanytarsus	81	7	6
Thienemannimyia grp.		1	
Tipulidae			1
Tribelos	5	6	2
undescribed Empididae		1	

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0703264], Station #8, Sample Date: 9/26/2007 10:00:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Xenochironomus		1	
<b>EPHEMEROPTERA</b>			
Acerpenna	2		
Baetis	6	1	1
Caenis latipennis	52	11	4
Hexagenia limbata	8		
Leptophlebiidae	2	25	
Paracloeodes	2		
Proclleon	2		4
Stenacron	8	1	4
<b>HEMIPTERA</b>			
Microvelia			6
Neoplea		1	
Ranatra fusca		1	
Rhagovelia			2
Rheumatobates		1	
<b>LIMNOPHILA</b>			
Helisoma	-99		
Lymnaeidae		2	
Menetus		38	
Physella	11	13	17
<b>MEGALOPTERA</b>			
Sialis		-99	
<b>MESOGASTROPODA</b>			
Hydrobiidae	1		
<b>ODONATA</b>			
Argia	2	26	4
Basiaeschna janata			1
Calopteryx			1
Enallagma		4	
Nasiaeschna pentacantha			1
Progomphus obscurus	2		
<b>TRICHOPTERA</b>			
Cheumatopsyche	4		
Nectopsyche		1	
Neotrichia		1	
Oecetis	1		
Triaenodes		2	
<b>TUBIFICIDA</b>			
Branchiura sowerbyi	2	1	

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0703264], Station #8, Sample Date: 9/26/2007 10:00:00 AM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Enchytraeidae			1
Tubificidae	4	2	3
<b>VENEROIDEA</b>			
Sphaeriidae	3	31	

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0703265], Station #7, Sample Date: 9/26/2007 1:10:00 PM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	16	4	
<b>AMPHIPODA</b>			
Hyaella azteca	1	41	29
<b>COLEOPTERA</b>			
Dubiraphia	26	56	5
Helichus lithophilus		1	
Macronychus glabratus		3	6
Neoporus	1		
Peltodytes	1		1
Scirtidae		8	3
<b>DECAPODA</b>			
Orconectes virilis		-99	
<b>DIPTERA</b>			
Ablabesmyia	4	3	
Ceratopogoninae	6	3	
Chironomus	13		3
Chrysops		1	
Cladotanytarsus	1		
Cryptochironomus	9		
Dicrotendipes	5	35	126
Forcipomyiinae		1	5
Glyptotendipes		4	8
Labrundinia		1	
Parachironomus		3	
Parakiefferiella	1	1	
Paratanytarsus		5	
Polypedilum		1	1
Polypedilum halterale grp	7		
Polypedilum illinoense grp	6	20	2
Polypedilum scalaenum grp	3		1
Procladius	13		3
Pseudochironomus			34
Stelechomyia		1	1
Stempellinella	2		
Stenochironomus			1
Tanytarsus	29	14	37
Thienemannimyia grp.		3	2
Tribelos	11		45
undescribed Empididae		2	

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0703265], Station #7, Sample Date: 9/26/2007 1:10:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>EPHEMEROPTERA</b>			
Brachycercus	1		
Caenis latipennis	99	15	49
Callibaetis	1		
Hexagenia	3		1
Leptophlebiidae		3	1
Proclleon	1		1
Stenacron	1	1	7
<b>HEMIPTERA</b>			
Belostoma		-99	
Corixidae	1		
Neoplea		2	
<b>LIMNOPHILA</b>			
Menetus	1	1	3
Physella		1	
<b>LUMBRICULIDA</b>			
Lumbriculidae	4		1
<b>ODONATA</b>			
Argia		22	14
Basiaeschna janata		-99	
Enallagma		4	
Nasiaeschna pentacantha		-99	
<b>TRICHOPTERA</b>			
Neotrichia		3	
Neureclipsis			3
Nyctiophylax			4
Oecetis	7	1	
Polycentropus	1	2	
<b>TRICLADIDA</b>			
Planariidae		5	1
<b>TUBIFICIDA</b>			
Branchiura sowerbyi	3		
Tubificidae	54	2	3
<b>VENEROIDEA</b>			
Sphaeriidae	2		

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0703266], Station #6, Sample Date: 9/27/2007 10:30:00 AM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	4	3	3
<b>AMPHIPODA</b>			
Hyaella azteca		12	1
<b>BRANCHIOBDELLIDA</b>			
Branchiobdellida	3	1	
<b>COLEOPTERA</b>			
Dubiraphia	28	91	2
Helichus lithophilus		3	1
Macronychus glabratus	2	5	12
Scirtidae		11	1
<b>DECAPODA</b>			
Orconectes luteus	-99		
Orconectes virilis	1	1	
<b>DIPTERA</b>			
Ablabesmyia	6	2	3
Ceratopogonidae	4		
Chironomus	1		
Corynoneura			1
Crictopus/Orthocladius	1		3
Cryptochironomus	1		
Cryptotendipes	2		
Dicrotendipes	2	2	22
Diptera			1
Forcipomyiinae	1		5
Glyptotendipes	1	1	4
Harnischia	1		
Labrundinia	1		
Parachironomus		2	
Paralauterborniella	2		
Paratanytarsus		1	
Polypedilum		1	1
Polypedilum fallax grp			1
Polypedilum halterale grp	1		1
Polypedilum illinoense grp	1	6	5
Polypedilum scalaenum grp			4
Procladius	3	1	
Pseudochironomus			27
Stelechomyia			9
Stempellinella	1		

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0703266], Station #6, Sample Date: 9/27/2007 10:30:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Stenochironomus			5
Tabanus		1	
Tanytarsus	8	4	22
Thienemannimyia grp.		1	8
Tipulidae	1		
Tribelos	7	2	48
<b>EPHEMEROPTERA</b>			
Caenis latipennis	149	14	28
Hexagenia limbata	7	1	
Leptophlebiidae	1	27	
Procloeon	2	1	4
Stenacron	27	9	41
Stenonema femoratum	2		
<b>HEMIPTERA</b>			
Belostoma		1	
<b>ISOPODA</b>			
Caecidotea	4		
<b>LIMNOPHILA</b>			
Ancylidae	1		3
Menetus		5	
Physella		1	
<b>MEGALOPTERA</b>			
Sialis	8	-99	
<b>ODONATA</b>			
Argia	3	29	6
Boyeria	-99		
Enallagma		13	
Ischnura		1	
<b>TRICHOPTERA</b>			
Neureclipsis			3
Nyctiophylax			5
Polycentropus		3	
Triaenodes		6	
<b>TUBIFICIDA</b>			
Branchiura sowerbyi	28	3	
Tubificidae	29	2	6
<b>VENEROIDEA</b>			
Sphaeriidae	5	4	

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0703267], Station #5, Sample Date: 9/27/2007 1:30:00 PM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	9	2	2
<b>AMPHIPODA</b>			
Hyaella azteca		7	29
<b>COLEOPTERA</b>			
Berosus			2
Dubiraphia	32	83	11
Helichus lithophilus		3	
Macronychus glabratus		8	4
Scirtidae		11	2
<b>DECAPODA</b>			
Orconectes luteus	-99		
Orconectes virilis		-99	
<b>DIPTERA</b>			
Ablabesmyia	7	4	4
Ceratopogoninae	3		
Chaoborus	2		
Cladotanytarsus	3		
Cryptochironomus	2		
Cryptotendipes	1		
Culicidae		1	
Dicrotendipes		1	12
Diptera			1
Dixella		4	
Ephydriidae			1
Forcipomyiinae			3
Glyptotendipes		1	1
Parachironomus		2	1
Parakiefferiella		1	2
Paratanytarsus	1		
Polypedilum halterale grp	14		1
Polypedilum illinoense grp	4	6	1
Procladius	4		
Pseudochironomus		1	43
Stelechomyia		1	
Stempellina			1
Stenochironomus			1
Tanytarsus	9	4	4
Thienemannimyia grp.		1	1
Tribelos	5		3

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0703267], Station #5, Sample Date: 9/27/2007 1:30:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Zavrelimyia	1		
<b>EPHEMEROPTERA</b>			
Caenis latipennis	132	56	133
Hexagenia limbata	3		
Leptophlebiidae	1	12	
Proclleon	2	1	7
Stenacron	5	6	6
Stenonema femoratum	2		1
<b>HEMIPTERA</b>			
Belostoma		2	
Microvelia			1
Neoplea		2	
<b>LIMNOPHILA</b>			
Ancylidae	1		5
Fossaria	1		
Menetus		4	
Physella		1	
<b>ODONATA</b>			
Argia		27	4
Enallagma		14	
Gomphus		1	
Libellula		1	
Macromia		1	
Nasiaeschna pentacantha		1	
<b>TRICHOPTERA</b>			
Hydroptila			1
Neureclipsis		18	2
Nyctiophylax			4
Oecetis	2		
Triaenodes		1	
<b>TRICLADIDA</b>			
Planariidae		1	
<b>TUBIFICIDA</b>			
Branchiura sowerbyi	5	2	1
Enchytraeidae	3		
Limnodrilus cervix	1		
Tubificidae	45	22	12
<b>VENEROIDEA</b>			
Sphaeriidae	2	-99	1

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0703268], Station #4, Sample Date: 10/2/2007 9:30:00 AM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	8	17	
<b>AMPHIPODA</b>			
Hyaella azteca	1	5	21
<b>BRANCHIOBDELLIDA</b>			
Branchiobdellida		1	
<b>COLEOPTERA</b>			
Berosus		1	3
Dubiraphia	26	118	21
Hydroporus	1		
Macronychus glabratus		5	17
Peltodytes	2		
Scirtidae		12	1
Stenelmis		13	6
<b>DECAPODA</b>			
Orconectes virilis		-99	
<b>DIPTERA</b>			
Ablabesmyia	6	2	5
Anopheles		2	1
Ceratopogoninae	6		2
Chironomus	5		
Cladotanytarsus	5		1
Corynoneura	1	1	1
Cryptochironomus	6		1
Dicrotendipes	10	2	54
Forcipomyiinae			4
Glyptotendipes	1	1	7
Labrundinia		5	1
Microtendipes	7		
Nanocladius		1	
Parachironomus	1	9	
Parakiefferiella			1
Paratanytarsus	1		
Polypedilum convictum			1
Polypedilum fallax grp			1
Polypedilum halterale grp	3		
Polypedilum illinoense grp	3	3	3
Procladius	15		
Pseudochironomus	2	1	57
Stelechomyia			3

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0703268], Station #4, Sample Date: 10/2/2007 9:30:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Stenochironomus			3
Stictochironomus	9		
Tanytarsus	22	5	9
Thienemannimyia grp.		2	4
Tribelos	2		12
<b>EPHEMEROPTERA</b>			
Brachycercus	1		
Caenis latipennis	167	11	25
Leptophlebiidae		9	
Proclleon	3		10
Stenacron			8
Stenonema femoratum	1		2
Tricorythodes	1		13
<b>HEMIPTERA</b>			
Belostoma		-99	
Corixidae	2		
Neoplea		1	
Ranatra fusca		-99	
Rheumatobates		1	1
<b>LIMNOPHILA</b>			
Ancylidae	2		
Ferrissia		1	
Menetus		3	
Physella	7	5	2
<b>MEGALOPTERA</b>			
Corydalus			1
<b>NEUROPTERA</b>			
Sisyra		3	
<b>ODONATA</b>			
Argia		28	8
Enallagma		29	
Erpetogomphus	-99		
Gomphus	1		
Macromia	4	-99	1
Progomphus obscurus	1		
<b>TRICHOPTERA</b>			
Cernotina	1		
Nectopsyche	2	13	
Neotrichia		1	
Nyctiophylax			7
Oecetis	3	2	1

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0703268], Station #4, Sample Date: 10/2/2007 9:30:00 AM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Polycentropus		3	
Triaenodes		1	
<b>TUBIFICIDA</b>			
Branchiura sowerbyi	1		
Tubificidae	13	7	5
<b>VENEROIDEA</b>			
Sphaeriidae	1	1	-99

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0703269], Station #3, Sample Date: 10/2/2007 11:40:00 AM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	40	3	2
<b>AMPHIPODA</b>			
Hyaella azteca		21	
<b>COLEOPTERA</b>			
Berosus	1		
Dubiraphia	20	99	3
Helichus lithophilus		1	5
Macronychus glabratus		6	25
Scirtidae		18	9
Stenelmis		19	9
<b>DECAPODA</b>			
Orconectes luteus	1		
Orconectes virilis		-99	
<b>DIPTERA</b>			
Ablabesmyia	9	4	1
Anopheles		1	1
Ceratopogoninae	5		
Corynoneura	2		
Cricotopus/Orthocladius		1	7
Cryptochironomus	3		
Culex		1	
Dicrotendipes	12	1	4
Forcipomyiinae			13
Glyptotendipes	2	1	3
Harnischia	1		
Hemerodromia			5
Labrundinia		6	2
Microtendipes	9		
Nanocladius	2	5	
Parachironomus	2	4	
Parakiefferiella	4		
Polypedilum	1		
Polypedilum convictum			1
Polypedilum halterale grp	2		
Polypedilum illinoense grp	7	20	7
Procladius	6		
Pseudochironomus	1		19
Rheotanytarsus		1	1
Stelechomyia			1

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0703269], Station #3, Sample Date: 10/2/2007 11:40:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Stempellina	1		
Stenochironomus	2	1	8
Tanytarsus	22	5	10
Thienemanniella		1	
Thienemannimyia grp.		5	3
Tribelos	24		12
Zavrelimyia	1		
<b>EPHEMEROPTERA</b>			
Acerpenna		1	9
Baetis			2
Caenis latipennis	25	9	6
Leptophlebiidae		15	
Maccaffertium pulchellum			4
Procloeon			3
Stenacron	18	3	28
Stenonema femoratum	10		4
Tricorythodes		2	44
<b>HEMIPTERA</b>			
Belostoma		-99	
Corixidae	1		
Pelocoris			1
<b>LIMNOPHILA</b>			
Menetus	5	34	
<b>LUMBRICINA</b>			
Lumbricina	7	-99	
<b>MEGALOPTERA</b>			
Corydalus		-99	
<b>NEUROPTERA</b>			
Sisyra			1
<b>ODONATA</b>			
Argia	2	17	4
Basiaeschna janata		-99	
Boyeria		-99	
Enallagma		6	1
Gomphus	-99		
Hetaerina		1	
Macromia		-99	
<b>TRICHOPTERA</b>			
Ceratopsyche morosa grp			1
Cheumatopsyche			6

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0703269], Station #3, Sample Date: 10/2/2007 11:40:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Nectopsyche	1	3	3
Neureclipsis	1	4	1
Nyctiophylax			4
Oecetis	4		1
<b>TRICLADIDA</b>			
Planariidae		3	
<b>TUBIFICIDA</b>			
Branchiura sowerbyi	9		
Tubificidae	52	4	
<b>VENEROIDEA</b>			
Sphaeriidae	5	22	2

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0703270], Station #2, Sample Date: 10/2/2007 1:30:00 PM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	31		8
<b>AMPHIPODA</b>			
Hyaella azteca		6	4
<b>COLEOPTERA</b>			
Berosus			5
Dubiraphia	30	87	8
Helichus lithophilus		1	
Hydroporus	1		
Macronychus glabratus		6	4
Scirtidae	1	34	2
Stenelmis	3	20	12
<b>DIPTERA</b>			
Ablabesmyia		1	2
Anopheles		5	
Ceratopogoninae	5	1	1
Chaoborus	3		
Chironomus	9		
Chrysops		6	
Cladotanytarsus	1		1
Corynoneura		2	1
Cricotopus/Orthocladius	1		
Cryptochironomus	1	2	1
Dicrotendipes	10	2	54
Forcipomyiinae			1
Glyptotendipes	6	35	17
Labrundinia	2		
Lipiniella	1		
Microtendipes	3		7
Nanocladius	3		
Pagastiella	1		
Parachironomus		2	
Parakiefferiella	9		3
Paratendipes	1		
Pilaria		2	
Polypedilum		1	
Polypedilum halterale grp	8		
Polypedilum illinoense grp	5	26	1
Polypedilum scalaenum grp			1
Procladius	6		1

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0703270], Station #2, Sample Date: 10/2/2007 1:30:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Pseudochironomus	4		105
Stempellina	1		1
Stempellinella	1		1
Stenochironomus			2
Stictochironomus	1		
Tanytarsus	9	1	15
Thienemannimyia grp.	1		
Tribelos	23	5	23
undescribed Empididae		5	
<b>EPHEMEROPTERA</b>			
Acerpenna		1	
Caenis latipennis	6	4	3
Callibaetis	1		
Hexagenia	1		
Leptophlebiidae	3	1	
Procloeon	3		6
Stenacron	18		
Stenonema femoratum	12		
Tricorythodes			1
<b>HEMIPTERA</b>			
Belostoma		1	
Corixidae	1		
Microvelia		2	
Neoplea		1	
Ranatra nigra		-99	
Rheumatobates		4	
<b>LIMNOPHILA</b>			
Ancylidae	1		1
Menetus	1		
Physella	4		
<b>LUMBRICINA</b>			
Lumbricina	1	-99	
<b>LUMBRICULIDA</b>			
Lumbriculidae	1	1	
<b>MEGALOPTERA</b>			
Sialis	1		
<b>ODONATA</b>			
Argia	2	6	8
Boyeria		-99	
Enallagma	1	26	1
Gomphus	1		

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0703270], Station #2, Sample Date: 10/2/2007 1:30:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Macromia			1
Stylurus	1		
<b>TRICHOPTERA</b>			
Glossosomatidae	1		
Hydroptila			1
Nectopsyche	1	3	
Neureclipsis	1	1	1
Oecetis	6	1	
Polycentropus		2	
<b>TRICLADIDA</b>			
Planariidae	1	2	
<b>TUBIFICIDA</b>			
Branchiura sowerbyi	7		
Tubificidae	22	14	4
<b>VENEROIDEA</b>			
Sphaeriidae	9		1

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0703271], Station #1, Sample Date: 10/3/2007 10:00:00 AM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	2		3
<b>AMPHIPODA</b>			
Hyaella azteca		21	
<b>BRANCHIOBDELLIDA</b>			
Branchiobdellida		1	
<b>COLEOPTERA</b>			
Berosus		5	
Dubiraphia	5	64	3
Helichus basalis			1
Macronychus glabratus		12	4
Neoporus		1	
Stenelmis		42	7
<b>DECAPODA</b>			
Orconectes virilis	-99		
<b>DIPTERA</b>			
Ablabesmyia	6	3	4
Ceratopogoninae	14	2	16
Chaoborus	1		
Chironomus	4		
Cladotanytarsus	6		1
Clinotanypus	2		
Coelotanypus			1
Cricotopus/Orthocladius	1	1	
Cryptochironomus	12	2	
Cryptotendipes	1		
Dicrotendipes	29	8	65
Dolichopodidae		2	
Forcipomyiinae			3
Glyptotendipes		35	37
Goeldichironomus		2	
Gonomyia	1		
Labrundinia		13	3
Lipiniella	5		
Microtendipes			1
Nanocladius	7	10	
Parachironomus		4	
Parakiefferiella		1	
Polypedilum halterale grp	5		
Polypedilum illinoense grp	3	49	10

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0703271], Station #1, Sample Date: 10/3/2007 10:00:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Polypedilum scalaenum grp	1		1
Procladius	3		1
Pseudochironomus	7	6	18
Simuliidae			1
Stelechomyia			2
Stempellina	6		2
Stempellinella	4		
Stenochironomus			8
Stictochironomus	1		
Tanypus	1		
Tanytarsus	32	30	33
Thienemanniella		8	2
Thienemannimyia grp.		2	5
Tribelos			10
<b>EPHEMEROPTERA</b>			
Acerpenna		6	5
Anthopotamus	1		
Baetis			10
Brachycercus	1		
Caenis hilaris	2	1	1
Caenis latipennis	21	6	7
Heptageniidae	2		4
Hexagenia limbata	3		
Leptophlebiidae		1	
Maccaffertium pulchellum			1
Procloeon	-99	3	3
Stenacron		6	20
Stenonema femoratum	4	1	15
Tricorythodes		3	8
<b>HEMIPTERA</b>			
Corixidae	37		1
Gerridae		1	
Neoplea		2	
<b>LIMNOPHILA</b>			
Fossaria		10	
Menetus		1	
Physella	1	5	18
<b>MEGALOPTERA</b>			
Sialis	-99	1	
<b>ODONATA</b>			
Argia		58	18

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0703271], Station #1, Sample Date: 10/3/2007 10:00:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Enallagma		22	1
Gomphus	-99		
Hetaerina	1		
Libellulidae	2		
Macromia		1	
<b>TRICHOPTERA</b>			
Cheumatopsyche			1
Hydroptila		1	1
Nectopsyche	1	2	
Neureclipsis		1	
Orthotrichia	1		
Oxyethira	1		
<b>TRICLADIDA</b>			
Planariidae		1	
<b>TUBIFICIDA</b>			
Aulodrilus	20	1	1
Branchiura sowerbyi	1	1	
Ilyodrilus templetoni	2		
Tubificidae	23	17	3
<b>VENEROIDEA</b>			
Sphaeriidae	-99		

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0804026], Station #8, Sample Date: 4/1/2008 11:45:00 AM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina		2	
<b>AMPHIPODA</b>			
Crangonyx		2	1
<b>COLEOPTERA</b>			
Dubiraphia		14	
<b>DECAPODA</b>			
Orconectes virilis		-99	
<b>DIPTERA</b>			
Ablabesmyia	1	3	
Ceratopogoninae	3	2	
Chironomidae	2	1	1
Chironomus	2		
Chrysops		-99	
Corynoneura		2	
Cricotopus bicinctus			1
Cricotopus/Orthocladius	3	50	65
Cryptochironomus	1		
Dicrotendipes		2	2
Diplocladius	1		1
Empididae	3		
Eukiefferiella			2
Hydrobaenus	40	58	58
Nanocladius		1	
Ormosia		1	
Paralauterborniella	2		
Paratanytarsus	1	2	3
Pericoma	1		
Pilaria			1
Polypedilum convictum		1	2
Polypedilum halterale grp	1		
Pseudosmittia			4
Rheocricotopus		1	
Simulium		22	131
Stictochironomus	2		
Tabanus		1	1
Tanytarsus	5	3	1
Thienemanniella		2	8
Thienemannimyia grp.		2	2
Zavreliomyia		1	

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0804026], Station #8, Sample Date: 4/1/2008 11:45:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>EPHEMEROPTERA</b>			
Caenis latipennis	5	93	1
Hexagenia limbata	1		
Leptophlebia		1	
Stenacron	1	2	2
<b>LIMNOPHILA</b>			
Lymnaeidae		4	
Physella		-99	-99
<b>LUMBRICULIDA</b>			
Lumbriculidae	1		
<b>MESOGASTROPODA</b>			
Hydrobiidae		1	
<b>ODONATA</b>			
Calopteryx		1	
Enallagma		1	
Progomphus obscurus	2		
<b>TRICHOPTERA</b>			
Cheumatopsyche			1
Limnephilidae		3	1
Ptilostomis		-99	
<b>TUBIFICIDA</b>			
Enchytraeidae	4	10	34
Limnodrilus hoffmeisteri	5	4	
Tubificidae	16	6	
<b>VENEROIDEA</b>			
Sphaeriidae	3	2	

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0804027], Station #6a, Sample Date: 4/2/2008 10:45:00 AM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	1		
<b>BRANCHIOBDELLIDA</b>			
Branchiobdellida		1	
<b>COLEOPTERA</b>			
Dubiraphia	14	1	
Helichus lithophilus		2	
Macronychus glabratus	1		
Scirtidae		1	
Tropisternus		1	
<b>DECAPODA</b>			
Orconectes		2	
Orconectes virilis	1	-99	
<b>DIPTERA</b>			
Ablabesmyia	2	3	
Ceratopogoninae	6	1	
Chironomidae	1	1	
Chrysops	2	1	
Corynoneura		1	1
Cricotopus/Orthocladius	12	38	17
Cryptochironomus	1		
Dicrotendipes	1	1	
Diplocladius		1	
Diptera			3
Dolichopodidae		1	
Hydrobaenus	73	50	34
Labrundinia	1		
Limnophyes		2	
Nanocladius	1		
Ormosia		12	
Parakiefferiella	1		
Paratanytarsus	2	5	1
Pilaria		2	
Polypedilum scalaenum grp		2	
Procladius	3	1	
Simulium	2	2	
Tanytarsus	13	2	1
Thienemanniella	1	1	4
Thienemannimyia grp.	2	1	2
Tribelos	12		

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0804027], Station #6a, Sample Date: 4/2/2008 10:45:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Zavrelimyia		5	
<b>EPHEMEROPTERA</b>			
Caenis latipennis	71	52	7
Hexagenia limbata	-99		
Leptophlebia		2	
Stenacron	10	1	2
<b>ISOPODA</b>			
Lirceus		2	
<b>LIMNOPHILA</b>			
Lymnaeidae		1	
Physella		1	
<b>LUMBRICINA</b>			
Lumbricina	1		
<b>MEGALOPTERA</b>			
Sialis	1		
<b>ODONATA</b>			
Argia	4	1	
Enallagma		1	
<b>RHYNCHOBDELLIDA</b>			
Piscicolidae	1		
<b>TRICHOPTERA</b>			
Cheumatopsyche	1		
Limnephilidae			1
<b>TUBIFICIDA</b>			
Branchiura sowerbyi	8		
Enchytraeidae	1	18	1
Limnodrilus hoffmeisteri	7		
Tubificidae	13	4	2
<b>VENEROIDEA</b>			
Sphaeriidae	1		

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0804028], Station #6b, Sample Date: 4/2/2008 10:45:00 AM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	12	2	
<b>AMPHIPODA</b>			
Crangonyx		1	
Hyaella azteca		1	
<b>COLEOPTERA</b>			
Dubiraphia	8	26	
Helichus basalis		1	
Helichus lithophilus		2	
Macronychus glabratus	1	3	
Peltodytes		1	
Scirtidae		2	
<b>DECAPODA</b>			
Orconectes		-99	
Orconectes virilis		-99	
<b>DIPTERA</b>			
Ablabesmyia	1	5	
Ceratopogoninae	16	9	1
Chironomidae	2	1	
Chrysops	1	1	
Cricotopus/Orthocladius	29	32	3
Cryptochironomus	1		
Dasyheleinae			1
Dicrotendipes	1		
Diplocladius		1	
Diptera		2	
Endochironomus	1		
Ephydriidae		1	
Hydrobaenus	76	50	1
Nanocladius		1	
Ormosia	1		
Paralauterborniella	3		
Paratanytarsus	2	5	
Pilaria	1	7	
Polypedilum halterale grp	1		
Polypedilum illinoense grp	1		1
Polypedilum scalaenum grp			1
Procladius	10	2	
Rheotanytarsus	1		
Simulium	6	3	1

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0804028], Station #6b, Sample Date: 4/2/2008 10:45:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Stenochironomus		1	
Tanytarsus	24	3	
Thienemanniella	3		
Tipula	-99		
Zavreliomyia		10	
<b>EPHEMEROPTERA</b>			
Caenis latipennis	69	123	
Centroptilum		1	
Hexagenia limbata	1		
Leptophlebia		2	
Stenacron	14	3	
<b>ISOPODA</b>			
Caecidotea		8	
<b>LIMNOPHILA</b>			
Lymnaeidae		3	
<b>LUMBRICINA</b>			
Lumbricina		1	
<b>MEGALOPTERA</b>			
Sialis	-99		
<b>ODONATA</b>			
Argia		1	
Calopteryx		1	
<b>PLECOPTERA</b>			
Perlidae	1		
<b>RHYNCHOBDELLIDA</b>			
Piscicolidae		1	
<b>TRICHOPTERA</b>			
Cheumatopsyche	-99		
Ironoquia		1	
Nectopsyche	1		
Ptilostomis		1	
<b>TUBIFICIDA</b>			
Branchiura sowerbyi	5		
Enchytraeidae	3	3	
Limnodrilus hoffmeisteri	7	3	
Tubificidae	17	24	
<b>VENEROIDEA</b>			
Sphaeriidae		4	

**Aquid Invertebrate Database Bench Sheet Report**

**Middle Fk Salt R [0804029], Station #3, Sample Date: 4/2/2008 2:00:00 PM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	6		2
<b>AMPHIPODA</b>			
Crangonyx		9	
Hyaella azteca		22	
<b>COLEOPTERA</b>			
Dubiraphia	9	19	
Helichus lithophilus		1	
Hydroporus		1	
Macronychus glabratus		2	
Scirtidae		2	
Stenelmis	5	1	
<b>DECAPODA</b>			
Orconectes	1		
Orconectes luteus	1		
<b>DIPTERA</b>			
Ablabesmyia	8	7	
Ceratopogoninae	12	4	
Chironomidae	2	5	3
Chironomus	2		
Cladotanytarsus	10		
Cnephia	2		2
Corynoneura	2		
Cricotopus bicinctus			1
Cricotopus/Orthocladius	9	32	117
Cryptochironomus	4		
Dicrotendipes	10		8
Diplocladius		2	1
Diptera	1		
Dolichopodidae	1		
Eukiefferiella		1	18
Glyptotendipes		2	1
Hemerodromia	2	1	
Hydrobaenus	36	39	44
Microtendipes	1	1	
Nanocladius		3	
Natarsia		1	
Parakiefferiella	8	1	10
Paratanytarsus		1	1
Polypedilum convictum	2	1	1

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0804029], Station #3, Sample Date: 4/2/2008 2:00:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Polypedilum halterale grp	7		
Polypedilum scalaenum grp	1		
Procladius	3		
Simulium	1	6	124
Stenochironomus			2
Stictochironomus	8		
Tanytarsus	9	6	4
Thienemanniella			2
Thienemannimyia grp.	1	4	
Tipula		-99	
Tribelos		2	
<b>EPHEMEROPTERA</b>			
Acerpenna		2	1
Caenis latipennis	67	107	3
Leptophlebia	-99	1	
Stenacron	6	2	
Stenonema femoratum	3	1	
<b>HEMIPTERA</b>			
Belostoma		-99	
Microvelia		1	
<b>LIMNOPHILA</b>			
Laevapex			1
<b>MEGALOPTERA</b>			
Sialis	1	-99	
<b>ODONATA</b>			
Argia		5	
Enallagma	3	1	
Gomphus	1		
Ischnura		-99	
Macromia	-99		
<b>PLECOPTERA</b>			
Perlesta		1	
<b>RHYNCHOBDELLIDA</b>			
Glossiphoniidae	-99		
<b>TRICHOPTERA</b>			
Cheumatopsyche	2		
Hydroptila	1		
Nectopsyche	1		
Polycentropus		2	
Pycnopsyche		1	

**Aquid Invertebrate Database Bench Sheet Report****Middle Fk Salt R [0804029], Station #3, Sample Date: 4/2/2008 2:00:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Triaenodes		1	
<b>TUBIFICIDA</b>			
Branchiura sowerbyi	16	1	
Enchytraeidae	5	8	
Ilyodrilus templetoni		2	
Limnodrilus claparedianus	1		
Limnodrilus hoffmeisteri	11	9	
Tubificidae	31	9	3
<b>VENEROIDEA</b>			
Sphaeriidae	7	1	