APPENDIX D
CURRY'S FORK WATER QUALITY DATA REPORT

Curry's Fork Water Quality Data Report

Report

Oldham County Fiscal

Court, KY

July 2011

Report for

Oldham County Fiscal Court, Kentucky

Curry's Fork Water Quality Data Report

Prepared by:

STRAND ASSOCIATES, INC.®
325 West Main Street, Suite 710
Louisville, KY 40202
www.strand.com

July 2011

STRAND ASSOCIATES®

TABLE OF CONTENTS

Page No.
or Following

FIGURES

Page No.
or Following

FIGURES (Continued)

TABLES

TABLE OF CONTENTS Continued

Page No.
or Following

TABLES (Continued)

APPENDICES

SECTION 1
INTRODUCTION

1.01 PROJECT BACKGROUND

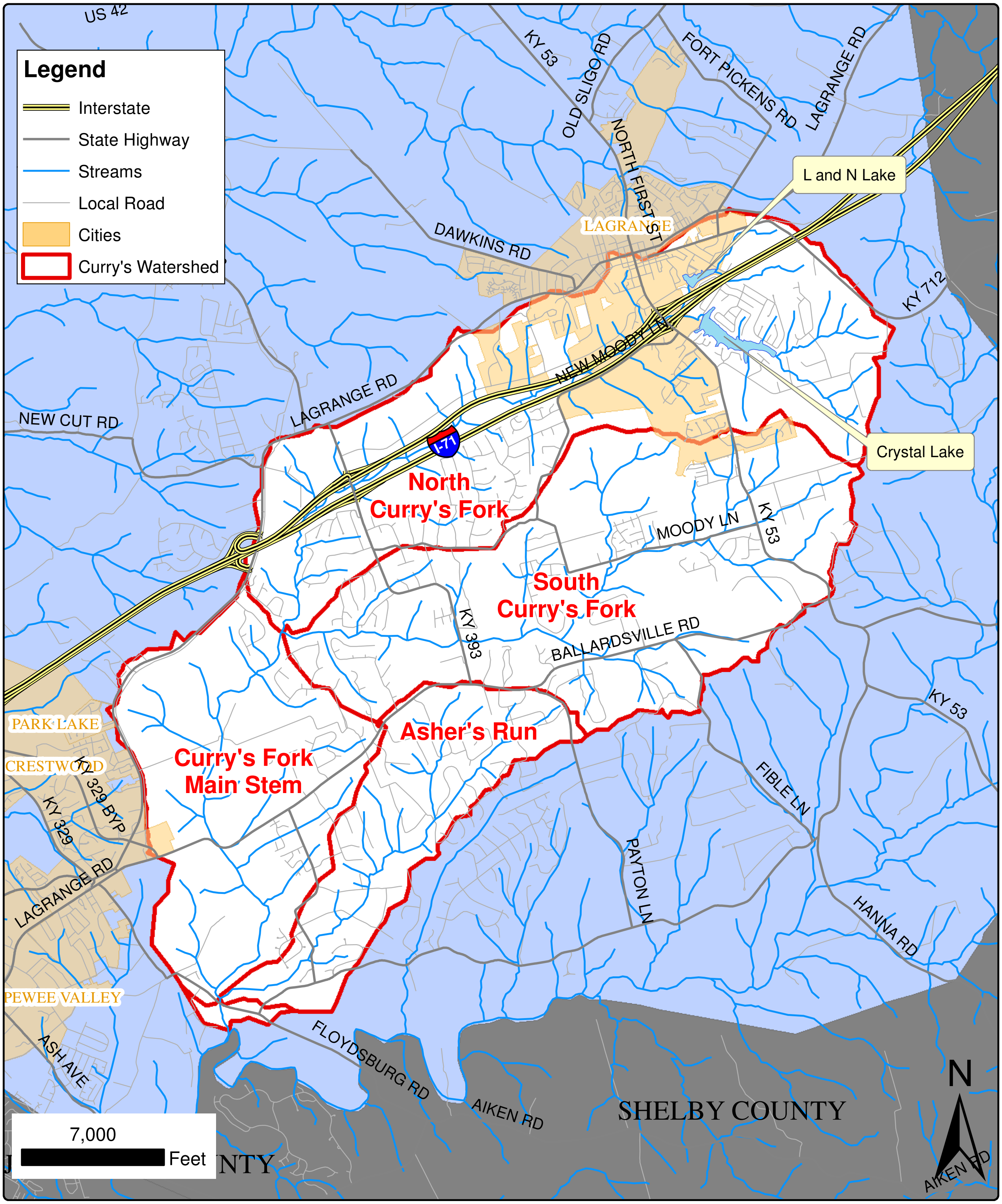
The Curry's Fork watershed is located in northern Kentucky upstream of Floyds Fork in Oldham County, Kentucky. Figure 1.01-1 shows the location of the Curry's Fork watershed and delineates the four subwatersheds within the watershed. The Kentucky Division of Water (KDOW) contracted funds to the Oldham County Fiscal Court (OCFC) to develop and begin implementation of a Watershed Plan (WP) as part of the FFY2006 Clean Water Act Section 319(h) grant awarded by the United Sates Environmental Protection Agency (USEPA) to the state. Curry's Fork is impaired and does not meet water quality standards for Primary Contact Recreation (nonsupport) and Warm Water Aquatic Habitat (WAH) (partial support) according to the 2008 Integrated Report to Congress on the Condition of Water Resources in Kentucky, Volume II, 303(d) List of Surface Waters (303(d) List). A WP is being developed to identify and address the impairments in Curry's Fork.

1.02 PURPOSE

The Curry's Fork Water Quality Data Report (WQDR) is a supplemental document to the Curry's Fork WP. The purpose of the WQDR is to present the water quality data and assessments used in the development of the WP. The WQDR does not discuss potential pollutant sources or causes of stream impairment. Refer to the Curry's Fork Watershed Plan for information regarding pollutant sources. The WQDR includes discussions of the following items:

- Water quality standards.
- Pollutants of concern in the Curry's Fork watershed.
- Available sampling data in the Curry's Fork watershed.
- Data collected for the WP sampling program.
- Sampling results.

It is not the intent of this report to identify pollutant sources. The data and data trends in this report were used by the Curry's Fork Technical Committee, Internal Project Team, Water Quality Data Analysis Team, and the Curry's Fork community to identify pollutant sources and select appropriate Best Management Practices (BMPs) for the WP. Refer to the WP for discussions of pollutant source identification and BMP selection.



CURRY'S FORK WATERSHED

CURRY'S FORK WATER QUALITY DATA REPORT
OLDHAM COUNTY FISCAL COURT
OLDHAM COUNTY, KENTUCKY

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 1.01-1
5994.100

1.03 DEFINITIONS

BMP	Best Management Practices
CWA	Clean Water Act
FDC	Flow duration curve
KAR	Kentucky Administrative Regulations
KDOW	Kentucky Division of Water
MS4	Municipal Separate Storm Sewer Systems
NPDES	National Pollutant Discharge Elimination System
OCFC	Oldham County Fiscal Court
ONRWs	Outstanding National Resource Waters
QAPP	Quality Assurance Protection Plan
SRWW	Salt River Watershed Watch
Strand	Strand Associates, Inc.®
TC	Technical Committee
Third Rock	Third Rock Consultants
TMDLs	Total Maximum Daily Loads
TSS	total suspended solids
UL	University of Louisville Stream Institute
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WAH	Water Aquatic Habitat
WP	Watershed Plan
WQDAT	Water Quality Data Analysis Team
WQDR	Water Quality Data Report
WQS	Water Quality Standards

SECTION 2
WATER QUALITY STANDARDS

2.01 WATER QUALITY STANDARDS

State regulatory agencies are required to develop Water Quality Standards (WQS) to support the goals of the Clean Water Act (CWA). In accordance with 40 CFR 131.2, the goal of WQS should include the following:

1. Include provisions for restoring and maintaining chemical, physical, and biological integrity of state waters.

2. Provide, wherever attainable, water quality for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water ("fishable/swimmable").

3. Consider the use and value of state waters for public water supplies, propagation of fish and wildlife, recreation, agricultural and industrial purposes, and navigation.

The three major components of WQS include designated uses, numeric and narrative water quality criteria, and antidegradation policies. The United States Environmental Protection Agency (USEPA) defines the importance of WQS as follows:

> "to help and protect and restore the quality of the Nation's surface waters and to help identify water quality problems caused by improperly treated wastewater discharges, runoff or discharges from active or abandoned mining sites, sediment, fertilizers, and chemicals from agricultural areas, and erosion of stream banks caused by improper grazing practices. These standards also support efforts to achieve and maintain protective water quality conditions. Efforts include total maximum daily loads (TMDLs) for point sources of pollution, load allocations for nonpoint sources of pollution, water quality management plans, National Pollutant Discharge Elimination System (NPDES) water quality-based effluent limitations for point source discharges, water quality certifications under CWA 401, various reports that document current water quality conditions, and CWA 319 management plans for the control of nonpoint sources of pollution" (www.epa.gov/waterscience/standards/about/imp.htm).

A. <u>Designated Uses</u>

Appropriate uses of the water body, established by Kentucky, are determined through consideration of the use and value of the water body as well as the suitability of a water body for these uses. The USEPA defines the suitability of a water body through consideration of "the physical, chemical, and biological characteristics of the water body, its geographical setting and scenic qualities, and economic considerations." Kentucky must conduct a use attainability analysis for any water body that does not include the fishable/swimmable goal identified in the CWA. Kentucky WQS, outlined in the Kentucky Administrative Regulations (KAR) 10:026, defines six designated uses, including warm water aquatic habitat, cold water aquatic habitat, primary contact recreation, secondary contact recreation, domestic water supply, and outstanding state resource water. Although this statute specifically identifies many surface waters throughout Kentucky and their respective designated uses, any surface water that is not specifically listed in the Kentucky

Water Quality regulations is by default designated as suitable for support of warm water aquatic habitat, primary contact recreation, secondary contact recreation, and domestic water supply.

The designated uses of Curry's Fork are specifically established within 401 KAR 10:026 as warm water aquatic habitat, primary contact recreation, and secondary contact recreation. The designated uses for the other tributaries within the watershed, including North Curry's Fork and South Curry's Fork, and Asher's Run are not specified in the Kentucky Water Quality regulations and therefore, by default, are included as warm water aquatic habitat, primary contact recreation, secondary contact recreation, and domestic water supply categories.

B. Numeric and Narrative Criteria

States must adopt water quality criteria that properly protects the designated uses of the water bodies throughout the state. The states may adopt the criteria established by the USEPA in Section 304(a) of the CWA, modify these criteria to meet site-specific conditions, or adopt criteria based on other scientifically defended methods (www.epa.gov/waterscience/standards/about/crit.htm). Kentucky has adopted both numeric and narrative standards that can be reviewed in KAR Title 401 Chapter 10:051. Throughout the water quality data analysis section of this report, maximum allowable values denote the limits established by the Kentucky WQS. For certain parameters such as total suspended solids (TSS) and nutrients, Kentucky has not established water quality criteria. However, the USEPA has established recommended values of pollutant concentrations. These are nonenforceable values recommended to promote healthy water quality and aquatic habitats. The values are noted and used for data comparison purposes in Section 4 of this report.

C. Antidegradation Policies

The WQS regulations established in the CWA require states to develop a tiered antidegradation program. This program provides for the prevention, abatement, and control of water pollution. According to Kentucky WQS, "it is the policy of the commonwealth to conserve its waters for legitimate uses and to safeguard from pollution the uncontaminated waters of the commonwealth, prevent the creation of any new pollution in the waters of the commonwealth, and abate any existing pollution." The antidegradation policy requires surface waters to be placed into one of the four categories including outstanding national resource waters, exceptional waters, high quality water, and impaired water. The USEPA defines the three tiers of the antidegradation program as follows:

1. Tier 1 maintains and protects existing uses and water quality conditions necessary to support such uses. An existing use can be established by demonstrating that fishing, swimming, or other uses have actually occurred since November 28, 1975, or water quality is suitable to allow such uses to occur. Where an existing use is established, it must be protected even if it is not listed in the WQS as a designated use.

2. Tier 2 maintains and protects "high quality" waters bodies where existing conditions are better than necessary to support CWA 101 (a)(2) "fishable/swimmable" uses. Water quality can be lowered in such waters. However, state and Tribal Tier 2 programs identify procedures that must be followed and questions that must be answered before a reduction in water quality can be allowed. In no case may water quality be lowered to a level that would interfere with existing or designated uses.

3. Tier 3 maintains and protects water quality in outstanding national resource waters (ONRWs). Except for certain temporary changes, water quality cannot be lowered in such waters. ONRWs generally include the highest quality waters of the United States. However, the ONRW classification also offers special protection for waters of exceptional ecological significance, i.e., those that are important, unique, or sensitive ecologically. Decisions regarding which water bodies qualify to be ONRWs are made by states and authorized Indian Tribes. (www.epa.gov/waterscience/standards/about/adeg.htm). Curry's Fork is classified under Tier 1 as an impaired water body in Kentucky's 303(d) List.

2.02 POLLUTANTS OF CONCERN

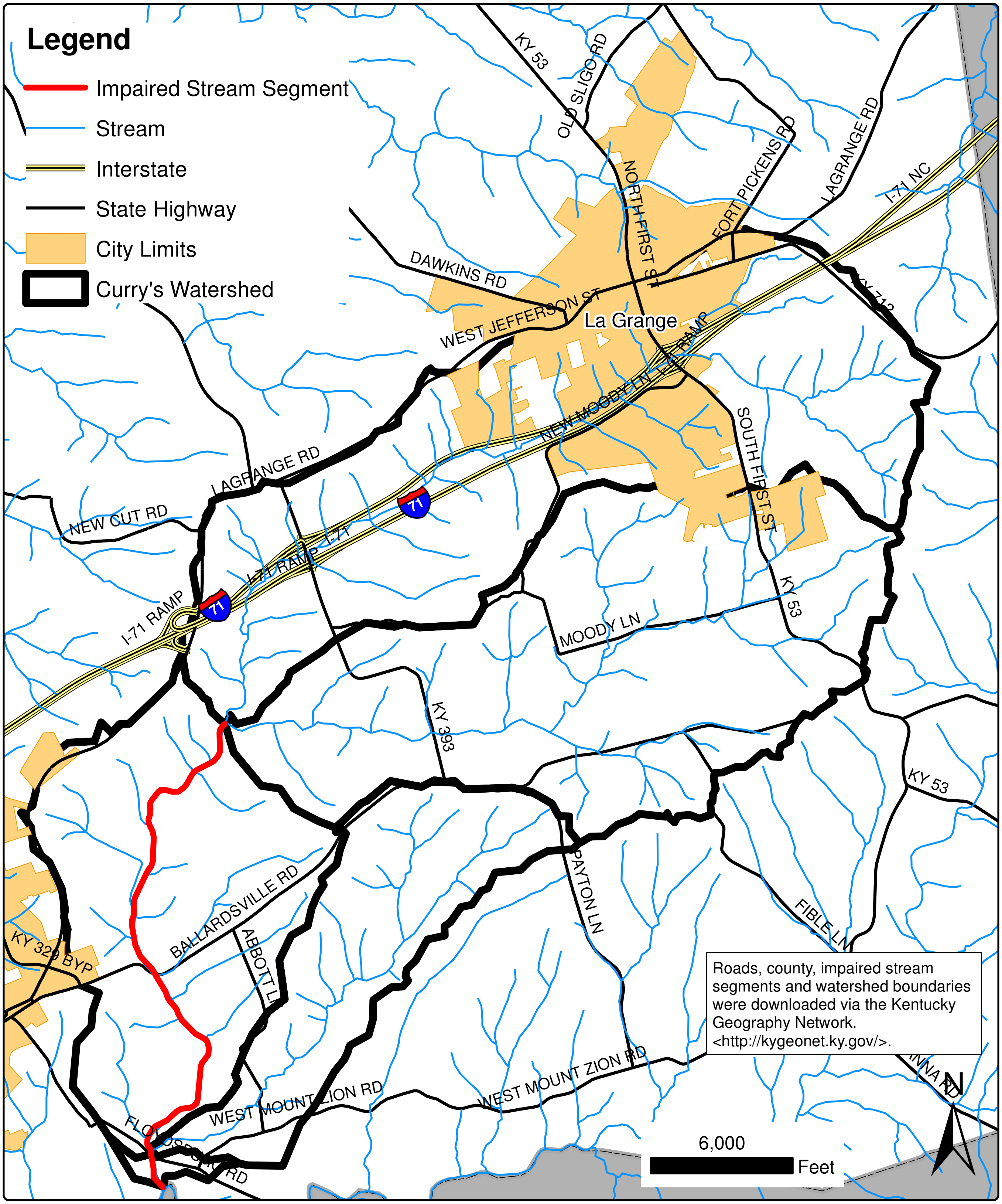
Pollutants of concern for Curry's Fork are the pollutants identified in its listing in the 303(d) List. The Curry's Fork listing in the 303(d) List is shown in Table 2.02-1. Figure 2.02-1 shows the location of the impaired stream segment in Curry's Fork described in Table 2.02-1.

Curry's Fork - Miles 0.0 to 4.8 Into Floyds Fork	Oldham County Segment Length: 4.8
Impaired Use(s):	Warm Water Aquatic Habitat (Partial Support), Primary Contact Recreation Water (Nonsupport)
Pollutant(s):	Fecal Coliform; Nutrient/Eutrophication; Biological Indicators; Oxygen, Dissolved; Sedimentation/Siltation
Suspected Sources:	Agriculture; Discharges from Municipal Separate Storm Sewer Systems (MS4); Habitat Modification other than Hydromodification; Highway/Road/Bridge Runoff (Nonconstruction-Related); Municipal (Urbanized High Density Area); Package Plant or Other Permitted Small Flows Discharges

[1] 2008 303(d) List

Table 2.02-1 Curry's Fork 303(d) Listing[1]

The sampling program focused primarily on the pollutants of concern identified above. Other pollutants were monitored in the sampling program; refer to Section 3 of this report for more details on the sampling program.



CURRY'S FORK
303(D) IMPAIRED STREAM SEGMENT

CURRY'S FORK WATER QUALITY DATA REPORT
OLDHAM COUNTY FISCAL COURT
OLDHAM COUNTY, KENTUCKY

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 2.02-1
5994.100

SECTION 3
WATER QUALITY SAMPLING

3.01 WATER QUALITY SAMPLING

To develop a comprehensive Watershed Plan (WP), the condition of the watershed must be well documented through water quality data. Existing water quality data was compiled and reviewed by the WP Internal Project Team and considered insufficient for developing a WP. Existing data was either collected without an approved Quality Assurance Protection Plan (QAPP) or was considered too old for use in the WP. Thus, a Curry's Fork Watershed Sampling Program developed, approved, and conducted specifically for the development of the WP. The WP data collection effort included bacteria, physicochemical parameters, biology and habitat assessments, and a sediment and geomorphic assessment collected by Strand, Third Rock Consultants (Third Rock), and the University of Louisville Stream Institute (UL). An existing mussel study performed by KDOW was also used in the development of the WP. The *Curry's Fork Biological Data Assessment* prepared by Third Rock is shown in Appendix A. Third Rock also prepared an additional Technical Memorandum with a further subwatershed analysis and comparison for Best Management Practices (BMPs) which is shown in Appendix B. The *Sediment and Geomorphic Assessment of the Curry's Fork Watershed* by UL is shown in Appendix C. The *Qualitative Mussel Survey of the Floyds Fork Watershed* by KDOW is shown in Appendix D. These sources were considered primary data sources. All other data sources reviewed for the WP were considered secondary data sources.

Results from the WP sampling program were used to identify potential pollutant sources, priority areas for protection and restoration, probable causes, and solutions for remediating water pollution problems in Curry's Fork. The WP sampling program ensured water quality data collected were recent enough to be used for planning purposes and were collected using Kentucky Division of Water (KDOW) approved sampling plans, sampling methods, or procedures to confirm accuracy and reduce risks of contaminating samples. The QAPP used for the WP sampling program is shown in Appendix E.

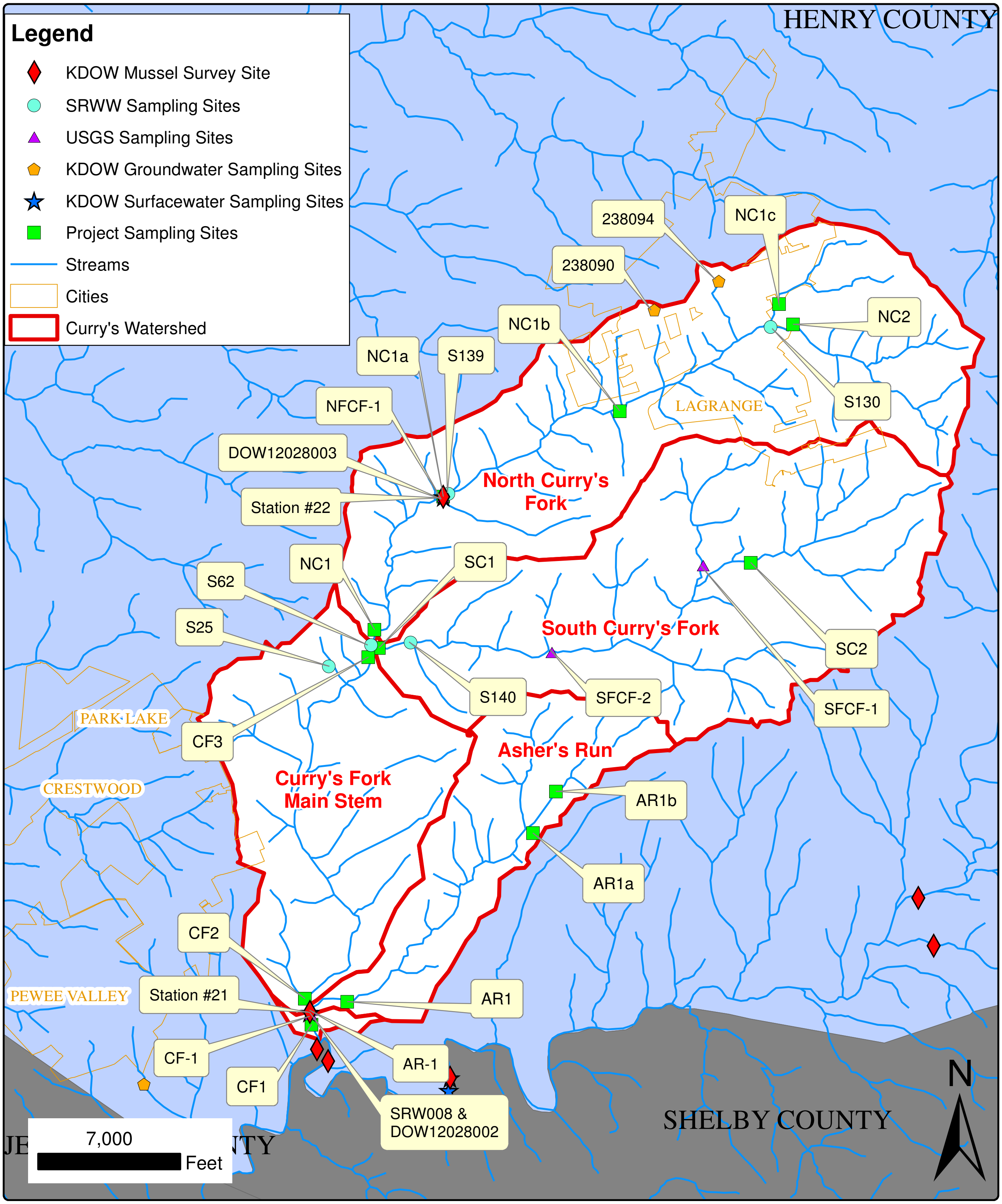
The following subsections briefly discuss sampling data collected by Strand, Third Rock, and UL collected for the WP sampling program, including the types of data collected, why it was collected, the time frame of data collection, and the quantity of data. Figure 3.01-1 is a comprehensive figure showing all sampling data sites within the Curry's Fork watershed. Refer to each subsection for a list of sampling sites and sampling locations.

3.02 PHYSICOCHEMICAL SAMPLING DATA

Table 3.02-1 summarizes the physicochemical parameters measured for the WP sampling program.

Parameter	Analysis Type
Temperature	Field Data
pH	Field Data
Dissolved oxygen	Field Data
Conductivity	Field Data
Stream depth	Field Data
Stream velocity	Field Data
Fecal coliform	Laboratory Data
Total suspended solids	Laboratory Data
Nutrients	Laboratory Data
Sulfate	Laboratory Data
Ammonia	Laboratory Data
5-Day biological oxygen demand	Laboratory Data

Table 3.02-1 Physicochemical Data Summary



SAMPLING SITES WITHIN CURRY'S FORK

CURRY'S FORK WATER QUALITY DATA REPORT
OLDHAM COUNTY FISCAL COURT
OLDHAM COUNTY, KENTUCKY

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 3.01-1
5994.100

A. Primary Data Sources

Physicochemical data sources include sampling conducted by Strand Third Rock, and UL. Rock and UL. Figure 3.02-1 shows the primary data source physicochemical sampling site locations.

Strand's physicochemical portion of the WP sampling program provides baseline conditions in the Curry's Fork watershed and was used by the Water Quality Data Analysis Team (WQDAT) and the Technical Committee (TC) to identify pollutants of concern, priority protection and restoration areas, pollutant sources, pollutant causes to develop pollutant loads for select parameters, and to select appropriate solutions and BMPs.

Physicochemical water quality samples were collected as part of the WP sampling program during the 2007 primary contact recreational season at eight sampling sites within Curry's Fork. Four of the eight initial sampling sites had portable automatic samplers with flow metering equipment installed to take continuous flow velocity and depth measurements; these sites were NC1, SC1, AR1, and CF2. Refer to Figure 3.02-1 for the location of these sites. Physicochemical water quality samples were taken approximately every other week for a total of 12 sampling dates. Samples were taken as close to the same day each week as possible regardless of weather conditions.

As a result of drought conditions observed in May through September 2007 and the subsequent missed sampling events because of low flow or no flow conditions in streams, the physicochemical water quality sampling conducted in 2007 was repeated in 2009 with the addition of three sampling sties. The area in and around Curry's Fork typically receives 19.26 inches of rainfall between May and September (ORSANCO, 1994). Between May and September of 2007, Curry's Fork received 15.66 inches of rainfall according to the Jeffries Farm rain gauge located in South Curry's Fork, which is 3.6 inches or approximately 19 percent less than average. The three additional sites were added in consultation with KDOW and others to further aid identification of pollutant sources based on 2007 sampling results. The QAPP was updated to reflect change made to the sampling program in 2009. Curry's Fork received 32.42 inches of rainfall between May and September of 2009.

Two storm events were also sampled intensively during the recreational contact season in 2009 to obtain additional wet weather sampling data, one on September 20, 2009, and one on October 30, 2009. Samples were taken at Hour 0 (start of the storm), Hour 4 (4 hours after the start of the storm, and Hour 12 (12 hours after the start of the storm) to determine wet weather influences on stream water quality. Storm event samples were taken at all WP project sites except NC1a, NC1b, and NC2 for safety reasons.

B. Normal vs. Rain Influenced Events

To differentiate between normal and rain influenced WP sampling events during 2007 and 2009 physicochemical water quality sampling, sampling dates were compared with rainfall information obtained from the Jeffries Farm rain gauge located in the South Curry's Fork watershed. It is important to identify which sampling events were affected by stormwater/runoff conditions so that the types and sources of pollutants throughout the watershed are determined.

Rainfall and stream flow conditions (depth and velocity) were also used to help determine if an event was dry weather or wet weather. Initially, any sampling event that occurred within 24 hours of a precipitation event (defined for this evaluation as > 0.1 inches from the Jeffries Farm rain gauge) was tagged as a potential wet weather event.

Stream flow conditions were then reviewed for each potential wet weather event. If stream flow conditions were elevated and indicative of runoff conditions in response to rainfall, the event was considered a wet weather event. If stream flow conditions were indicative of base flow conditions (dry conditions), the rainfall had not impacted the stream and the event was considered a dry weather event. This process was repeated for each sampling event.

C. Secondary Data Sources

Secondary data sources include sampling conducted by KDOW, Salt River Watershed Watch (SRWW), and United States Geological Survey (USGS). Refer to Figure 3.02-1 for the locations of the secondary data source physicochemical sampling sites.

1. KDOW

KDOW conducts numerous sampling and monitoring programs for sampling sites within Kentucky. Within these programs, KDOW has two surface water sampling sites and two groundwater sampling sites located within the Curry's Fork watershed that collected physicochemical sampling data.

Physicochemical water quality data was collected at the surface water sampling sites in 1981, 1999, 2000, and 2004. Physicochemical water quality data was collected at the groundwater sampling sites from 1999 through 2003. Physicochemical data collected as part of the WP was considered sufficient and was more current compared to KDOW data. Therefore, KDOW physicochemical data was considered a secondary data source.

2. SRWW

The SRWW is part of Kentucky's Watershed Watch Program, which is a statewide association of individuals committed to the improvement of water resources across Kentucky through water quality monitoring, skill development, and advocacy. This program uses trained volunteers to conduct sampling efforts.

SRWW has five sampling sites within the Curry's Fork watershed. The sampling program has three major components: herbicides and pesticides collected in the spring, pathogen data collected in the summer, and low-flow nutrient samples taken in the fall. SRWW monitoring data is available from 1998 to 2007.

Data collected by SRWW is considered a secondary data source for two reasons. First, some of the data was considered to be out-of-date for planning purposes because it does not represent the current conditions of the watershed. Second, although collected by trained volunteers, data was not collected under a KDOW-approved sampling plan.

3. USGS

As part of the program to assist in the development of the total maximum daily load (TMDL) program for the Floyd's Fork watershed, the USGS Kentucky Water Science Center collected data at various sites throughout the Floyd's Fork watershed. Curry's Fork is a tributary of Floyd's Fork, and USGS had five sampling sites in the Curry's Fork watershed as part of this sampling program.

Samples were taken at the five sites in the Curry's Fork watershed during the 2007 and 2008 recreational contact seasons, which is during the months of May through October. Seventeen sampling trips were made to each of the sites to document a variety of physicochemical parameters of the water.

Physicochemical data collected as part of the WP sampling program was considered sufficient. Therefore, physicochemical data collected by USGS was considered a secondary data source.

3.03 BACTERIA DATA

Fecal coliform bacteria data was collected as part of the WP sampling program. Fecal coliform bacteria data is collected for many water quality sampling programs because it is an indicator organism. Indicator organisms, while not pathogenic themselves, may indicate the presence of waterborne pathogens. Indicator organisms are typically used in water quality monitoring because testing for the pathogens themselves is impractical. There are many types of pathogens and they typically require a specific test with special materials or equipment, making the cost for directly monitoring pathogens expensive. Testing for indicator organisms can identify areas of concern in a watershed but at a fraction of the cost.

A. Primary Data Sources

The WP sampling program was considered the only primary data source for pathogen data. Fecal coliform pathogen data was collected at the same time as physicochemical data at project sites during biweekly sampling and the two storm events described in Subsection 3.02. Refer to Figure 3.02-1 for sampling site locations.

B. Secondary Data Sources

Secondary data sources include sampling conducted by USGS, KDOW, and SRWW. Refer to Figure 3.02-2 for sampling site locations

1. USGS

USGS collected *E. coli* pathogen data at the same time as the physicochemical data described in Subsection 3.02. *E. coli* data cannot be compared directly to fecal coliform data, and more fecal coliform data was collected during the WP sampling program. Therefore, USGS pathogen data was considered a secondary data source.

2. KDOW

Fecal coliform pathogen data was collected by KDOW during 1999 at the same time as the physicochemical samples described in Subsection 3.02. Pathogen data collected by KDOW was out of date for planning purposes and was therefore considered as a secondary data source.

3. SRWW

Pathogen data was collected by SRWW between 2002 and 2007 during the summer. Fecal coliform and *E. coli* pathogen data were collected at four of the five SRWW sites within Curry's Fork. As discussed in Subsection 3.02, SRWW data was considered a secondary data source because it was not collected using a KDOW-approved sampling plan.

3.04 GEOMORPHOLOGIC DATA

Geomorphological data was collected by UL as part of the WP sampling program and was considered a primary data source.

UL conducted a sediment and geomorphic assessment to assess and quantify water pollutant loads being contributed from different sources within the watershed. The three objectives of the assessment were to calculate loads of fine sediment from the four subwatersheds, evaluate the relative contributions of different sediment sources, and interpret possible links between sediment production and WAH impairment.

The assessment comprised of three main activities: measurement of sediment yields at the mouth of each subwatershed, assessment of sediment production along stream reaches and uplands within each subwatershed, and a geomorphic assessment to identify potential causes of WAH impairment. UL utilized numerous instream measurements and modeling software to perform the sediment and geomorphic assessment. Sampling site selections, data collection, and data analysis methods are described in Appendix C.

The four sampling sites installed with portable samplers mentioned in Subsection 3.02 collected total suspended solids (TSS) and flow data to support the geomorphology study. Between November 2007 and July 2008, the portable samplers were programmed to collect samples at specified time intervals once the stream depth reached a specified value such as a flow depth indicative of wet weather flow. The samples were used to determine TSS loads throughout the length of a storm event. Table 3.04-1 summarizes the number of events sampled by the portable samplers.

Event Date	NC1	AR1	CF2	SC1
November 22, 2007			1	
November 26, 2007	1	1		
December 9, 2007	1	1	1	
February 5, 2008		1	1	
February 12, 2008	1			
March 4, 2008		1		1
March 18, 2008	1	1	1	1
March 27, 2008	1	1	1	1
April 3, 2008	1			1
April 11, 2008			1	
May 3, 2008	1			
May 11, 2008	1			1
May 14, 2008	1	1		1
June 3, 2008		1		
July 31, 2008		1		
Total Events Sampled	**9**	**9**	**6**	**6**

Table 3.04-1 Portable Sampler Event Summary

3.05 BIOLOGICAL AND PHYSICAL HABITAT DATA

Aquatic, biological, and physical habitat data conducted or used as part of the WP sampling program included mussels, benthic macroinvertebrates (visible bottom-dwelling invertebrates), fish, algae, and in stream and near stream physical habitat assessments. See Figure 3.01-1 for the locations of the biological and physical habitat assessments.

Biological and physical habitat assessments were performed to evaluate the biological and physical habitat condition of surface water using biological surveys, stream surveys, and other direct measurements. These assessments integrate the collection and analysis of algal, mussel, macroinvertebrate, fish, habitat, and water chemistry data to arrive at conclusions on the health of the surface water and the subwatersheds of Curry's Fork.

A. Primary Data Sources

Primary biological and physical habitat data sources include sampling conducted by Third Rock and KDOW.

1. Third Rock Consultants, Inc.

Biological and habitat assessments were performed in the summer of 2007 at four sampling sites within Curry's Fork; these sites are NC1, SC1, AR1, and CF2. Sampling data was collected as part of the WP sampling program.

2. KDOW

KDOW conducted a qualitative mussel survey for Floyds Fork during the summer and fall of 2003. Twenty-three sites were surveyed during this study and results were compared to a previous study conducted in 1978 to provide updated mussel information and to document the changes in mussel population. Curry's Fork is a tributary of Floyds Fork and two of the 23 project sites are located in the Curry's Fork watershed.

B. Secondary Data Sources

The KDOW also conducted biological assessments at the two surface water sites mentioned in the previous subsection. The assessments were performed in 1981 and 1999. The data was considered to be out of date for planning purposes and was therefore considered a secondary data source.

3.06 WATERSHED PLAN WATER QUALITY SAMPLING PROCEDURES

To ensure water quality samples taken represent the conditions in the stream, standardized sampling procedures were followed. The following describes the various sampling procedures followed for the types of data collected.

A. Flow Conditions

Flow conditions at sampling sites were determined two ways, through portable samplers with flow metering equipment or through field measurements.

As mentioned in Subsection 3.05, four sampling sites had portable samplers with flow metering equipment installed; these sites were NC1, SC1, AR1, and CF2. The portable samplers with flow metering equipment continuously measure and record stream depth and velocity at 15-minute intervals.

Flow conditions at project sites that did not have a portable sampler with flow metering equipment were determined in the field using a yard stick (to measure depth) and velocity meter. Stream cross sections were surveyed at each sampling site so that flow, depth, and velocity measurements could be used to calculate stream flow.

B. Biological Sampling Procedures

Biological sampling and assessments were conducted according to the guidelines specified in the *Standard Methods for Assessing Biological Integrity of Surface Waters in Kentucky, KDOW 2002.* The 2008 edition of the KDOW *Standard Methods for Assessing Biological Integrity of Surface Waters in Kentucky* was used for some metric results and indices calculations as it became available after biological surveys were conducted.

C. Physical and Water Chemistry Sampling Procedures

Physical and water chemistry sampling procedures for project sites were collected in accordance with the approved QAPP for the Data Collection Program of the Curry's Fork WP. The QAPP was reviewed and approved by KDOW. Refer to Appendix E for a coy of the QAPP.

D. Geomorphic Sampling Procedures

Geomorphic sampling procedures are described in further detail in the Sediment and Geomorphic Assessment of the Curry's Fork Watershed by UL.

3.07 SAMPLING DATA SUMMARY

Table 3.07-1 summarizes the amount of sampling data collected for the Curry's Fork WP. Table 3.07-2 summarizes the locations and types of sampling sites for primary and secondary data sources within Curry's Fork. Additional sampling conducted by UL for the geomorphic assessment is described in the Sediment and Geomorphic Assessment for the Curry's Fork Watershed.

TABLE 3.07-1

CURRY'S FORK SAMPLING DATA SUMMARY

Source	Year	Number of Samples																
		Metals	Alkalinity	Organic Carbon	Chloride	Field Data[1]	Sulfate	Bacteria[2]	Hardsness	Nutrients[3]	Ammonia	TSS	TDS	BOD_5	Turbidity[4]	Herbicides & Pesticides	Specific Cond.	Ground Water
KDOW	1981		2		2	2	2		2	2	1	2			1			
	1999	9	9	9	9	10	9	8		1	10						9	2
	2000	3	3	3	3	3	3		3	3	3	3					3	
	2001																	3
	2002																	4
	2003																	2
	2004	3	3	3	3		3		3	3	3	3						
KDOW TOTAL		**15**	**17**	**15**	**17**	**15**	**17**	**8**	**8**	**9**	**17**	**8**			**1**		**12**	**11**
SRWW	1998				1	1			1	1	1	1						
	2000			1	1				1	1	1	1	1				1	
	2001			1	1	1			1	1	1	1	1				1	
	2002			2	2	2		1	2	2	2	2	2			1	2	
	2003			1	1	1			1	1	1	1	1			1	1	
	2004				1	1	1	1	1	1	1	1	1			4	1	
	2005				4			1	4	4	4	4				4	4	
	2006				4	4	4	1	4	4	4	4					4	
	2007				4		4	1	4	4	4	4				4	4	
SRWW TOTAL				**5**	**19**	**10**	**9**	**5**	**19**	**19**	**19**	**19**	**6**			**14**	**18**	
USGS	2007			42				43		42	42	42		43	34		43	
	2008			32				22		32	32	32		32	33		32	
USGS TOTAL				**74**				**65**		**74**	**74**	**74**		**75**	**67**		**75**	
Project Sites	2007	1				86	86	86		86	86	228		86	-			
	2008											546			-			
	2009					181		181		181		181			-			
PROJECT TOTAL		**1**				**267**	**86**	**267**		**267**	**86**	**955**		**86**				
OVERALL TOTAL		**16**	**17**	**94**	**36**	**292**	**112**	**345**	**27**	**369**	**196**	**1,056**	**6**	**161**	**68**	**14**	**105**	**11**

[1]Field data includes pH, DO, conductance, and/or temperature readings.
[2]Bacteria includes fecal coliform and/or *E. coli* concentrations.
[3]Nutrients include nitrates + nitrites, total nitrogen, total Kjeldahl nitrogen, and/or total phosphorus.
[4]Turbidity readings were taken continuously at four project sampling sites.

TABLE 3.07-2

CURRY'S FORK SAMPLING SITE LOCATIONS

Site ID	Stream	Site Description	Data Type(s)	Source Type	Latitude	Longitude
12028002	Curry's Fork	KDOW Site	PC, B, H, P	Secondary	38.30750	-85.45080
CF1	Curry's Fork	Project Site	PC, B, H, P	Primary	38.30588	-85.45044
CF-1	Curry's Fork	USGS Site	PC, P	Secondary	38.35611	-85.40889
CF2	Curry's Fork	Project Site	PC, P	Primary	38.30938	-85.45159
CF3	Curry's Fork	Project Site	PC, P	Primary	38.35554	-85.44050
S62	Curry's Fork	SRWW Site	PC, P	Secondary	38.35716	-85.44001
SRW008	Curry's Fork	KDOW Site	PC, P	Secondary	38.30740	-85.45060
Station 21	Curry's Fork	KDOW Site	B	Primary	38.3075	-85.4508
AR-1	Asher's Run	USGS Site	PC, P	Secondary	38.36778	-85.38278
S25	Asher's Run	SRWW Site	PC, P	Secondary	38.35430	-85.44730
TB1	Asher's Run	Project Site	PC, B, H, P	Primary	38.30894	-85.44429
TB1a	Asher's Run	Project Site	PC, P	Primary	38.33167	-85.41222
12028003	North Curry's Fork	KDOW Site	PC, B	Secondary	38.7720	-85.42750
Station 22	North Curry's Fork	KDOW Site	B	Primary	38.3772	-85.4275
NC1	North Curry's Fork	Project Site	PC, B, H, P	Primary	38.35926	-85.43942
NC1a	North Curry's Fork	Project Site	PC, P	Primary	38.37722	-85.42750
NC1b	North Curry's Fork	Project Site	PC, P	Primary	38.38872	-85.39703
NC2	North Curry's Fork	Project Site	PC, P	Primary	38.40033	-85.36715
NFCF-1	North Curry's Fork	USGS Site	PC, P	Secondary	38.30784	-85.45028
S130	North Curry's Fork	SRWW Site	PC, P	Secondary	38.42000	-85.37100
S139	North Curry's Fork	SRWW Site	PC, P	Secondary	38.37762	-85.42659
S140	South Curry's Fork	SRWW Site	PC, P	Secondary	38.35752	-85.43318
SC1	South Curry's Fork	Project Site	PC, B, H, P	Primary	38.35679	-85.43863
SC2	South Curry's Fork	Project Site	PC, P	Primary	38.36812	-85.37460
SFCF-1	South Curry's Fork	USGS Site	PC, P	Secondary	38.30722	-85.45056
SFCF-2	South Curry's Fork	USGS Site	PC, P	Secondary	38.37722	-85.42750

Data Type Notes: B = Biological
H = Habitat
P = Pathogen
PC = Physicochemical

SECTION 4
WATER QUALITY SAMPLING DATA

4.01 FLOW CONDITIONS

Flow conditions for each WP sampling site are represented by flow duration curves (FDCs). FDCs are created by compiling all flow records at the sampling site and ranking them. The Y axis represents the flow and the X axis relates the flow values to the percentage of time those values have been met or exceeded. The use of the percentage of time provides a uniform scale ranging from 0 to 100; therefore, the full range of the stream is considered. FDCs are typically separated into zones representing varying stream conditions. The zones are: High Flows (0 to 10 percent), Moist Conditions (10 to 40 percent), Mid-Range Flows (40 to 60 percent), Dry Conditions (60 to 90 percent), and Low Flows (90 to 100 percent).

The following FDCs for the subwatersheds within the Curry's Fork watershed are organized to show the sampling site farthest upstream first and the remaining sites moving downstream through the subwatershed.

A. <u>North Curry's Fork Subwatershed</u>

Flow conditions were taken at the following sampling sites located in the North Curry's Fork subwatershed: NC2, NC1b, NC1a, and NC1. Figures 4.01-1, 4.01-2, 4.01-3, and 4.01-4 show the FDCs for sites NC2, NC1b, NC1a, and NC1, respectively.

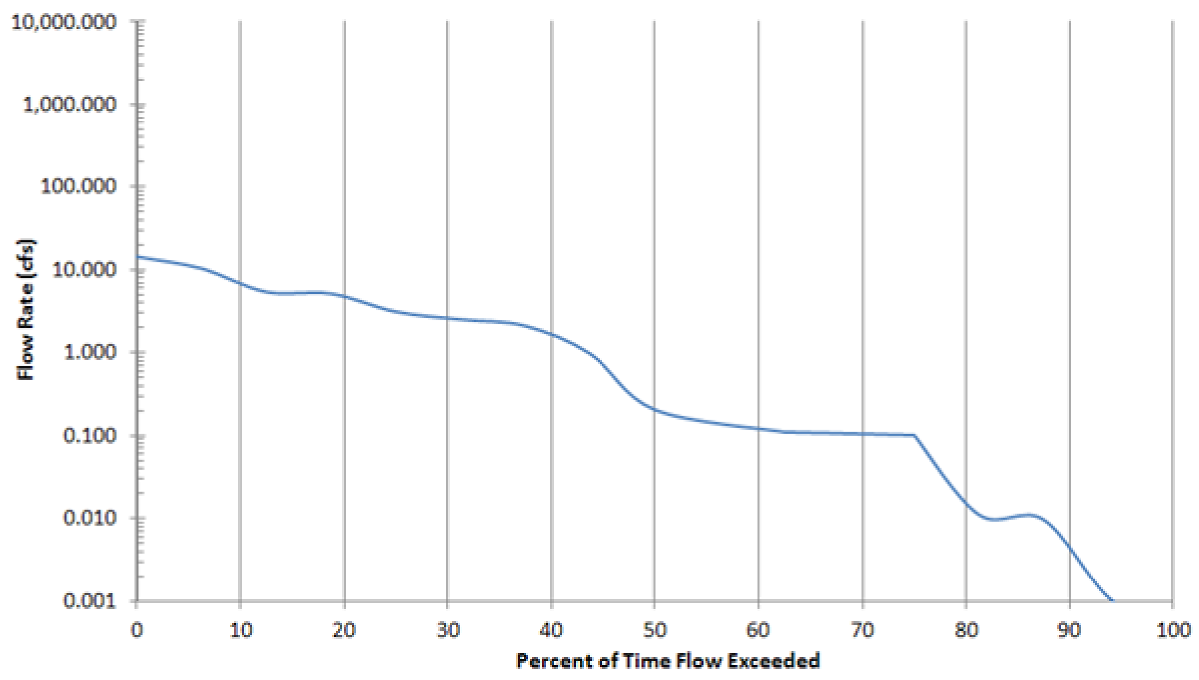


Figure 4.01-1 NC2 Flow Duration Curve

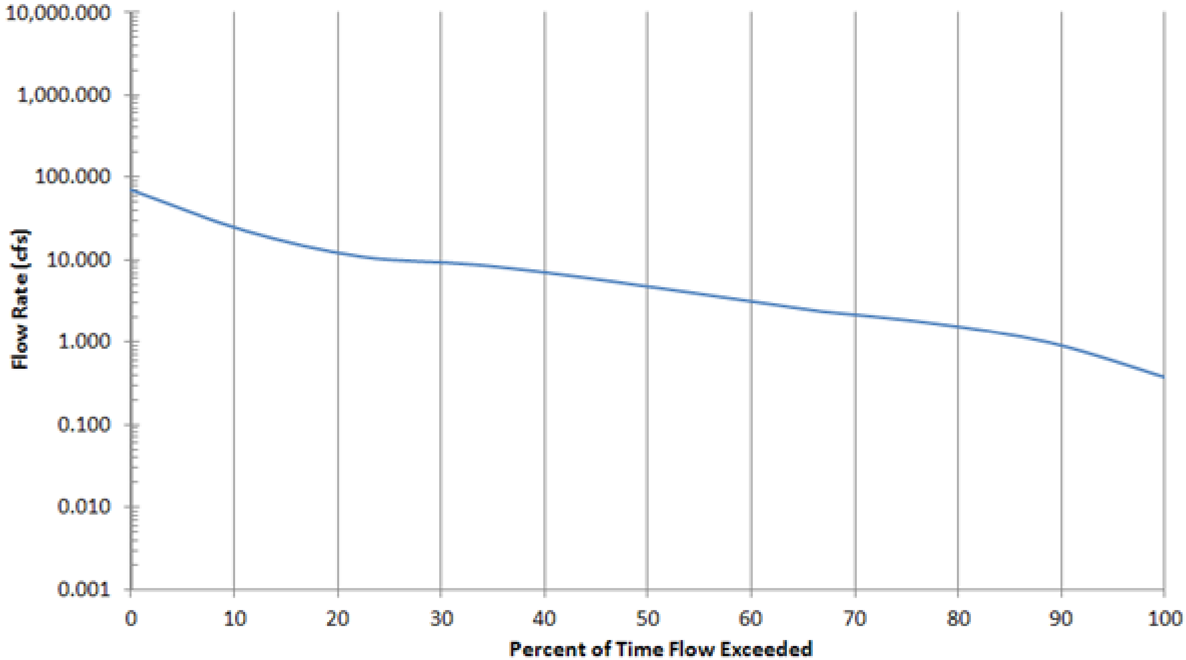


Figure 4.01-2 NC1b Flow Duration Curve

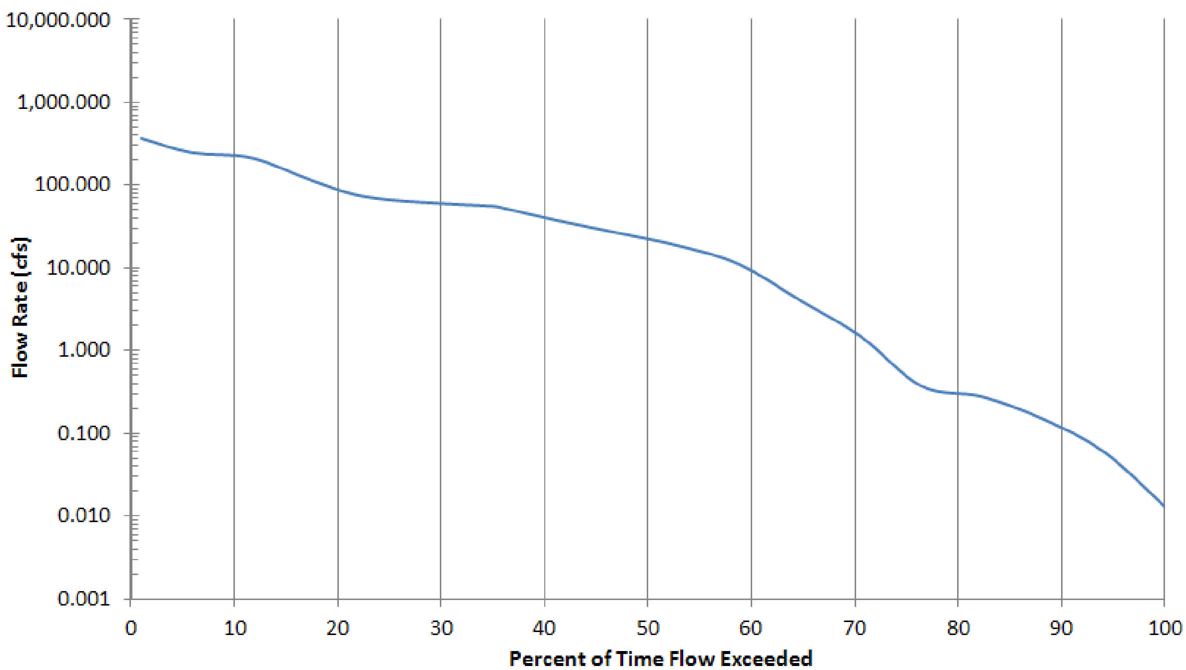


Figure 4.01-3 NC1a Flow Duration Curve

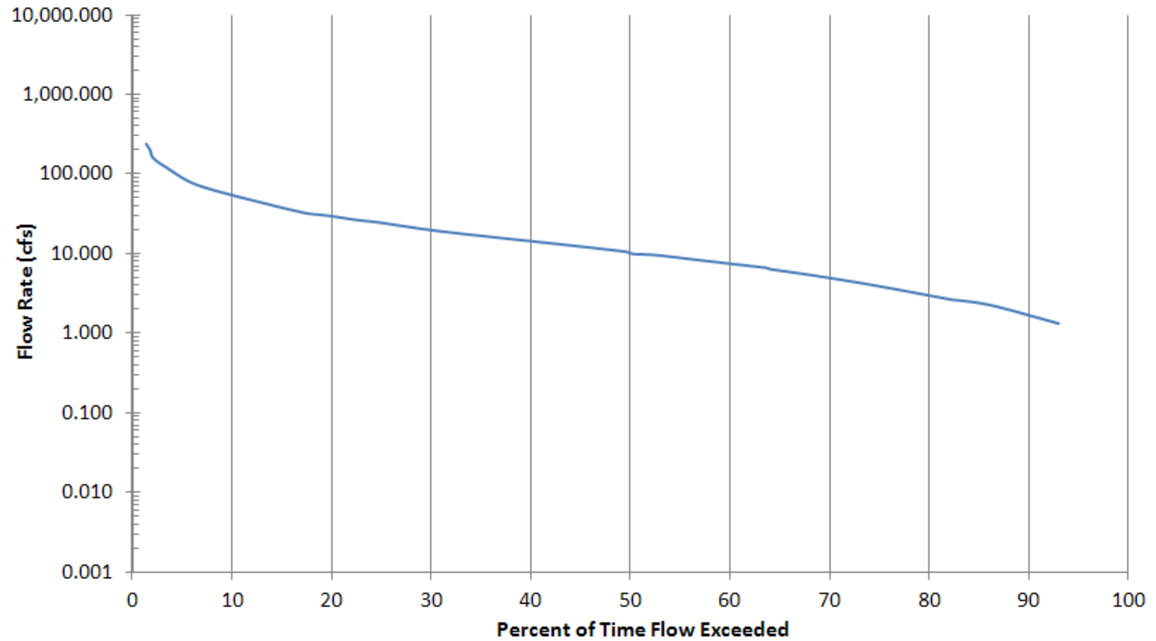


Figure 4.01-4 NC1 Flow Duration Curve

B. South Curry's Fork Subwatershed

Flow conditions were taken at the following sampling sites located in the South Curry's Fork subwatershed: SC2 and SC1. Figures 4.01-5 and 4.01-6 show the FDCs for sites SC2 and SC1, respectively.

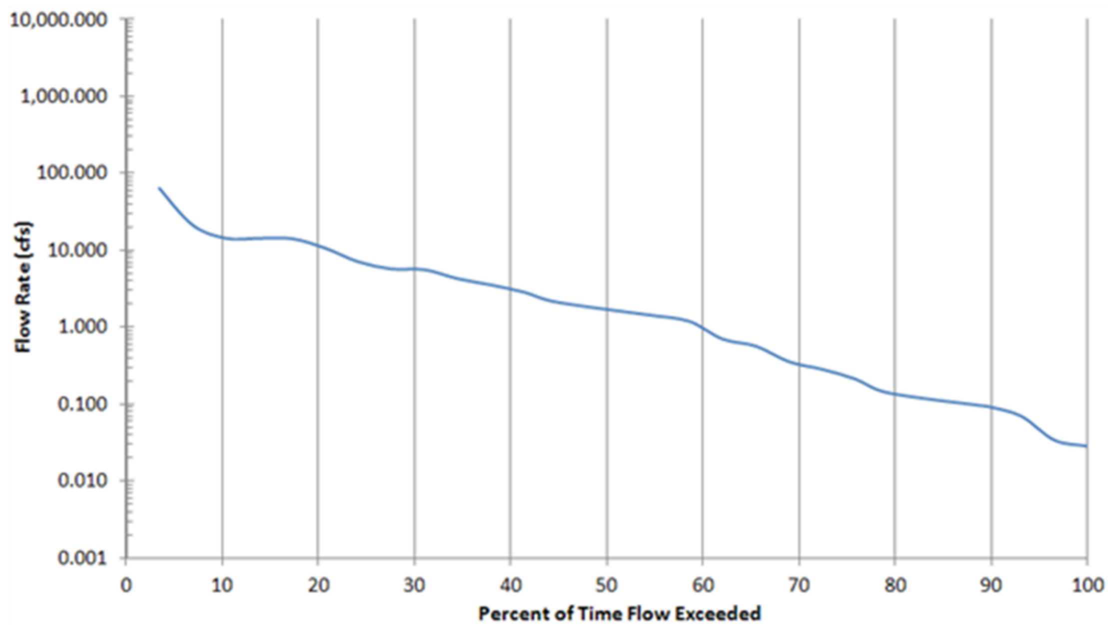


Figure 4.01-5 SC2 Flow Duration Curve

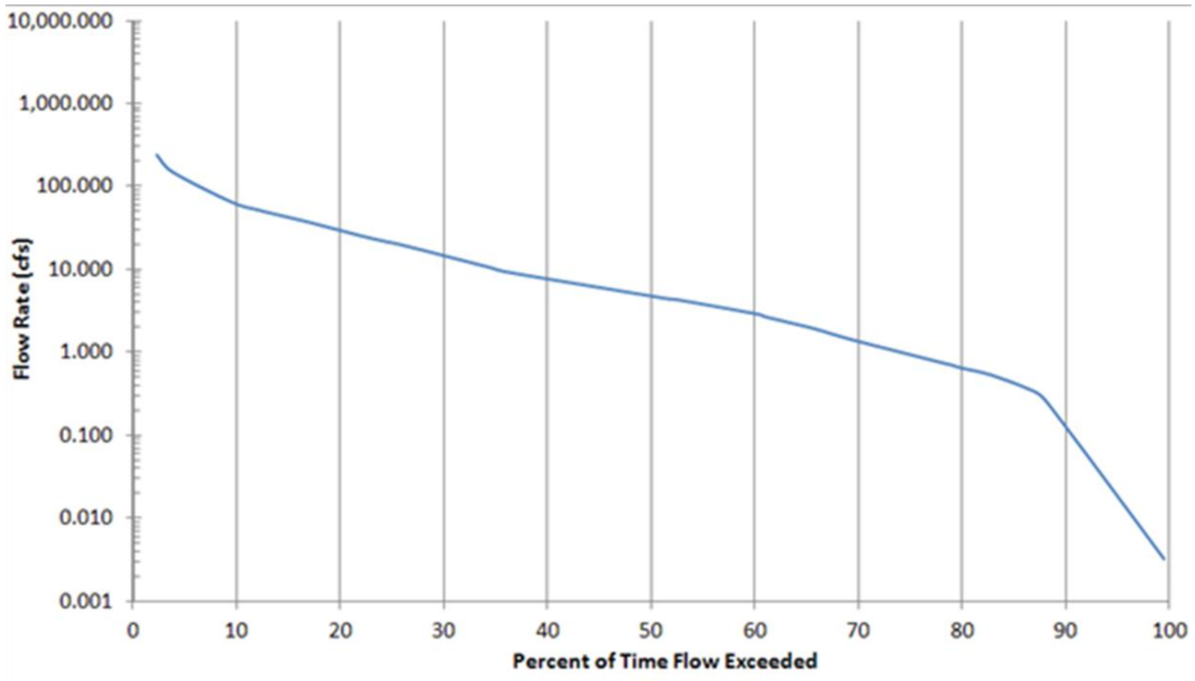


Figure 4.01-6 SC1 Flow Duration Curve

C. Asher's Run Subwatershed

Flow conditions were taken at the following sampling sites located in the Asher's Run subwatershed: AR1a and AR1. Figures 4.01-7 and 4.01-8 show the FDCs for sites AR1a and AR1, respectively.

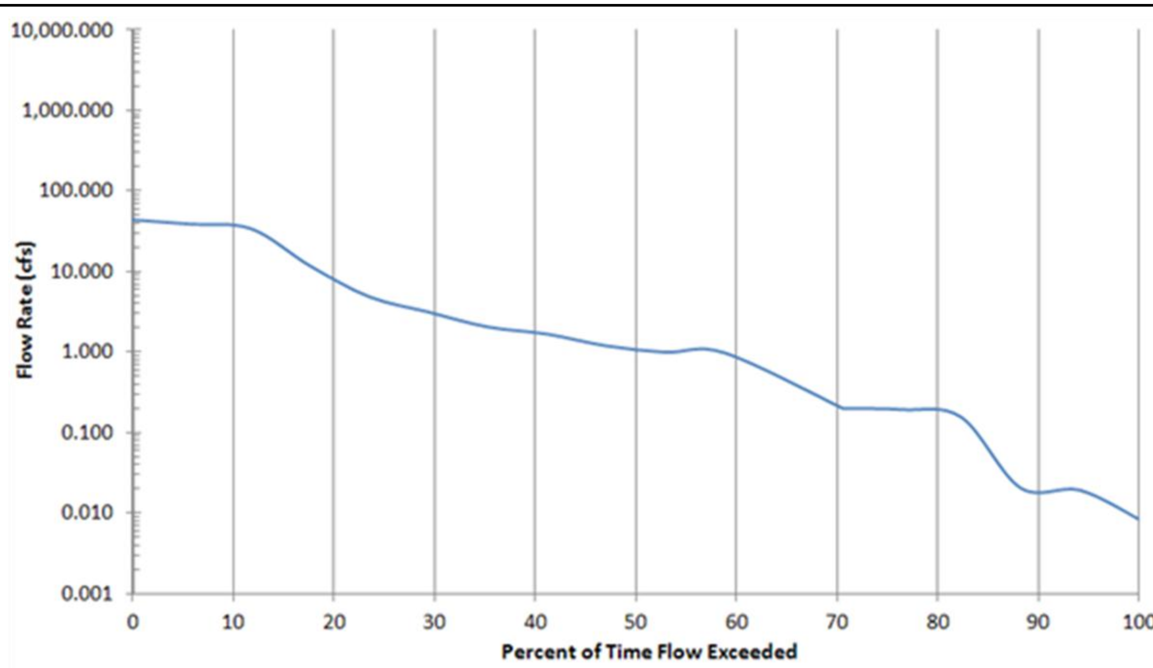


Figure 4.01-7 AR1a Flow Duration Curve

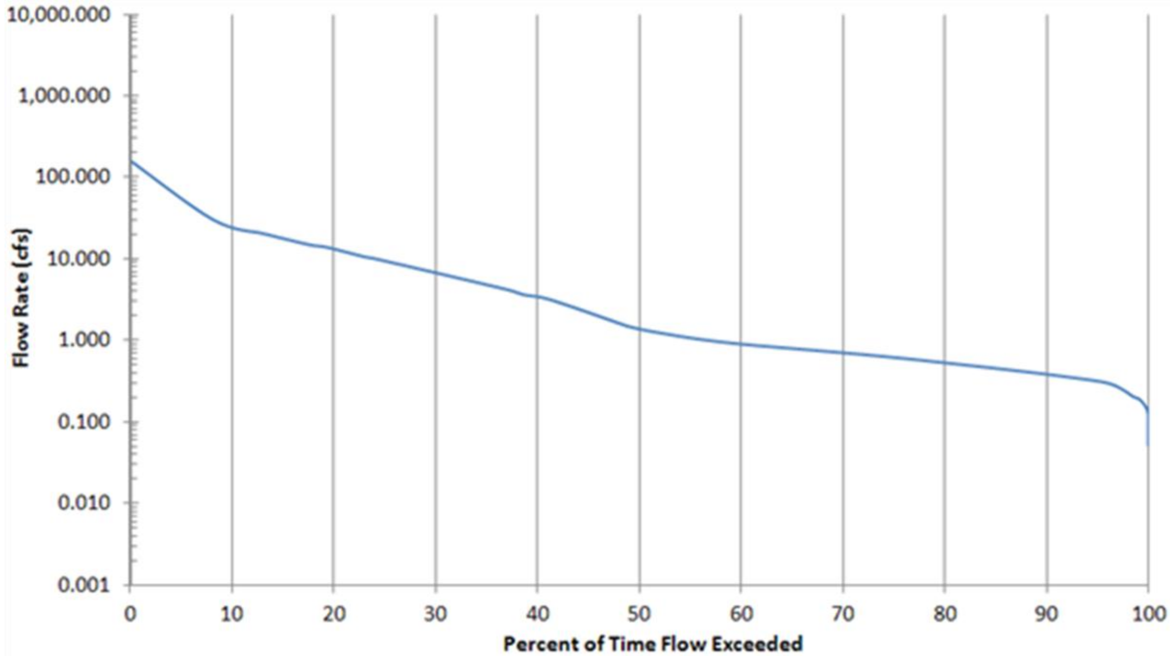


Figure 4.01-8 AR1 Flow Duration Curve

D. <u>Curry's Fork Main Stem Subwatershed</u>

Flow conditions were observed at the following sampling sites located in the Curry's Fork Main Stem subwatershed: CF3, CF2, CF1. Figures 4.01-9, 4.01-10, and 4.01-11 show the FDCs for sites NC2, NC1b, NC1a, and NC1, respectively.

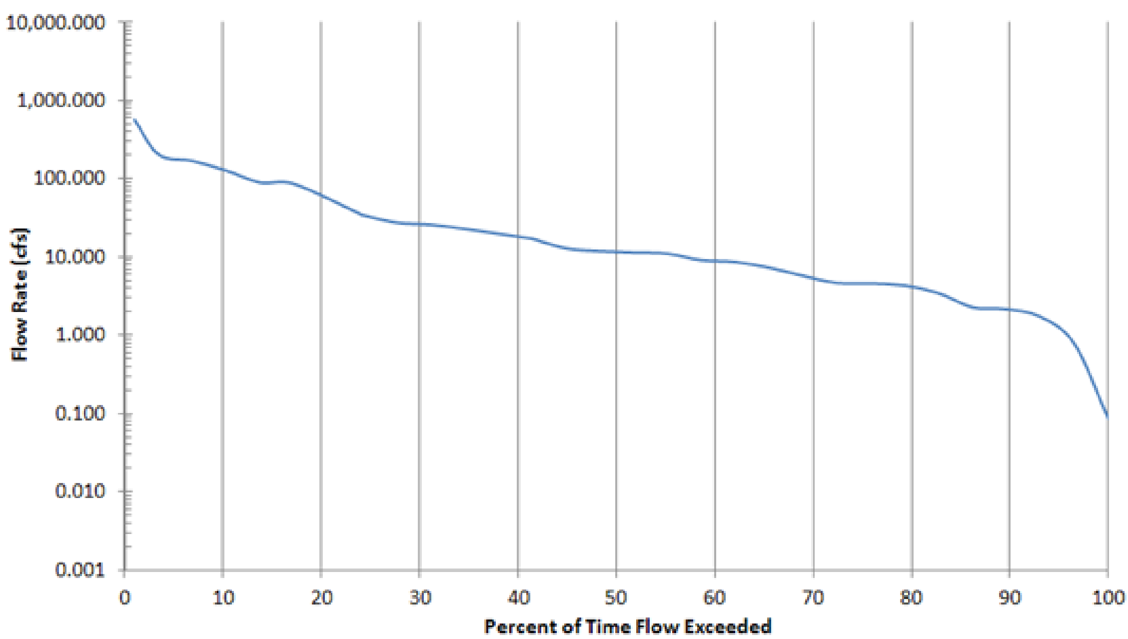


Figure 4.01-9 CF3 Flow Duration Curve

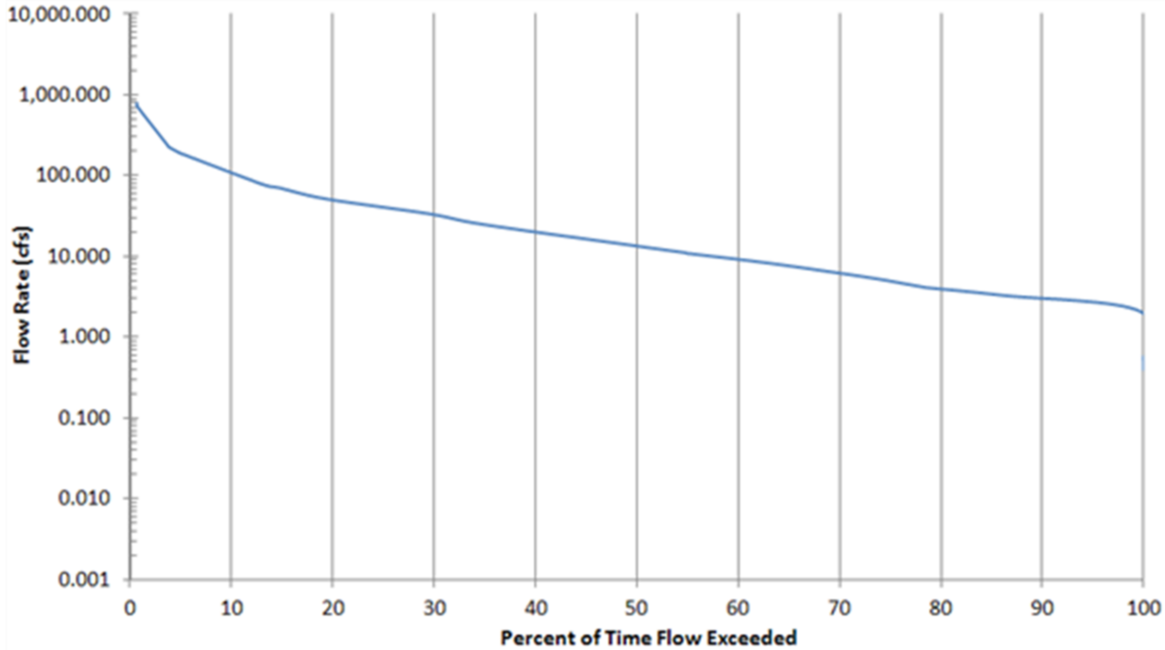


Figure 4.01-10 CF2 Flow Duration Curve

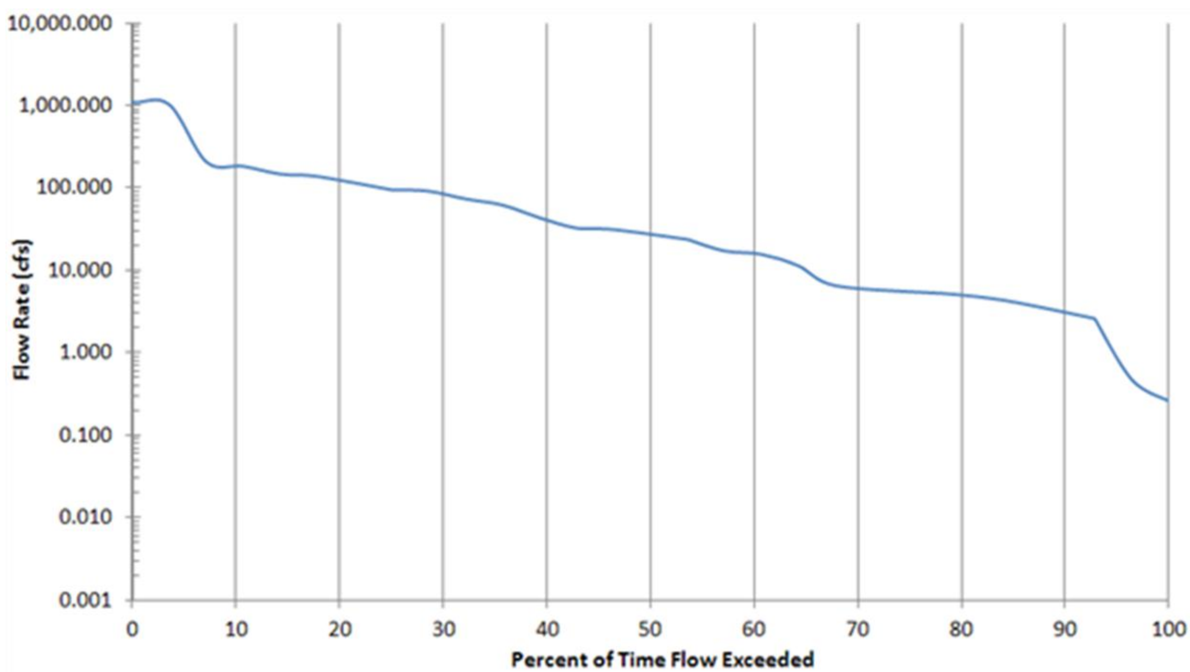


Figure 4.01-11 CF1 Flow Duration Curve

4.02 STORM SAMPLING DATA

As stated in Section 3, two storm events were sampled during the 2009 recreational contact season, one on September 20, 2009, and one on October 30, 2009. As mentioned in the previous section, samples were not taken at NC1b and NC2 for safety reasons.

Tables 4.02-1 and 4.02-2 show the physicochemical and pathogen sampling results for the September 20, 2009 and October 30, 2009 storm events, respectively.

Sample Site	Date	Sample Hour	Time of Sample	Fecal Coliform (colonies / 100 ml)[1]	TSS (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Nitrite + Nitrate (mg/l)	TKN (mg/l)	TN (mg/l)	Water Clarity (1=Clear 5=Muddy)	Temp. (C°)	pH	DO (mg/l)	Cond. (µS/cm)	Water Velocity (ft/s)	Water Depth (ft)
CF1	9/20/2009	0	7:45	2,500	6	0.15	13.00	13.15	1.30	14.00	2	18.7	7.4	5.00	720	0.40	0.5
CF1	9/20/2009	4	12:20	2,500	5	0.15	12.00	12.15	1.10	13.00	3	19.7	7.0	7.26	644	1.00	0.6
CF1	9/20/2009	12	18:45	5,600	20	0.15	8.10	8.25	1.30	9.40	4	20.2		7.90	515	2.00	1.3
			Average	**3,271**	**10**	**0.15**	**11.03**	**11.18**	**1.23**	**12.13**	**3**	**19.5**	**7.2**	**6.72**	**626**	**1.13**	**0.8**
CF2	9/20/2009	0	8:00	2,500	5	0.15	14.00	14.15	1.40	15.00	3	18.9	7.5	7.40	709	0.20	0.8
CF2	9/20/2009	4	12:30	8,000	8	0.15	13.00	13.15	1.50	15.00	3	19.2	7.1	6.70	590	0.30	0.9
CF2	9/20/2009	12	18:55	8,400	31	0.15	8.50	8.65	1.20	9.70	4	20.2		8.35	515	1.00	1.2
			Average	**5,518**	**15**	**0.15**	**11.83**	**11.98**	**1.37**	**13.23**	**3**	**19.4**	**7.3**	**7.48**	**605**	**0.50**	**1.0**
CF3	9/20/2009	0	8:45	2,700	6	0.15	2.70	2.85	0.97	3.70	1	17.8	7.4		423	0.80	0.2
CF3	9/20/2009	4	12:50	20,000	370	0.15	11.00	11.15	4.00	15.00	5	18.9	7.4	7.12	590	2.00	1.2
CF3	9/20/2009	12	18:40	6,200	17	0.15	0.32	0.47	1.20	1.50	3	19.0	7.6	7.60	421	1.00	0.7
			Average	**6,944**	**131**	**0.15**	**4.67**	**4.82**	**2.06**	**6.73**	**3**	**18.6**	**7.5**	**7.36**	**478**	**1.27**	**0.7**
NC1	9/20/2009	0	8:55	3,400	5	0.15	2.60	2.75	2.60	5.20	2	18.2	6.6		452	0.30	0.7
NC1	9/20/2009	4	11:45	9,400	7	0.15	2.70	2.85	1.60	4.30	4	18.2	6.6	6.05	440	1.30	1.0
NC1	9/20/2009	12	19:55	19,000	50	0.15	1.80	1.95	1.20	3.00	4	19.9	6.0	7.96	300	1.00	1.0
			Average	**8,468**	**21**	**0.15**	**2.37**	**2.52**	**1.80**	**4.17**	**3**	**18.8**	**6.4**	**7.01**	**397**	**0.87**	**0.9**
NC1a	9/20/2009	0	7:00	490	10	0.15	17.00	17.15	1.60	19.00	2	18.3	6.5		685	0.01	1.3
NC1a	9/20/2009	4	12:00	21,000	270	0.15	3.90	4.05	1.90	5.80	5	18.7	6.3	8.22	632	2.50	2.7
NC1a	9/20/2009	12	19:40	11,000	26	0.15	3.90	4.05	1.10	5.00	5	20.2	6.2	5.92	389	1.43	1.0
			Average	**4,837**	**102**	**0.15**	**8.27**	**8.42**	**1.53**	**9.93**	**4**	**19.1**	**6.4**	**7.07**	**569**	**1.31**	**1.6**
SC1	9/20/2009	0	8:30	4,600	22	0.15	0.53	0.68	0.96	1.50	2	17.3	7.5		475	0.10	0.3
SC1	9/20/2009	4	12:40	8,500	39	0.15	0.96	1.11	1.20	2.20	4	18.2	6.8	7.72	470	0.50	0.5
SC1	9/20/2009	12	18:20	6,600	25	0.15	0.32	0.47	0.91	1.20	3	19.1	7.5	7.30	415	1.25	0.7
			Average	**6,367**	**29**	**0.15**	**0.60**	**0.75**	**1.02**	**1.63**	**3**	**18.2**	**7.3**	**7.51**	**453**	**0.62**	**0.5**
SC2	9/20/2009	0	7:30	140	5	0.15	0.11	0.26	1.10	1.10	2	19.2	8.0		385	0.01	0.7
SC2	9/20/2009	4	12:25	50	8	0.15	0.11	0.26	1.00	1.00	4	18.5	7.1	6.45	366	0.01	0.7
SC2	9/20/2009	12	19:20	4,600	81	0.15	0.40	0.55	0.96	1.30	3	19.2	7.3	4.70	353	0.01	0.7
			Average	**318**	**31**	**0.15**	**0.21**	**0.36**	**1.02**	**1.13**	**3**	**19.0**	**7.5**	**5.58**	**368**	**0.01**	**0.7**
TB1	9/20/2009	0	7:15	90	5	0.15	0.11	0.26	0.75	0.75	1	18.2	7.6	4.90	476	0.05	0.3
TB1	9/20/2009	4	11:50	51,000	24	0.15	0.16	0.31	1.20	1.40	3	18.4	7.1	5.60	329	0.01	0.4
TB1	9/20/2009	12	18:25	10,000	25	0.15	0.20	0.35	1.10	1.30	3	20.0		7.20	395	0.40	0.8
			Average	**3,580**	**18**	**0.15**	**0.16**	**0.31**	**1.02**	**1.15**	**2**	**18.9**	**7.3**	**5.90**	**400**	**0.15**	**0.5**
TB1a	9/20/2009	0	8:20	110	5	0.15	0.11	0.26	1.00	1.00	3	18.6	7.4	5.40	395	0.01	1.1
TB1a	9/20/2009	4	12:55	6,400	20	0.15	0.17	0.32	0.75	0.92	3	19.1	7.1	6.60	313	0.15	1.3
TB1a	9/20/2009	12	19:10	7,100	13	0.15	0.24	0.39	1.10	1.30	3	20.7		5.52	325	0.01	1.3
			Average	**1,710**	**13**	**0.15**	**0.17**	**0.32**	**0.95**	**1.07**	**3**	**19.5**	**7.2**	**5.84**	**344**	**0.06**	**1.2**

Table 4.02-1 Storm Event Physicochemical and Pathogen Sampling Results (September 20, 2009)

Sample Site	Date	Sample Hour	Time of Sample	Fecal Coliform (colonies / 100 ml)[1]	TSS (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Nitrite + Nitrate (mg/l)	TKN (mg/l)	TN (mg/l)	Water Clarity (1=Clear 5=Muddy)	Temp. (C°)	pH	DO (mg/l)	Cond. (µS/cm)	Water Velocity (ft/s)	Water Depth (ft)
CF1	10/30/2009	0	21:10	540	7	0.15	0.55	0.70	0.64	1.20	2	17.7	7.0	8.02	845	2.00	0.8
CF1	10/31/2009	4	0:50	990	12	0.15	0.46	0.61	0.62	1.10	4	16.6	7.1	7.50		4.00	1.3
CF1	10/31/2009	12	9:00	9,200	41	0.15	0.27	0.42	1.90	2.20	4	13.2	7.1	7.40		2.50	8.5
			Average	**1,701**	**20**	**0.15**	**0.43**	**0.58**	**1.05**	**1.50**	**3**	**15.8**	**7.0**	**7.64**	**530**	**2.83**	**3.5**
CF2	10/30/2009	0	21:20	370	5	0.15	0.61	0.76	0.58	1.20	2	17.7	7.2	8.68	960	0.50	1.5
CF2	10/31/2009	4	1:10	3,800	78	0.15	0.59	0.74	1.50	2.10	4	15.5	6.5	8.82		2.00	2.5
CF2	10/31/2009	12	9:15	10,000	53	0.15	0.30	0.45	1.10	1.40	4	13.3	6.7	7.50		3.50	4.0
			Average	**2,414**	**45**	**0.15**	**0.50**	**0.65**	**1.06**	**1.57**	**3**	**15.5**	**6.8**	**8.33**	**537**	**2.00**	**2.7**
CF3	10/30/2009	0	21:40	720	5	0.15	0.31	0.46	0.59	0.90	1	17.5	7.2	7.80	514	2.00	0.5
CF3	10/31/2009	4	1:00	9,300	100	0.15	0.13	0.28	1.30	1.40	5	15.6	6.8	7.60	388	2.00	2.0
CF3	10/31/2009	12	8:55	9,500	35	0.15	0.22	0.37	1.10	1.30	4	13.7	6.6	9.50	230	1.50	3.0
			Average	**3,992**	**47**	**0.15**	**0.22**	**0.37**	**1.00**	**1.20**	**3**	**15.6**	**6.8**	**8.30**	**377**	**1.83**	**1.8**
NC1	10/30/2009	0	20:24	100	5	0.15	0.78	0.93	0.73	1.50	3	17.9	6.8	7.50	594	1.50	1.0
NC1	10/31/2009	4	0:20	4,800	50	0.15	1.10	1.25	0.80	1.90	0	17.1		6.87	450	3.00	1.5
NC1	10/31/2009	12	9:55	4,000	32	0.15	0.41	0.56	0.67	1.10	5	13.4	7.1	7.70	306	3.00	2.5
			Average	**1,243**	**29**	**0.15**	**0.76**	**0.91**	**0.73**	**1.50**	**3**	**16.1**	**6.9**	**7.36**	**450**	**2.50**	**1.7**
NC1a	10/30/2009	0	20:35	770	5	0.15	1.90	2.05	0.82	2.70	3	17.9	7.8	6.40	589	1.00	1.0
NC1a	10/31/2009	4	0:40	2,500	72	0.15	1.40	1.55	0.67	2.10	4	17.0	7.4	7.20	440	2.50	4.0
NC1a	10/31/2009	12	9:35	2,500	28	0.15	0.46	0.61	0.49	0.95	4	13.7	6.5	8.86	306	2.00	3.5
			Average	**1,688**	**35**	**0.15**	**1.25**	**1.40**	**0.66**	**1.92**	**4**	**16.2**	**7.2**	**7.49**	**445**	**1.83**	**2.8**
SC1	10/30/2009	0	21:35	200	5	0.15	0.32	0.47	0.83	1.20	1	17.5	7.6	6.12	567	2.00	0.5
SC1	10/31/2009	4	0:50	10,000	54	0.15	0.14	0.29	0.92	1.10		16.2		6.59	439	0.80	2.5
SC1	10/31/2009	12	9:25	8,500	120	0.15	0.22	0.37	1.50	1.70	4	12.4	6.6	9.25	222	2.50	2.0
			Average	**2,571**	**60**	**0.15**	**0.23**	**0.38**	**1.08**	**1.33**	**3**	**15.4**	**7.1**	**7.32**	**409**	**1.77**	**1.7**
SC2	10/30/2009	0	20:55	190	6	0.15	0.32	0.47	0.59	0.91	3	17.9	7.4	6.40	489	0.10	1.0
SC2	10/31/2009	4	1:35	6,300	80	0.15	0.37	0.52	1.10	1.50	5	15.4		7.50	370	1.50	2.0
SC2	10/31/2009	12	9:20	5,200	27	0.15	0.40	0.55	1.20	1.60		13.7	7.1	7.75	270	0.25	1.5
			Average	**1,839**	**38**	**0.15**	**0.36**	**0.51**	**0.96**	**1.34**	**4**	**15.7**	**7.3**	**7.22**	**376**	**0.62**	**1.5**
TB1	10/30/2009	0	20:45	54	5	0.15	0.11	0.26	0.62	0.73	2	17.5	6.7	7.46	550	1.00	0.8
TB1	10/31/2009	4	0:30	1,300	22	0.15	0.11	0.26	0.51	0.51	3	16.8	6.7	7.27		2.00	1.0
TB1	10/31/2009	12	8:40	6,100	42	0.15	0.21	0.36	1.00	1.20	4	13.5	6.7	9.60		5.00	1.8
			Average	**754**	**23**	**0.15**	**0.14**	**0.29**	**0.71**	**0.81**	**3**	**15.9**	**6.7**	**8.11**	**438**	**2.67**	**1.2**
TB1a	10/30/2009	0	21:50	150	5	0.15	0.11	0.26	0.49	0.49	3	17.3	7.0	6.70		0.10	1.3
TB1a	10/31/2009	4	1:30	8,800	120	0.15	0.13	0.28	1.40	1.50	5	15.3	6.6	8.60		1.00	2.6
TB1a	10/31/2009	12	9:40	2,500	16	0.15	0.29	0.44	0.51	0.80	4	13.6	6.6	9.24		1.00	2.3
			Average	**1,489**	**47**	**0.15**	**0.18**	**0.33**	**0.80**	**0.93**	**4**	**15.4**	**6.7**	**8.18**	**372**	**0.70**	**2.1**

Table 4.02-2 Storm Event Physicochemical and Pathogen Sampling Results (October 30, 2009)

4.03 PHYSICOCHEMICAL SAMPLING DATA

A. Primary Data Sources

The following sampling data for the subwatersheds within the Curry's Fork watershed are organized to show the sampling site farthest upstream first and the remaining sites moving downstream through the subwatershed.

1. North Curry's Fork

Physicochemical sampling data results for sampling sites NC2, NC1b, NC1a, and NC1 in the North Curry's Fork subwatershed are shown in Tables 4.03-1, 4.03-2, 4.03-3, and 4.03-4, respectively.

2. South Curry's Fork

Physicochemical sampling data results for sampling sites SC2 and SC1 in the South Curry's Fork subwatershed are shown in Tables 4.03-5 and 4.03-6, respectively.

3. Asher's Run

Physicochemical sampling data results for sampling sites AR1a and AR1 in the Asher's Run subwatershed are shown in Tables 4.03-7 and 4.03-8, respectively.

4. Curry's Fork Main Stem

Physicochemical sampling data results for sampling sites CF3, CF2, and CF1 in the Curry's Fork main stem subwatershed are shown in Tables 4.03-9, 4.03-10, and 4.03-11, respectively.

NORTH CURRY'S FORK

TABLE 4.03-1–NC2 PHYSICOCHEMICAL SAMPLING DATA RESULTS

Sample Site	Date	Sample Type	Time	Temp (°C)	Conduct. (mS)	pH	DO (mg/l)	Velocity (ft/s)	Depth (ft)	BOD_5 (mg/l)	TSS (mg/l)	NH_3 (mg/l)	TP (mg/l)	NO_2 (mg/l)	NO_3 (mg/l)	TN (mg/l)	TKN (mg/l)	Sulfate (mg/l)
NC2	5/7/2007	Dry	10:30	19.6	435	8.64	9.67	5.00	0.3	5	11	0.1	0.05	0.15	0.11	0.26		19
NC2	5/23/2007	Dry	12:20	24.0	440	8.20	8.00	1.00	0.2	6	29	0.35	0.16	0.15	0.11	0.26		18
NC2	6/11/2007	Wet	12:01	26.7	125	8.06	8.86	1.00	0.2	5	8	0.19	0.16	0.15	0.11	0.26		16
NC2	6/25/2007	Wet	12:31	27.9	329	8.44	14.50	0.05	0.3	5	30	0.39	0.05	0.15	0.11	0.26		14
NC2	7/11/2007	Wet	12:40	28.9	359	8.25	6.50	0.01	0.2	5	14	0.3	0.16	0.15	0.11	0.26		14
NC2	7/25/2007	Dry	11:12	26.2	338	8.28	7.44	0.10	0.2	28	390	0.27	0.16	0.15	0.11	0.26		15
NC2	8/9/2007	Dry	11:40	31.7	295	8.72	6.75	0.01	0.1	19	1100	0.32	0.9	0.75	0.55	1.3		130
NC2	8/22/2007	Low or No Flow, No Sample Taken																
NC2	9/11/2007	Low or No Flow, No Sample Taken																
NC2	9/26/2007	Low or No Flow, No Sample Taken																
NC2	10/10/2007	Low or No Flow, No Sample Taken																
NC2	10/25/2007	Wet	9:35	15.3	463	7.50	6.69	10.00	0.5	5	45	0.28	1.6	1.5	1.1	2.6		18
2007 Site Average				**25.0**	**348**	**8.26**	**8.55**	**2.15**	**0.2**	**10**	**203**	**0.28**	**0.41**	**0.39**	**0.3**	**0.68**		**31**
NC2	5/21/2009	Dry	13:45	24.5	353	8.41		15.00	0.2		12			0.75	0.55	0.93	0.93	
NC2	6/5/2009	Dry	15:03	24.0	342	8.04	7.15	2.00	0.1		12			0.75	0.55	0.68	0.68	
NC2	6/18/2009	Wet	15:00	26.4	360	8.50	6.95	12.40	0.3		7			0.15	0.11	1.20	1.20	
NC2	7/2/2009	Dry	13:47	25.6	139	7.45	6.46	2.00	0.1		7			0	0	0.96	0.96	
NC2	7/15/2009	Low or No Flow, No Sample Taken																
NC2	7/30/2009	Wet	14:30	25.5	98	7.30	4.46	10.80	0.8		17			0.75	0.55	1.20	1.20	
NC2	8/13/2009	Dry	13:25	29.0	305	7.03	8.39	10.00	0.3		13			0.75	0.55	1.20	1.20	
NC2	8/27/2009	Low or No Flow, No Sample Taken																
NC2	9/10/2009	Dry	13:30	26.0	267	8.56	8.49	4.05	0.1		12			0.75	0.55	0.66	0.66	
NC2	9/24/2009	Wet	13:30	20.2	259	7.60	8.02	8.20	0.6		12			0.75	0.55	0.93	0.93	
NC2	10/8/2009	Wet	13:15	17.4	260	7.68	9.76	15.00	0.8		18			0.75	0.55	0.64	0.64	
NC2	10/23/2009	Low or No Flow, No Sample Taken																
2009 Site Average				**24.3**	**265**	**7.84**	**7.46**	**8.83**	**0.4**		**12**			**0.60**	**0.4**	**0.93**	**0.93**	
Overall Site Average				**24.6**	**304**	**8.04**	**8.01**	**5.68**	**0.3**	**10**	**102**	**0.28**	**0.41**	**0.50**	**0.4**	**0.82**	**0.93**	**31**

TABLE 4.03-2–NC1b PHYSICOCHEMICAL SAMPLING DATA RESULTS

Sample Site	Date	Sample Type	Time	Temp (°C)	Conduct. (mS)	pH	DO (mg/l)	Velocity (ft/s)	Depth (ft)	BOD_5 (mg/l)	TSS (mg/l)	NH_3 (mg/l)	TP (mg/l)	NO_2 (mg/l)	NO_3 (mg/l)	TN (mg/l)	TKN (mg/l)	Sulfate (mg/l)
NC1b	5/21/2009	Dry	13:30	20.0	720	7.79	0.00	0.30	1.0		5			0.75	6.8	8.00	1.20	
NC1b	6/5/2009	Dry	14:45	19.8	775	7.87	7.87	0.20	1.0		5			0.75	3.5	4.40	0.92	
NC1b	6/18/2009	Wet	14:51	21.7	350	7.81	7.95	0.20	0.8		56			0.15	0.38	1.80	1.40	
NC1b	7/2/2009	Dry	13:29	26.0	809	7.30	7.29	0.05	0.8		5					5.30	0.83	
NC1b	7/15/2009	Wet	15:00	21.9	890	7.93	7.75	0.20	1.0		8			0.75	9.6	11.00	1.30	
NC1b	7/30/2009	Wet	14:00	23.4	400	8.08	6.88	1.90	1.5		32			0.75	0.55	1.00	1.00	
NC1b	8/13/2009	Dry	13:10	24.1	487	7.67	6.91	0.40	0.9		5			0.75	2.8	3.70	0.93	
NC1b	8/27/2009	Wet	13:22	23.3	905	7.65	7.40	0.02	0.8		5			0.75	25	26.00	0.97	
NC1b	9/10/2009	Dry	13:07	20.8	770	7.71	7.10	0.09	0.8		5			0.75	19	20.00	0.85	
NC1b	9/24/2009	No Sample Taken for Safety Purposes																
NC1b	10/8/2009	No Sample Taken for Safety Purposes																
NC1b	10/23/2009	Wet	13:50	15.1	368	7.50	8.12	0.50	1.0		19			0.75	1.8	2.40	0.59	
Overall Site Average				**21.6**	**647**	**7.73**	**6.73**	**0.39**	**0.9**		**15**			**0.68**	**7.7**	**8.36**	**1.00**	

NORTH CURRY'S FORK (CONTINUED)

TABLE 4.03-3–NC1a PHYSICOCHEMICAL SAMPLING DATA RESULTS

Sample Site	Date	Sample Type	Time	Temp (°C)	Conduct. (mS)	pH	DO (mg/l)	Velocity (ft/s)	Depth (ft)	BOD_5 (mg/l)	TSS (mg/l)	NH_3 (mg/l)	TP (mg/l)	NO_2 (mg/l)	NO_3 (mg/l)	TN (mg/l)	TKN (mg/l)	Sulfate (mg/l)
NC1a	5/21/2009	Dry	13:10	19.7	664	8.05	0.00	0.30	1.5		5			0.75	4.5	5.26	0.76	
NC1a	6/5/2009	Dry	14:11	18.4	600	7.87	7.70	0.11	1.5		5			0.75	1.2	1.90	0.69	
NC1a	6/18/2009	Wet	14:23	21.7	487	7.66	8.60	0.90	2.5		150			0.15	0.26	1.10	0.79	
NC1a	7/2/2009	Dry	13:05	19.5	768	8.21	8.00	0.02	1.0		11					3.80	0.82	
NC1a	7/15/2009	Wet	12:57	22.6		6.16	3.90	0.00	2.1		6			0.75	13	14.00	1.10	
NC1a	7/30/2009	Wet	13:33	23.4	162	7.68	7.55	1.00	2.0		14			0.75	0.74	1.80	1.10	
NC1a	8/13/2009	Dry	12:56	23.3	481	8.12	8.34	0.10	0.8		5			0.75	2.4	3.20	0.83	
NC1a	8/27/2009	Wet	13:05	22.4	890	8.01	8.96	0.00	0.7		5			0.75	22	23.00	1.00	
NC1a	9/10/2009	Dry	12:58	19.8	720	8.04	8.50	0.01	0.8		5			0.75	14	15.00	0.72	
NC1a	9/24/2009	Wet	13:00	22.3	460	7.60	8.08	0.68	2.0		5			0.75	1.3	2.10	0.76	
NC1a	10/8/2009	Wet	13:00	16.7	370	7.44	9.30	1.75	2.2		27			0.75	0.58	1.30	0.73	
NC1a	10/23/2009	Wet	13:40	16.0	382	7.92	7.50	1.00	2.0		39			0.75	1	1.00	0.40	
Overall Site Average				**20.5**	**544**	**7.73**	**7.20**	**0.49**	**1.6**		**23**			**0.70**	**5.5**	**6.12**	**0.81**	

TABLE 4.03-4–NC1 PHYSICOCHEMICAL SAMPLING DATA RESULTS

Sample Site	Date	Sample Type	Time	Temp (°C)	Conduct. (mS)	pH	DO (mg/l)	Velocity (ft/s)	Depth (ft)	BOD_5 (mg/l)	TSS (mg/l)	NH_3 (mg/l)	TP (mg/l)	NO_2 (mg/l)	NO_3 (mg/l)	TN (mg/l)	TKN (mg/l)	Sulfate (mg/l)
NC1	5/7/2007	Dry	11:30	16.4	800	8.54	11.25	0.83	1.0	5	5	0.1	0.39	0.15	0.11	0.26		49
NC1	5/23/2007	Dry	12:45	20.8	962	8.50	12.60	1.00	1.5	5	5	0.15	1.2	1.5	9	10.5		66
NC1	6/11/2007	Wet	12:28	20.6	673	7.69	9.15	1.25	0.8	4	16	0.15	2.2	0.15	7.5	7.65		65
NC1	6/25/2007	Wet	12:53	22.7	930	7.45	7.90	0.40	1.3	5	23	14	2.3	0.15	14	14.15		75
NC1	7/11/2007	Wet	13:05	24.2	894	8.04	8.12	0.50	0.5	5	23	0.14	2.5	0.15	16	16.15		72
NC1	7/25/2007	Dry	14:13	22.0	939	8.17	9.27	0.50	1.0	5	11	0.32	1.4	0.15	18	18.15		69
NC1	8/9/2007	Dry	12:06	27.0	820	7.94	5.21	1.50	0.8	5	28	0.15	1.8	0.75	11	11.75		72
NC1	8/22/2007	Wet	11:13	23.5	885	7.79	5.71	0.75	0.5	5	15	0.1	1.4	0.15	16	16.15		80
NC1	9/11/2007	Wet	12:22	21.6	1026	7.61	6.46	0.10	0.5	5	6	0.1	3.8	0.75	26	26.75		75
NC1	9/26/2007	Wet	12:00	21.8	1050	7.54	4.20	0.20	0.5	5	5	0.38	4.9	0.75	27	27.75		94
NC1	10/10/2007	Dry	11:15	14.9	998	7.76	5.25	0.30	0.5	5	5	0.25	5.4	0.75	22	22.75		92
NC1	10/25/2007	Wet	13:25	13.6	470	7.45	9.05	2.00	3.0	5	31	0.25	1.6	1.5	2	3.5		58
2007 Site Average				**20.8**	**871**	**7.87**	**7.85**	**0.78**	**1.0**	**5**	**14**	**1.34**	**2.41**	**0.58**	**14.1**	**14.63**		**72**
NC1	5/21/2009	Dry	13:45	16.0	667	8.02		0.60	0.4		5			0.15	2.2	2.93	0.73	
NC1	6/5/2009	Dry	15:03	15.4	542	7.00	8.40	0.40	0.8		5			0.75	1.2	1.70	0.53	
NC1	6/18/2009	Wet	15:00	22.8	405	7.40	8.75	0.25	1.0		8			0.15	0.53	1.70	1.20	
NC1	7/2/2009	Dry	13:47	19.0	722	8.12	7.60	0.20	0.5		5			0	0	2.90	0.74	
NC1	7/15/2009	Wet	0:00	21.2	335	7.20	5.70	0.50	0.8		8			0.75	10	11.00	1.30	
NC1	7/30/2009	Wet	14:30	22.7	130	7.26	7.34	1.80	1.5		30			0.75	0.59	1.80	1.20	
NC1	8/13/2009	Dry	13:25	21.3	520	8.09	7.00	0.48	0.8		5			0.75	1.6	2.70	1.10	
NC1	8/27/2009	Wet	0:00	20.2	829	8.05	6.49	0.17	0.5		5			0.75	15	16.00	0.97	
NC1	9/10/2009	Dry	13:30	19.3	700	7.85	5.72	0.25	0.4		5			0.75	9.6	11.30	1.70	
NC1	9/24/2009	Wet	13:30	22.0	440	7.70	6.86	0.70	1.0		8			0.75	2	2.80	0.79	
NC1	10/8/2009	Wet	13:15	15.8	290	7.80	9.74	3.00	3.0		97			0.75	0.63	1.30	0.63	
NC1	10/23/2009	Wet	9:30	14.1	695	7.95	7.66	0.60	2.0		6			0.74	4	4.50	0.51	
2009 Site Average				**19.1**	**523**	**7.70**	**7.39**	**0.75**	**1.1**		**16**			**0.59**	**3.9**	**5.05**	**0.95**	
Overall Site Average				**19.5**	**518**	**7.77**	**7.15**	**0.84**	**1.2**	**5**	**15**	**1.34**	**2.41**	**0.58**	**9.0**	**9.84**	**0.95**	**72**

SOUTH CURRY'S FORK

TABLE 4.03-5–SC2 PHYSICOCHEMICAL SAMPLING DATA RESULTS

Sample Site	Date	Sample Type	Time	Temp (°C)	Conduct. (mS)	pH	DO (mg/l)	Velocity (ft/s)	Depth (ft)	BOD_5 (mg/l)	TSS (mg/l)	Ammonia (mg/l)	Phosph. (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Total Nitrogen (mg/l)	TKN (mg/l)	Sulfate (mg/l)
SC2	5/7/2007	Dry	10:10	14.5	570	7.91	8.45	0.17	0.5	5	6	1.3	0.013	0.15	0.11	0.26		28
SC2	5/23/2007	Dry	12:00	23.0	530	7.70	4.80	0.20	3.0	5	6	0.16	0.16	0.15	0.11	0.26		24
SC2	6/11/2007	Wet	11:40	22.9	450	7.38	4.97	0.25	2.5	5	18	0.12	0.16	0.15	0.13	0.28		22
SC2	6/25/2007	Wet	12:06	24.9	430	7.23	5.37	0.05	2.5	5	5	0.24	0.05	0.15	0.14	0.29		18
SC2	7/11/2007	Wet	12:17	24.4	418	7.19	7.00	0.10	1.0	5	75	0.18	0.16	0.15	0.26	0.41		21
SC2	7/25/2007	Dry	11:27	22.6	448	7.77	8.28	0.10	1.0	49	36	0.12	0.16	0.15	0.11	0.26		22
SC2	8/9/2007	Dry	11:20	29.4	386	8.08	5.40	0.10	2.5	5	30	0.1	0.9	0.75	0.55	1.3		15
SC2	8/22/2007	Wet	10:42	25.6	458	7.09	5.00	0.10	1.3	5	35	0.1	0.16	0.15	0.11	0.26		25
SC2	9/11/2007	Wet	11:44	22.2	458	7.47	3.80	0.05	1.0	5	64	0.19	0.1	0.75	0.55	1.3		7.4
SC2	9/26/2007	Wet	11:30	22.5	423	7.60	1.55	0.01	1.0	5	44	0.27	0.8	0.75	0.55	1.3		16
SC2	10/10/2007	Dry	8:30	17.2	475	7.69	2.62	0.01	0.5	6	55	0.25	0.8	0.75	0.55	1.3		21
SC2	10/25/2007	Wet	10:10	12.3	402	7.36	9.80	0.50	1.5	5	14	0.33	1.6	1.5	1.7	3.2		39
2007 Site Average				**21.8**	**454**	**7.54**	**5.59**	**0.14**	**1.5**	**9**	**32**	**0.28**	**0.42**	**0.46**	**0.4**	**0.87**		**22**
SC2	5/21/2009	Dry	12:55	20.5	471	7.87	0.00	0.00	1.5		6			0.75	0.55	0.59	0.59	
SC2	6/5/2009	Dry	13:55	20.5	501	8.15	10.30	0.01	1.3		5			0.75	0.55	0.87	0.87	
SC2	6/18/2009	Wet	12:20	20.3	500	7.88	8.50	0.02	1.5		9			0.15	0.76	2.10	1.30	
SC2	7/2/2009	Dry	12:46	20.1	490	7.56	6.90	0.01	1.5		5			0	0	0.84	0.84	
SC2	7/15/2009	Wet	12:26	20.8		6.70	6.24	1.00	0.4		10			0.75	0.55	0.82	0.82	
SC2	7/30/2009	Wet	13:13	22.3	123	7.25	5.13	0.25	2.0		110			0.75	0.8	1.90	1.10	
SC2	8/13/2009	Dry	12:35	26.0	320	7.45	5.52	0.10	1.8		5			0.75	0.55	0.87	0.87	
SC2	8/27/2009	Wet	12:50	24.6	460	7.53	6.02	0.00	1.7		6			0.75	0.55	0.78	0.78	
SC2	9/10/2009	Dry	13:45	20.5	456	7.75	7.20	0.01	1.8		5			0.75	0.55	0.84	0.84	
SC2	9/24/2009	Wet	12:45	21.7	537	7.00	7.55	0.10	2.0		6			0.75	0.55	0.68	0.68	
SC2	10/8/2009	Wet	12:40	17.3	290	7.30	8.70	1.50	2.0		42			0.75	0.62	1.30	0.63	
SC2	10/23/2009	Wet	14:00	14.9	344	7.23	7.37	0.50	2.0		32			0.75	0.55	0.90	0.90	
2009 Site Average				**20.8**	**408**	**7.47**	**6.62**	**0.29**	**1.6**		**20**			**0.64**	**0.5**	**1.04**	**0.85**	
Overall Site Average				**21.3**	**432**	**7.51**	**6.10**	**0.21**	**1.6**	**9**	**26**	**0.28**	**0.42**	**0.55**	**0.5**	**0.95**	**0.85**	**22**

SOUTH CURRY'S FORK (CONTINUED)

TABLE 4.03-6–SC1 PHYSICOCHEMICAL SAMPLING DATA RESULTS

Sample Site	Date	Sample Type	Time	Temp (°C)	Conduct. (mS)	pH	DO (mg/l)	Velocity (ft/s)	Depth (ft)	BOD_5 (mg/l)	TSS (mg/l)	Ammonia (mg/l)	Phosph. (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Total Nitrogen (mg/l)	TKN (mg/l)	Sulfate (mg/l)
SC1	5/7/2007	Dry	9:15	15.4	663	7.98	8.95	1.00	0.5	5	5	0.16	0.05	0.15	0.11	0.26		31
SC1	5/23/2007	Dry	11:15	20.3	620	8.00	9.90	0.50	0.5	5	12	0.24	0.16	0.15	0.46	0.61		34
SC1	6/11/2007	Wet	10:40	19.7	186	7.60	8.20	0.10	0.3	4	30	0.1	0.16	0.15	0.78	0.93		30
SC1	6/25/2007	Wet	11:05	21.9	487	7.35	8.39	0.05	0.3	5	29	0.33	0.17	0.15	1.3	1.45		29
SC1	7/11/2007	Wet	11:27	23.0	347	7.88	7.22	2.00	0.5	5	340	0.17	0.16	0.15	0.68	0.83		21
SC1	7/25/2007	Dry	11:51	20.7	525	8.17	8.35	0.50	0.3	34	32	0.2	0.16	0.15	1.3	1.45		34
SC1	8/9/2007	Dry	10:30	25.1	499	7.97	7.09	0.10	0.3	5	110	0.22	0.9	0.75	1.1	1.85		38
SC1	8/22/2007	Wet	9:55	22.9	469	7.09	2.97	0.10	0.2	5	16	0.17	0.16	0.15	1.5	1.65		35
SC1	9/11/2007	Low or No Flow, No Sample Taken																
SC1	9/26/2007	Low or No Flow, No Sample Taken																
SC1	10/10/2007	Low or No Flow, No Sample Taken																
SC1	10/25/2007	Wet	10:45	12.3	414	7.87	10.50	2.00	1.0	5	14	0.25	1.6	1.5	2	3.5		70
2007 Site Average				**20.1**	**468**	**7.77**	**7.95**	**0.71**	**0.4**	**8**	**65**	**0.20**	**0.39**	**0.37**	**1.0**	**1.39**		**36**
SC1	5/21/2009	Dry	9:40	16.8	522	8.01	0.00	0.30	0.3		7			0.15	0.22	1.03	0.81	
SC1	6/5/2009	Dry	9:55	15.7	425	7.00	9.05	0.32	0.4		9			0.75	0.8	1.70	0.88	
SC1	6/18/2009	Wet	10:00	21.6	27	7.29	0.00	0.41	0.5		13			0.15	0.64	1.60	0.97	
SC1	7/2/2009	Dry	9:42	19.1	560	8.07	7.71	0.10	0.3		38			0	0	0.68	0.68	
SC1	7/15/2009	Wet	11:40	20.7	229	7.84	3.56	0.20	0.3		100			0.75	1	11.00	1.50	
SC1	7/30/2009	Wet	9:50	21.3	27	7.29	7.88	1.00	1.0		26			0.75	0.67	1.70	1.00	
SC1	8/13/2009	Dry	9:48	21.4	59	8.01	7.30	0.87	0.5		7			0.75	0.55	0.50	0.49	
SC1	8/27/2009	Wet	9:30	20.0	584	7.96	2.80	0.00	0.2		5			0.75	0.66	1.40	0.77	
SC1	9/10/2009	Dry	9:37	19.2	500	7.94	5.97	0.10	0.3		5			0.75	0.59	1.00	0.43	
SC1	9/24/2009	Wet	10:20	21.1	525	7.55	7.16	0.40	0.5		5			0.75	0.87	1.40	0.56	
SC1	10/8/2009	Wet	9:45	14.7	226	7.56	9.50	4.00	2.0		100			0.75	0.55	1.30	1.30	
SC1	10/23/2009	Wet	10:15	13.7	558	7.90	7.26	2.00	0.8		13			0.75	0.55	0.50	0.46	
2009 Site Average				**18.8**	**354**	**7.70**	**5.68**	**0.81**	**0.6**		**27**			**0.59**	**0.6**	**1.98**	**0.82**	
Overall Site Average				**19.4**	**402**	**7.73**	**6.66**	**0.76**	**0.5**	**8**	**44**	**0.20**	**0.39**	**0.49**	**0.8**	**1.73**	**0.82**	**36**

ASHER'S RUN

TABLE 4.03-7–AR1a PHYSICOCHEMICAL SAMPLING DATA RESULTS

Sample Site	Date	Sample Type	Time	Temp (°C)	Conduct. (mS)	pH	DO (mg/l)	Velocity (ft/s)	Depth (ft)	BOD_5 (mg/l)	TSS (mg/l)	Ammonia (mg/l)	Phosph. (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Total Nitrogen (mg/l)	TKN (mg/l)	Sulfate (mg/l)
TB1a	5/21/2009	Dry	12:30	18.9	538	8.07	0.00	0.05	1.3		5			0	0	0.60	0.60	
TB1a	6/5/2009	Dry	13:05	18.2	563	8.03	10.30	0.08	1.3		20			0.75	0.55	0.80	0.80	
TB1a	6/18/2009	Wet	10:42	20.1	530	8.02	8.84	0.07	1.0		10			0.75	0.55	1.10	1.10	
TB1a	7/2/2009	Dry	11:40	18.8	500	8.02	8.35	0.01	1.3		5			0.75	0.55	0.68	0.68	
TB1a	7/15/2009	Wet	11:34	21.3		6.61	2.90	0.00	0.5		5			0.75	0.55	0.74	0.74	
TB1a	7/30/2009	Wet	13:00	21.7	144	8.00	6.98	0.19	1.7		5			0.75	0.55	1.70	0.40	
TB1a	8/13/2009	Dry	12:15	24.1	605	6.97	6.83	0.00	1.3		5			0.75	0.55	1.30	0.74	
TB1a	8/27/2009	Wet	12:15	22.3	420	7.85	5.86	0.00	1.2		22			0.75	0.55	0.73	0.73	
TB1a	9/10/2009	Dry	12:10	19.2	444	7.81	7.52	0.01	1.2		38			0.75	0.55	1.20	1.20	
TB1a	9/24/2009	Wet	12:10	21.5	530	7.37	7.32	0.06	1.3		13			0.67	0.5	0.98	0.78	
TB1a	10/8/2009	Wet	12:25	17.1	334	7.58	8.43	1.50	2.0		38			0.75	0.6	1.70	1.20	
TB1a	10/23/2009	Wet	13:25	14.6	377	7.24	8.88	0.40	2.0		5			0.00	0.0	0.60	0.40	
Overall Site Average				**19.8**	**453**	**7.63**	**6.85**	**0.20**	**1.3**		**13**			**0.67**	**0.5**	**0.98**	**0.78**	

TABLE 4.03-8–AR1 PHYSICOCHEMICAL SAMPLING DATA RESULTS

Sample Site	Date	Sample Type	Time	Temp (°C)	Conduct. (mS)	pH	DO (mg/l)	Velocity (ft/s)	Depth (ft)	BOD_5 (mg/l)	TSS (mg/l)	Ammonia (mg/l)	Phosph. (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Total Nitrogen (mg/l)	TKN (mg/l)	Sulfate (mg/l)
TB1	5/7/2007	Dry	8:10	14.3	692	8.00	8.90	0.17	0.7	5	6	0.13	0.05	0.15	0.11	0.26		30
TB1	5/23/2007	Dry	9:35	16.6	660	8.20	7.75	0.00	1.0	5	8	0.32	0.16	0.15	0.3	0.45		29
TB1	6/11/2007	Wet	9:13	17.8	175	7.78	6.95	0.01	0.5	4	9	0.15	0.16	0.15	0.49	0.64		24
TB1	6/25/2007	Wet	9:36	20.5	435	7.70	7.18	0.10	0.3	5	29	0.13	0.057	0.15	0.52	0.67		22
TB1	7/11/2007	Wet	9:46	22.7	526	8.15	8.00	1.00	1.0	5	19	0.37	0.16	0.15	0.35	0.5		23
TB1	7/25/2007	Dry	11:27	21.7	451	7.96	8.81	0.01	0.5	5	13	0.18	0.16	0.15	0.29	0.44		21
TB1	8/9/2007	Dry	8:45	23.2	484	7.19	5.50	0.10	0.3	5	20	0.13	0.9	0.75	0.72	1.47		22
TB1	8/22/2007	Wet	8:25	21.5	376	7.09	4.60	0.00	0.7	5	9	0.17	0.16	0.15	0.25	0.4		18
TB1	9/11/2007	Low or No Flow, No Sample Taken																
TB1	9/26/2007	Low or No Flow, No Sample Taken																
TB1	10/10/2007	Low or No Flow, No Sample Taken																
TB1	10/25/2007	Wet	11:45	12.3	400	7.18	10.30	1.50	0.7	86	5	0.25	1.6	1.5	2	3.5		37
2007 Site Average				**19.0**	**467**	**7.69**	**7.55**	**0.32**	**0.6**	**14**	**13**	**0.20**	**0.38**	**0.37**	**0.6**	**0.93**		**25**
TB1	5/21/2009	Dry	10:35	16.0	540	8.02		0.20	0.5		6			0.15	0.11	0.69	0.58	
TB1	6/5/2009	Dry	10:54	15.7	900	8.14	9.22	0.40	0.3		6			0.75	0.58	1.10	0.50	
TB1	6/18/2009	Wet	13:01	19.7	518	7.86	9.25	0.94	0.8		53			0.15	0.59	1.50	0.92	
TB1	7/2/2009	Dry	10:25	18.4	525	8.18	8.36	0.15	0.5		5			0	0	0.60	0.60	
TB1	7/15/2009	Wet	12:00	20.0	455	7.99	7.80	0.02	0.5		10			0.75	0.55	0.79	0.79	
TB1	7/30/2009	Wet	10:42	20.8	155	8.08	8.10	1.21	1.1		18			0.75	0.59	1.50	0.95	
TB1	8/13/2009	Dry	10:35	21.9	506	8.06	7.03	0.30	0.8		5			0.75	0.55	0.50	0.42	
TB1	8/27/2009	Wet	10:35	20.0	498	6.69	7.23	0.12	0.4		5			0.75	0.55	0.75	0.75	
TB1	9/10/2009	Dry	10:25	18.3	460	7.85	6.32	0.03	0.5		5			0.75	0.55	0.51	0.51	
TB1	9/24/2009	Wet	9:15	20.3	495	7.35	7.26	0.30	0.8		5			0.75	0.62	1.20	0.57	
TB1	10/8/2009	Wet	10:30	15.0	260	7.52	9.50	5.00	1.8		55			0.75	0.55	0.81	0.81	
TB1	10/23/2009	Wet	10:45	13.5	516	7.24	9.12	1.00	1.3		42			0.75	0.55	0.54	0.54	
2009 Site Average				**18.3**	**486**	**7.75**	**8.11**	**0.81**	**0.8**		**18**			**0.59**	**0.5**	**0.87**	**0.66**	
Overall Site Average				**18.6**	**477**	**7.73**	**7.86**	**0.60**	**0.7**	**14**	**16**	**0.20**	**0.38**	**0.49**	**0.5**	**0.90**	**0.66**	**25**

CURRY'S FORK MAIN STEM

TABLE 4.03-9–CF3 PHYSICOCHEMICAL SAMPLING DATA RESULTS

Sample Site	Date	Sample Type	Time	Temp (°C)	Conduct. (mS)	pH	DO (mg/l)	Velocity (ft/s)	Depth (ft)	BOD_5 (mg/l)	TSS (mg/l)	Ammonia (mg/l)	Phosph. (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Total Nitrogen (mg/l)	TKN (mg/l)	Sulfate (mg/l)
CF3	5/7/2007	Dry	9:25	15.5	659	8.08	10.42	1.00	0.5	5	5	0.11	0.05	0.15	0.11	0.26		32
CF3	5/23/2007	Dry	11:25	19.7	715	8.60	15.60	1.00	0.5	5	13	0.43	0.16	0.15	4.5	4.65		52
CF3	6/11/2007	Wet	10:57	20.0	215	7.53	9.05	0.50	0.3	4	11	0.31	1.1	0.15	3.7	3.85		44
CF3	6/25/2007	Wet	11:29	22.7	710	7.61	8.97	0.75	0.5	5	18	8.1	1.3	0.15	8.1	8.25		54
CF3	7/11/2007	Wet	11:45	23.3	349	7.95	7.50	2.00	0.5	5	320	0.21	0.16	0.15	0.66	0.81		21
CF3	7/25/2007	Dry	13:45	21.2	849	8.49	13.45	1.00	0.3	5	8	0.38	1.2	0.15	14	14.15		65
CF3	8/9/2007	Dry	10:45	25.2	510	7.19	5.74	0.10	0.5	5	11	0.14	0.9	0.75	1.1	1.85		38
CF3	8/22/2007	Wet	10:10	23.1	801	7.84	6.83	1.00	0.2	5	15	0.1	1.3	0.15	13	13.15		71
CF3	9/11/2007	Wet	11:14	21.7	1015	7.66	6.93	0.20	0.3	5	5	0.1	3.6	0.75	25	25.75		76
CF3	9/26/2007	Wet	10:50	21.5	1059	7.52	4.46	0.01	0.3	84	5	0.34	4.6	0.75	26	26.75		91
CF3	10/10/2007	Dry	9:20	15.4	980	7.70	3.90	0.50	0.5	7	5	0.25	4.8	0.75	21	21.75		95
CF3	10/25/2007	Wet	11:00	12.2	420	7.20	9.97	1.50	2.0	6	13	0.25	1.6	1.5	2.1	3.6		41
2007 Site Average				**20.1**	**690**	**7.78**	**8.57**	**0.80**	**0.5**	**12**	**36**	**0.89**	**1.73**	**0.46**	**9.9**	**10.40**		**57**
CF3	5/21/2009	Dry	10:00	17.0	527	7.89	0.00	0.80	0.3		5			0.15	0.21	0.95	0.74	
CF3	6/5/2009	Dry	10:06	15.8	423	7.00	9.50	0.64	0.5		8			0.75	0.73	1.60	0.85	
CF3	6/18/2009	Wet	10:20	21.5	0	7.07	8.25	0.27	0.5		11			0.15	0.65	1.60	0.98	
CF3	7/2/2009	Dry	9:56	19.1	590	8.22	9.55	0.25	0.3		5			0	0	2.40	0.67	
CF3	7/15/2009	Wet	11:55		183	7.28	5.70	0.20	0.5		5			0.75	9.4	10.00	1.00	
CF3	7/30/2009	Wet	10:02	21.4	15	7.13	7.81	1.50	1.5		28			0.75	0.57	1.60	1.00	
CF3	8/13/2009	Dry	9:54	21.5	512	8.06	8.03	0.53	0.4		5			0.75	0.55	0.56	0.56	
CF3	8/27/2009	Wet	9:45	20.5	760	8.00	8.40	0.15	0.2		5			0.75	12	13.00	0.95	
CF3	9/10/2009	Dry	9:50	18.8	560	7.87	7.87	1.60	0.5		5			0.75	4.4	5.30	0.89	
CF3	9/24/2009	Wet	10:40	21.2	522	7.55	7.67	0.59	0.6		5			0.75	1	1.40	0.42	
CF3	10/8/2009	Wet	9:53	14.6	223	7.14	9.65	3.00	4.0		65			0.75	0.55	0.97	0.97	
CF3	10/23/2009	Wet	10:30	13.6	557	8.00	8.64	1.00	0.8		9			0.75	0.55	0.58	0.58	
2009 Site Average				**18.6**	**406**	**7.60**	**7.59**	**0.88**	**0.8**		**13**			**0.59**	**2.6**	**3.33**	**0.80**	
Overall Site Average				**19.4**	**548**	**7.69**	**8.08**	**0.84**	**0.7**	**12**	**24**	**0.89**	**1.73**	**0.53**	**6.2**	**6.87**	**0.80**	**57**

TABLE 4.03-10–CF2 PHYSICOCHEMICAL SAMPLING DATA RESULTS

Sample Site	Date	Sample Type	Time	Temp (°C)	Conduct. (mS)	pH	DO (mg/l)	Velocity (ft/s)	Depth (ft)	BOD_5 (mg/l)	TSS (mg/l)	Ammonia (mg/l)	Phosph. (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Total Nitrogen (mg/l)	TKN (mg/l)	Sulfate (mg/l)
CF2	5/7/2007	Dry	8:25	15.1	677	8.10	8.55	0.50	1.3	5	8	0.14	0.094	0.15	0.11	0.26		33
CF2	5/23/2007	Dry	10:05	18.8	711	8.24	8.30	0.50	1.0	5	5	0.26	0.16	0.15	1.2	1.35		47
CF2	6/11/2007	Wet	9:36	19.5	250	7.56	6.10	0.20	0.8	4	10	0.28	0.16	0.15	1.8	1.95		62
CF2	6/25/2007	Wet	10:02	21.7	536	7.42	7.27	0.20	1.3	5	17	0.29	0.35	0.15	1.3	1.45		42
CF2	7/11/2007	Wet	10:08	23.6	633	8.07	7.75	1.20	1.5	5	37	0.26	0.16	0.15	3.8	3.95		51
CF2	7/25/2007	Dry	13:15	22.5	557	8.24	8.83	0.10	1.0	5	13	0.32	0.66	0.15	1.5	1.65		51
CF2	8/9/2007	Dry	9:02	24.5	473	7.75	4.30	0.20	1.0	5	10	0.17	0.9	0.75	1.5	2.25		46
CF2	8/22/2007	Wet	8:50	22.6	538	7.09	5.30	0.10	1.0	5	28	0.1	0.16	0.15	2.3	2.45		55
CF2	9/11/2007	Wet	9:38	22.3	890	7.89	4.57	0.10	0.5	5	5	0.1	0.84	0.75	12	12.75		86
CF2	9/26/2007	Wet	9:49	21.3	973	7.75	3.47	0.01	1.0	5	8	0.35	1.8	0.75	15	15.75		91
CF2	10/10/2007	Dry	10:20	15.2	770	7.78	3.30	0.50	1.0	5	5	0.27	1.6	0.75	2.1	2.85		79
CF2	10/25/2007	Wet	12:30	13.1	425	7.18	10.10	2.00	2.0	7	21	0.25	1.6	1.5	2	3.5		47
2007 Site Average				**20.0**	**619**	**7.76**	**6.49**	**0.47**	**1.1**	**5**	**14**	**0.23**	**0.71**	**0.46**	**3.7**	**4.18**		**58**
CF2	5/21/2009	Dry	11:20	17.8	558	8.22	0.00	0.35	1.5		5			0.15	0.7	1.30	0.60	
CF2	6/5/2009	Dry	11:45	16.5	558	8.06	9.13	0.30	1.1		5			0.75	0.75	2.00	1.20	
CF2	6/18/2009	Wet	13:59	20.2	400	7.81	9.08	0.60	2.5		44			0.15	0.64	2.00	1.40	
CF2	7/2/2009	Dry	11:16	19.4	551	8.24	8.79	0.16	0.8		5			0	0	0.64	0.64	
CF2	7/15/2009	Wet	12:30	21.2	679	7.97	8.85	0.16	1.5		12			0.75	2.8	3.60	0.84	
CF2	7/30/2009	Wet	11:36	21.4	143	8.11	7.80	1.50	3.0		36			0.75	0.67	1.70	1.00	
CF2	8/13/2009	Dry	11:18	23.6	505	7.79	7.93	0.50	1.1		9			0.75	1	1.70	0.71	
CF2	8/27/2009	Wet	11:15	21.1	585	8.04	7.50	0.02	0.7		9			0.75	3.1	4.00	0.95	
CF2	9/10/2009	Dry	11:05	19.5	511	7.99	7.64	0.10	0.8		5			0.75	2.5	2.50	0.40	
CF2	9/24/2009	Wet	10:00	21.8	448	7.70	6.69	0.75	2.0		9			0.75	1.9	2.80	0.89	
CF2	10/8/2009	Wet	11:10	15.9	92	7.16	8.72	1.50	9.0		88			0.75	0.69	1.50	0.85	
CF2	10/23/2009	Wet	10:00	14	518	8.02	9.24	2.00	2.0		24			0.75	0.89	0.89	0.40	
2009 Site Average				**19.4**	**462**	**7.93**	**7.61**	**0.66**	**2.2**		**21**			**0.59**	**1.3**	**2.05**	**0.82**	
Overall Site Average				**19.7**	**541**	**7.84**	**7.05**	**0.56**	**1.6**	**5**	**17**	**0.23**	**0.71**	**0.53**	**2.5**	**3.12**	**0.82**	**58**

CURRY'S FORK MAIN STEM (CONTINUED)

TABLE 4.03-11–CF3 PHYSICOCHEMICAL SAMPLING DATA RESULTS

Sample Site	Date	Sample Type	Time	Temp (°C)	Conduct. (mS)	pH	DO (mg/l)	Velocity (ft/s)	Depth (ft)	BOD_5 (mg/l)	TSS (mg/l)	Ammonia (mg/l)	Phosph. (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Total Nitrogen (mg/l)	TKN (mg/l)	Sulfate (mg/l)
CF1	5/7/2007	Dry	8:45	15.6	690	8.17	8.59	1.00	2.5	5	5	0.12	0.1	0.15	0.11	0.26		36
CF1	5/23/2007	Dry	10:33	18.9	690	8.20	9.05	0.50	1.5	5	5	0.21	0.16	0.15	1.1	1.25		45
CF1	6/11/2007	Wet	10:04	19.7	245	7.36	6.78	0.20	1.0	4	8	0.24	0.16	0.15	1.5	1.65		60
CF1	6/25/2007	Wet	10:26	21.8	523	7.53	7.75	0.25	2.0	5	12	8.1	0.32	0.15	1.2	1.35		40
CF1	7/11/2007	Wet	10:45	23.8	628	8.13	8.18	2.00	1.5	5	42	0.31	0.16	0.15	3.7	3.85		50
CF1	7/25/2007	Dry	13:33	21.7	544	8.36	10.00	0.10	1.0	5	8	0.43	0.79	0.15	1.4	1.55		49
CF1	8/9/2007	Dry	9:43	25.3	470	7.69	6.71	2.50	0.5	5	17	0.17	0.9	0.75	1.3	2.05		44
CF1	8/22/2007	Wet	9:15	22.9	526	7.56	5.87	0.30	-	5	19	0.22	0.16	0.15	2.1	2.25		52
CF1	9/11/2007	Wet	10:24	22.1	884	7.75	6.11	0.10	1.0	5	7	0.27	0.77	0.75	11	11.75		87
CF1	9/26/2007	Wet	10:07	21.5	940	7.64	3.76	0.01	1.0	5	5	0.5	1.8	0.75	14	14.75		89
CF1	10/10/2007	Dry	10:40	15.2	710	7.91	4.89	0.20	1.0	5	7	0.25	1.6	0.75	1.6	2.35		77
CF1	10/25/2007	Wet	12:15	12.8	430	7.50	11.05	2.00	2.0	5	24	0.39	1.6	1.5	2	3.5		49
2007 Site Average				**20.1**	**607**	**7.82**	**7.40**	**0.76**	**1.4**	**5**	**13**	**0.93**	**0.71**	**0.46**	**3.4**	**3.88**		**57**
CF1	5/21/2009	Dry	10:55	17.8	565	8.20	0.00	0.50	1.5		8			0.75	0.55	0.52	0.52	
CF1	6/5/2009	Dry	11:17	16.3	559	8.01	8.95	0.58	0.8		7			0.75	0.78	1.50	0.69	
CF1	6/18/2009	Wet	13:29	20.6	473	7.77	8.74	0.90	2.0		58			0.15	0.68	2.10	1.40	
CF1	7/2/2009	Dry	10:57	19.4	562	8.23	9.01	0.50	0.5		5			0	0	0.55	0.55	
CF1	7/15/2009	Wet	13:00	21.2	685	7.87	5.63	0.01	1.5		5			0.75	2.5	4.10	1.60	
CF1	7/30/2009	Wet	11:12	21.3	398	7.98	7.71	3.00	2.0		40			0.75	0.57	1.80	1.20	
CF1	8/13/2009	Dry	10:58	22.2	501	8.02	7.12	1.50	0.8		8			0.75	0.87	1.60	0.74	
CF1	8/27/2009	Wet	10:55	20.7	580	7.96	8.15	0.34	0.5		5			0.75	2.8	3.50	0.69	
CF1	9/10/2009	Dry	10:50	19.4	504	8.05	7.73	0.40	0.5		5			0.75	2.4	2.90	0.51	
CF1	9/24/2009	Wet	9:40	21.1	453	6.70	7.26	2.00	2.5		10			0.75	1.2	1.90	0.75	
CF1	10/8/2009	Wet	10:53	15.7	246	7.23	8.88	1.50	12.0		140			0.75	0.55	0.85	0.85	
CF1	10/23/2009	Wet	11:15	14.1	548	7.90	8.30	2.00	1.5		6			0.75	1.1	1.60	0.53	
2009 Site Average				**19.2**	**506**	**7.83**	**7.29**	**1.10**	**2.2**		**25**			**0.64**	**1.2**	**1.91**	**0.84**	

B. Secondary Data

1. KDOW

Secondary physicochemical data collected by KDOW is shown in detail in Appendix F. All data collected by KDOW prior to 2000 was considered a secondary data source.

2. SRWW

Secondary physicochemical data collected by SRWW is shown in detail in Appendix G.

3. USGS

Secondary physicochemical data collected by USGS is shown in Appendix H.

4.04 PATHOGEN DATA

A. Primary Data Sources

Pathogen sampling results collected as part of the WP sampling program are shown in Table 4.04-1.

B. Secondary Data Sources

1. KDOW

Pathogen data collected by KDOW is shown with the physicochemical data in Appendix F.

2. SRWW

Pathogen data collected by SRWW is shown with the physicochemical data in Appendix G.

3. USGS

Pathogen data collected by USGS is shown with the physicochemical data in Appendix H.

TABLE 4.04-1

CURRY'S FORK WP SAMPLING PROGRAM FECAL COLIFORM SAMPLING RESULTS

Date	Sample Type	NC2	NC1b	NC1a	NC1	SC2	SC1	AR1a	AR1	CF3	CF2	CF1
5/7/2007	Dry	100			700	200	500		900	200	100	100
5/23/2007	Dry	110			140	230	490		240	220	120	50
6/11/2007	Wet	110			540	764	600		330	1,030	2,000	300
6/25/2007	Wet	500			1,200	600	800		470	1,600	1,100	1,000
7/11/2007	Wet	4,000			1,000	4,900	87,000		1,300	88,000	1,900	1,500
7/25/2007	Dry	18			440	380	110		330	790	590	500
8/9/2007	Dry	5,000			2,300	5,100	5,000		0	2,000	590	780
8/22/2007	Wet	NS			5,700	1,600	650		1,700	330	780	490
9/11/2007	Wet	NS			180	150	NS		NS	230	930	480
9/26/2007	Wet	NS			120	260	NS		NS	210	860	310
10/10/2007	Dry	NS			140	150	NS		NS	200	260	140
10/25/2007	Wet	2,000			22,000	3,800	3,500		1,500	4,100	4,400	3,500
2007 Geomean		**380**			**734**	**662**	**1,327**		**661**	**845**	**694**	**421**
5/21/2009	Dry	70	170	60	250	240	400	200	30	400	210	200
6/5/2009	Dry	130	660	680	2,500	310	1,000	750	860	940	2,300	1,800
6/18/2009	Wet	450	6,800	11,000	660	3,800	1,700	3,000	3,600	1,800	7,200	6,500
7/2/2009	Dry	1,300	100	250	210	670	12,000	2,700	230	440	460	380
7/15/2009	Wet	NS	3,100	670	1,900	330	1,800	1,800	13,000	2,000	25,000	300
7/30/2009	Wet	640	2,300	520	4,300	4,200	1,000	2,000	882	2,700	2,300	2,200
8/13/2009	Dry	20	220	170	510	1,500	940	560	370	760	350	360
8/27/2009	Wet	NS	50	70	510	180	560	470	470	330	350	200
9/10/2009	Dry	90	780	140	2,000	260	290	550	280	1,100	60	190
9/24/2009	Wet	150	NS	600	8,800	1,100	850	690	560	1,300	3,700	3,000
10/8/2009	Wet	450	NS	3,500	8,200	4,800	13,000	5,900	5,700	8,000	9,600	9,900
10/23/2009	Wet	NS	4,100	4,000	2,000	5,800	1,700	2,700	3,000	1,000	1,600	1,300
2009 Geomean		**195**	**673**	**535**	**1,392**	**953**	**1,366**	**1,175**	**835**	**1,136**	**1,355**	**907**
Overall Geomean		**267**	**673**	**535**	**1,011**	**795**	**1,349**	**1,175**	**760**	**979**	**970**	**618**

All values are in colonies/100 ml.
NS = No sample taken.

4.05 GEOMORPHOLOGIC DATA

Refer to Appendix C for detailed information on geomorphologic data collected for the WP. Additional data was collected at project sites with portable samplers and flow meters (site NC1, AR1, SC1, and CF2) to supplement the geomorphologic study conducted by UL as described in Section 3 of this report. Sampling results, flow rates, and sediment loads for the wet weather events captured by the portable samplers are shown in Appendix I.

4.06 BIOLOGICAL AND PHYSICAL HABITAT DATA

A. Primary Data Sources

Primary data sources include sampling conducted by Third Rock and KDOW.

1. Third Rock

Table 4.06-1 summarizes the ratings and indices calculated from the biological and habitat assessments. Information on biological assessments, habitat assessments, and associated sampling data collected by Third Rock is shown in detail in Appendix A.

Site	Subwatershed	RBP		MBI		IBI		DBI	
		Score	Rating	Score	Rating	Score	Rating	Score	Rating
NC1	North Curry's	104	Not Supporting	56.9	Fair	0	Very Poor	74	Excellent
SC1	South Curry's	136	Not Supporting	44.4	Fair	32	Fair	71	Excellent
AR1	Asher's Run	113	Not Supporting	37.8	Poor	0	Very Poor	43	Fair, Poor
CF2	Curry's Fork Main Stem	141	Partially Supporting	63.9	Good	28	Poor	55	Excellent

Note: DBI = Diatom Bioassessment Index
IBI = Index of Biotic Integrity
MBI = Macroinvertebrate Biotic Index
RBP = Rapid Bioassessment Protocols

Table 4.06-1 Third Rock Inc. Biological and Habitat Data Summary

2. KDOW

Primary biological data collected by KDOW includes the qualitative mussel survey conducted from 23 sites in the summer and fall of 2003. Table 4.06-2 summarizes the results of the survey at the two stations within Curry's Fork. The following two paragraphs are excerpts from the survey discussing the results at the two stations within Curry's Fork:

Species	Station # 21 Curry's Fork	Station # 22 North Curry's Fork
Actinonaias ligamentina, Mucket - A	0.5WD	
Alasmidonta viridis, Slippershell - C	0.5WD	
Lampsilis siliquoidea, Fatmucket - A	3LV8.5WD	1LV8.5WD
Pyganodon grandis, Giant Floater	3.5WD	1LV3WD
Toxolasma parvus, Lilliput - O	0.5WD	3.5WD

Note: A = Abundant (found in > 10 survey stations)
C = Common (found in 6 to 10 of survey stations)
LV = Live specmimen
O = Occasional (found in 2 to 5 survey stations)
WD = Weathered, dry valve

Table 4.06-2 2003 Kentucky Division of Water Mussel Survey Results

"Station #21–Curry's Fork

In Curry's Fork on August 18th, five native species were identified (*Actinonaias ligamentina, Alasmidonta viridis, Lampsilis siliquoidea, Pyganodon grandis* and *Toxolasma parvus*). Three live specimens of *Lampsilis siliquoidea* were observed during the survey and this species was the most abundant taxa with an additional eight and a half weathered valves recorded.

Station #22–North Fork Curry's Fork

On August 14th, only three native mussel species were found at this North Fork Curry's Fork station (*Lampsilis siliquoidea, Pyganodon grandis* and *Toxolasma parvus*). Live specimens of *Lampsilis siliquoidea* and *Pyganodon grandis* were recorded. As with other stations in this survey, *Lampsilis siliquoidea* was the most abundant species at this location with one live specimen and eight and a half weathered valves observed."

B. Secondary Data Sources

Biological assessments conducted by KDOW are shown in Appendix J.

SECTION 5
POLLUTANT LOADS

5.01 LOAD DURATION CURVES

Load duration curves (LDC) were developed to show pollutant loads at each sampling site. A LDC is developed from an FDC by multiplying stream flow with a numeric water quality target and a conversion factor to calculate an associated pollutant load. This yields a similar curve to the FDC but the Y-axis now represents the pollutant load instead of the stream flow. This process develops a curve that shows the acceptable load a stream can convey of a pollutant of concern while maintaining the target water quality value. Measured pollutant concentrations and stream flows are then plotted on top of this curve to see the actual pollutant loads in the stream compared to the acceptable load. LDCs show if pollutants of concern exceed the target value and indicate the conditions by which they are elevated. This can help determine if the pollutant of concern is a point or nonpoint source.

5.02 PHYSICAL WATER QUALITY SAMPLING LOAD DURATION CURVES

Table 5.02-1 summarizes the physical water quality parameters and criterion used in the development of LDCs for WP sampling program.

Pollutant	Target Value	Basis
Total Suspended Solids	40 mg/l	Reference data
Conductivity	1,000 µS/cm	Reference data

Table 5.02-1 Physical Water Quality Pollutant Target Values

Reference data for the TSS target values comes from typical effluents values and limits from KPDES permitted facilities. The conductivity target value is a commonly used reference value for a healthy stream or waterway based on a wide range of sampling data from numerous entities.

Figures 5.02-1 to 5.02-21 showing physical water quality sampling LDCs for the subwatersheds within the Curry's Fork watershed are organized to show the sampling site furthest upstream first and then the remaining sites moving downstream through the subwatershed.

A. North Curry's Fork Subwatershed

Physical water quality sampling LDCs were developed for the following sites located in the North Curry's Fork subwatershed: NC2, NC1b, NC1a, and NC1. Figures 5.02-1, 5.02-2, 5.02-3, and 5.02-4 show the TSS LDCs for sites NC2, NC1b, NC1a, and NC1, respectively. Figures 5.02-5, 5.02-6, 5.02-7, and 5.02-8 show the conductivity LDCs for sites NC2, NC1b, NC1a, and NC1, respectively.

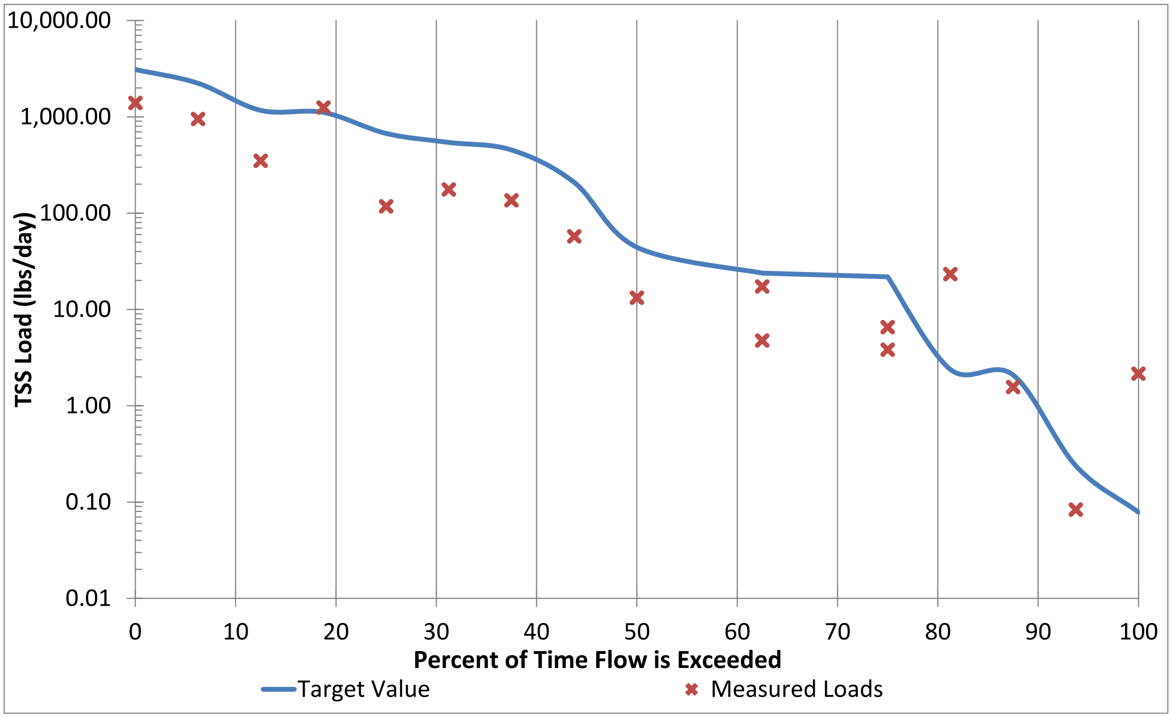


Figure 5.02-1 NC2 Total Suspended Solids Load Duration Curve

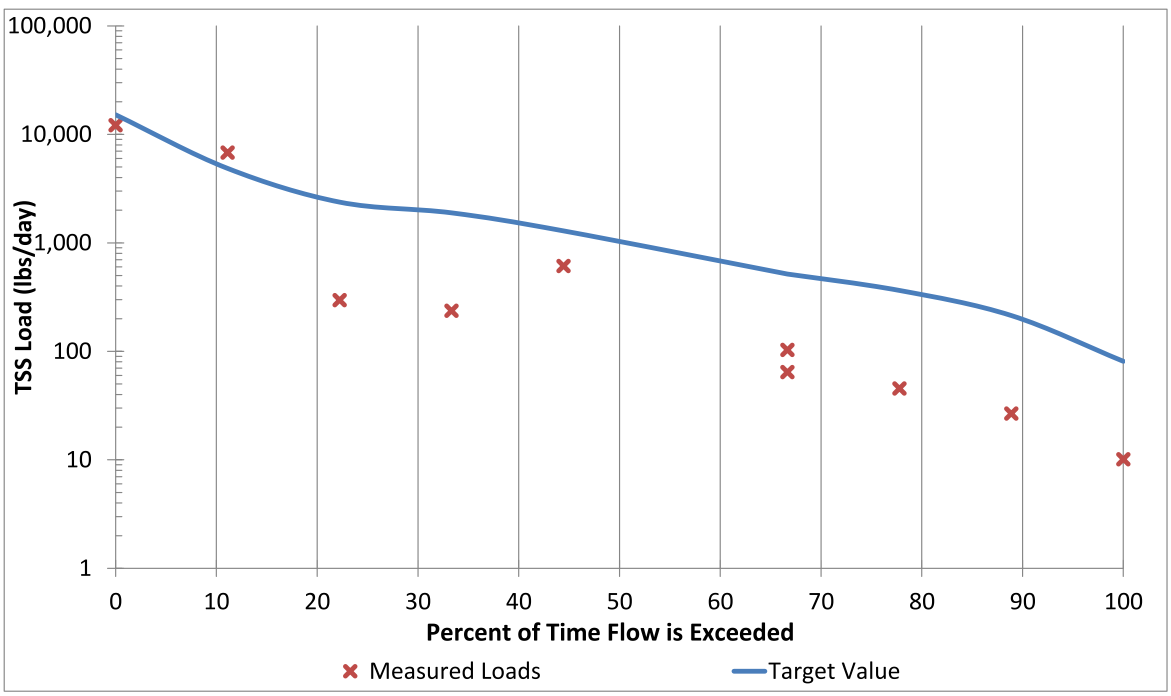


Figure 5.02-2 NC1b Total Suspended Solids Load Duration Curve

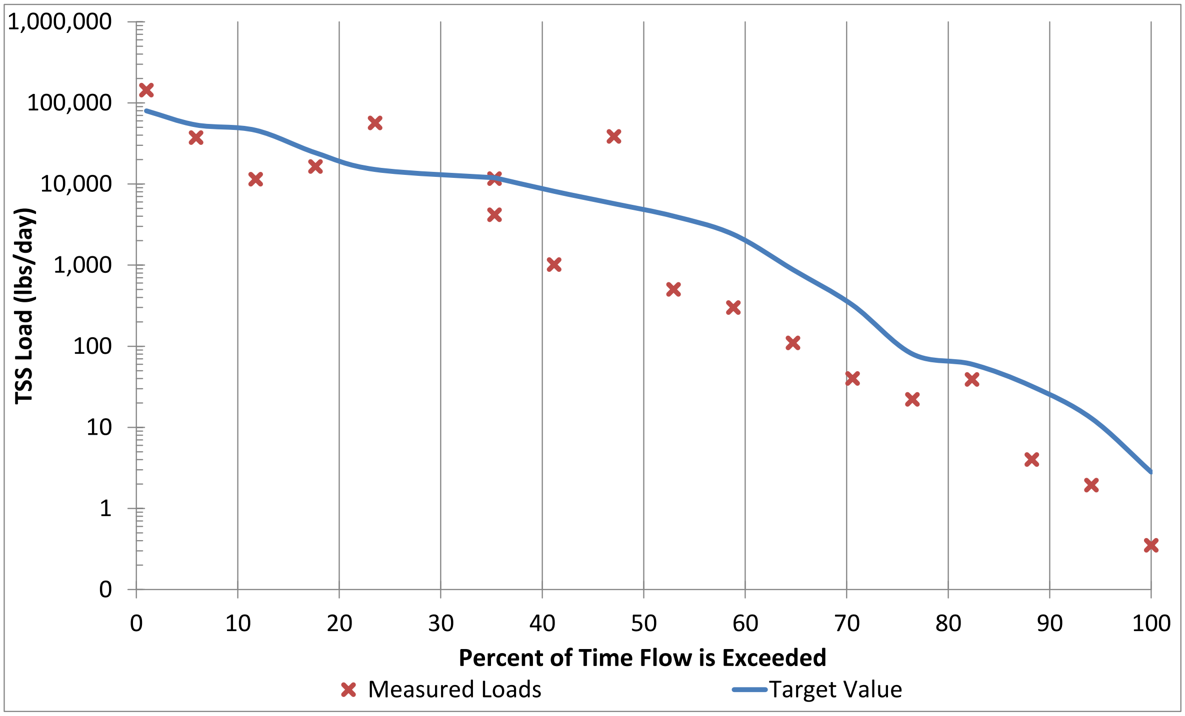


Figure 5.02-3 NC1a Total Suspended Solids Load Duration Curve

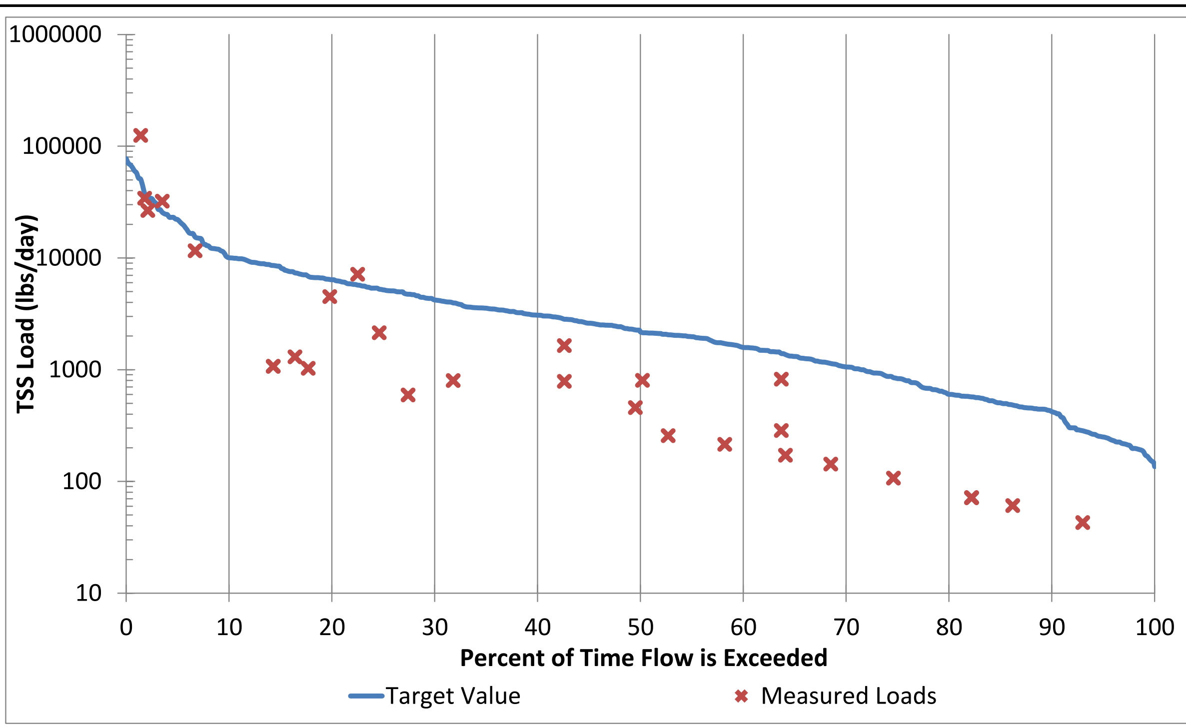


Figure 5.02-4 NC1 Total Suspended Solids Load Duration Curve

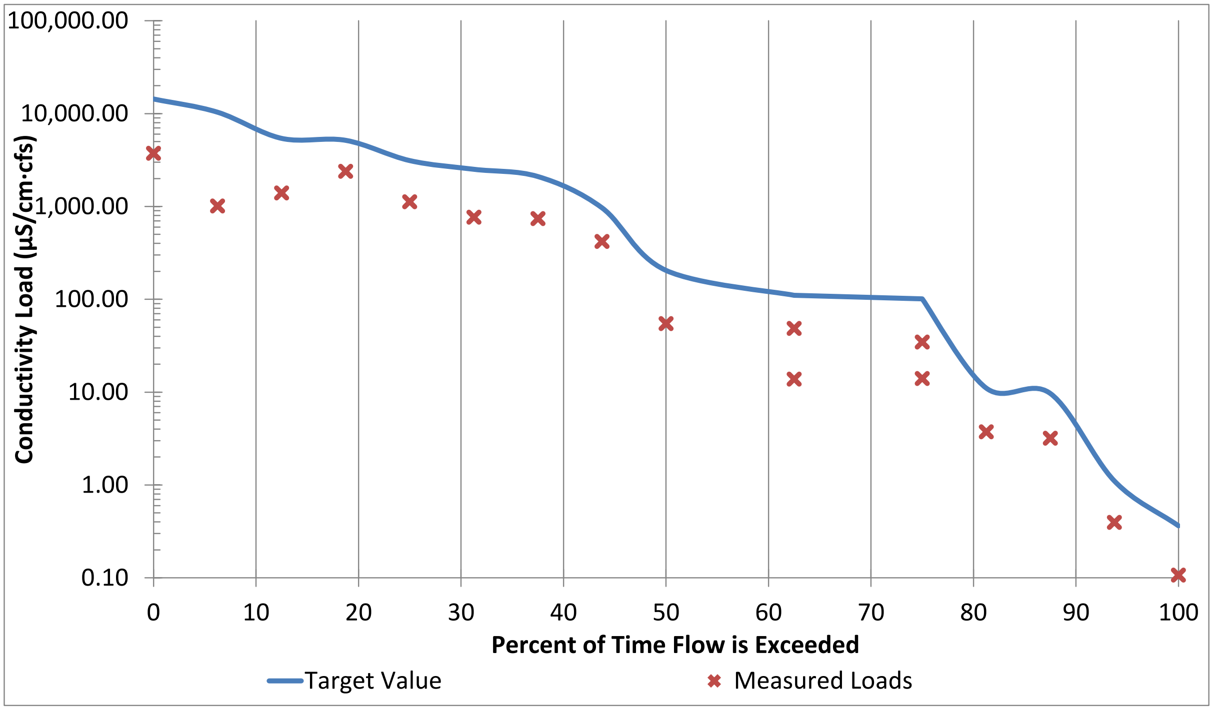


Figure 5.02-5 NC2 Conductivity Load Duration Curve

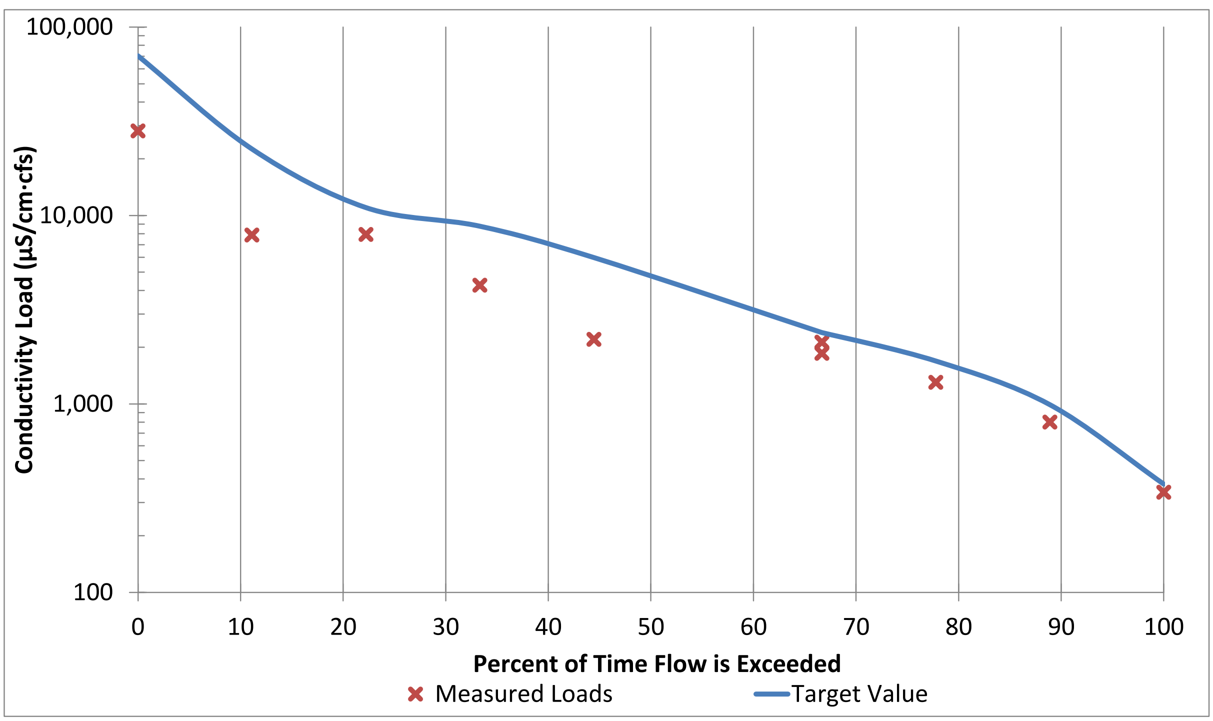


Figure 5.02-6 NC1b Conductivity Load Duration Curve

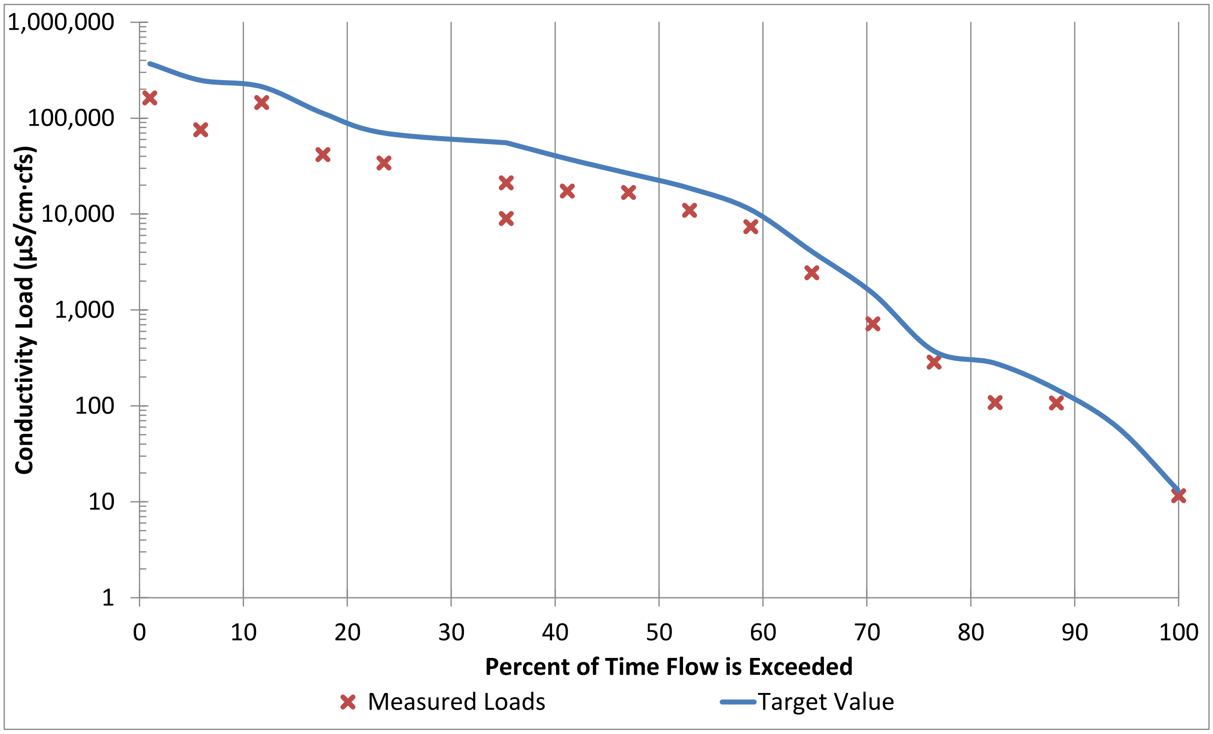


Figure 5.02-7 NC1a Conductivity Load Duration Curve

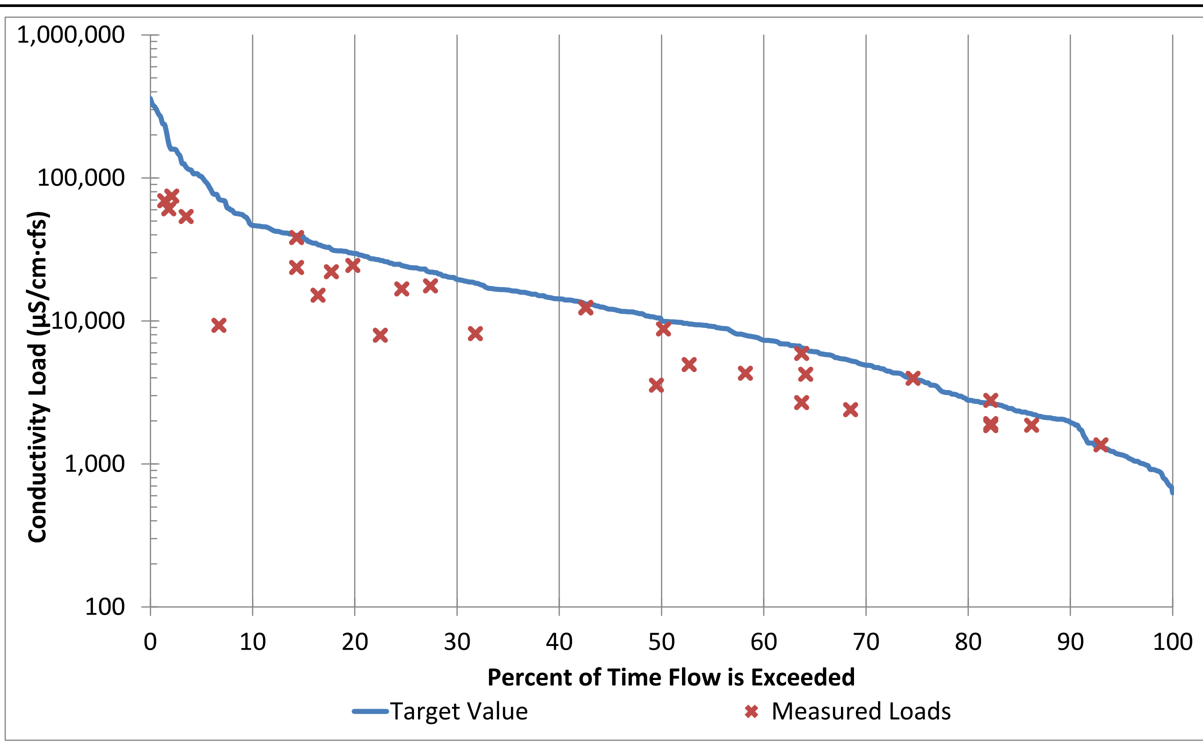


Figure 5.02-8 NC1 Conductivity Load Duration Curve

B. South Curry's Fork Subwatershed

Physical water quality sampling LDCs were developed for the following sites located in the South Curry's Fork subwatershed: SC2 and SC1. Figures 5.02-9 and 5.02-10 show the TSS LDCs for sites SC2 and SC1, respectively. Figures 5.02-11 and 5.02-12 show the conductivity LDCs for sites SC2 and SC1, respectively.

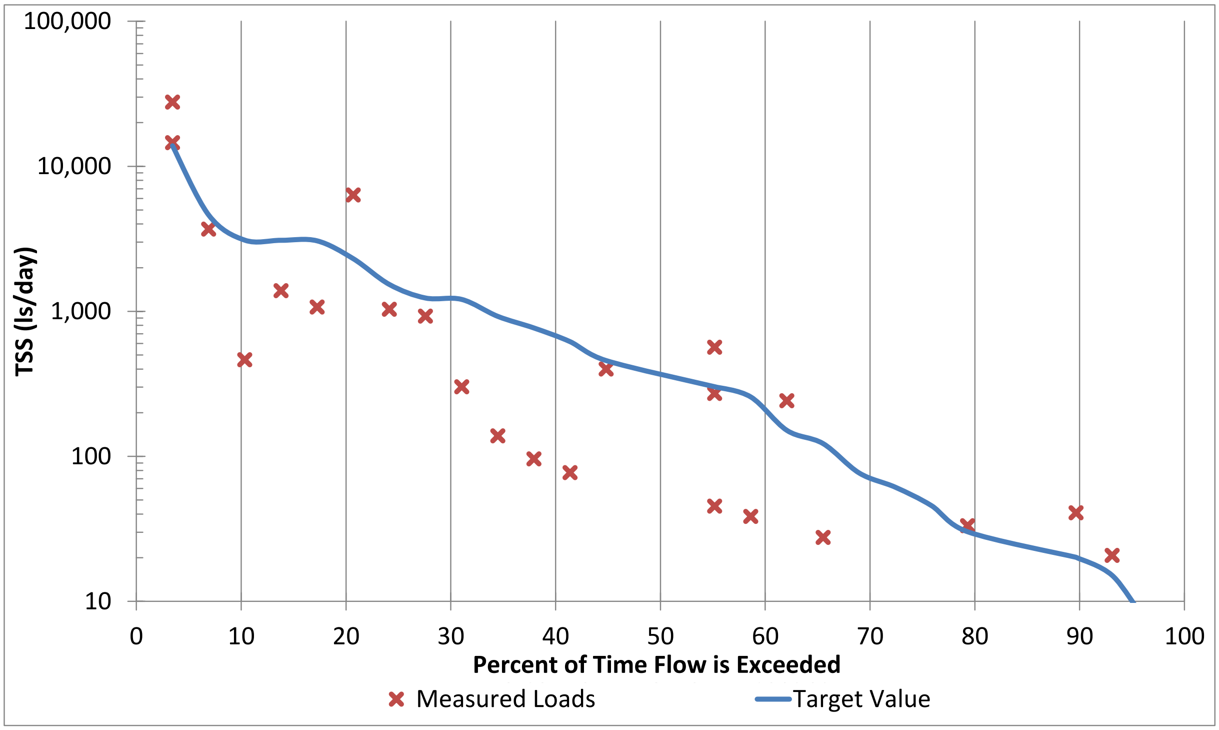


Figure 5.02-9 SC2 Total Suspended Solids Load Duration Curve

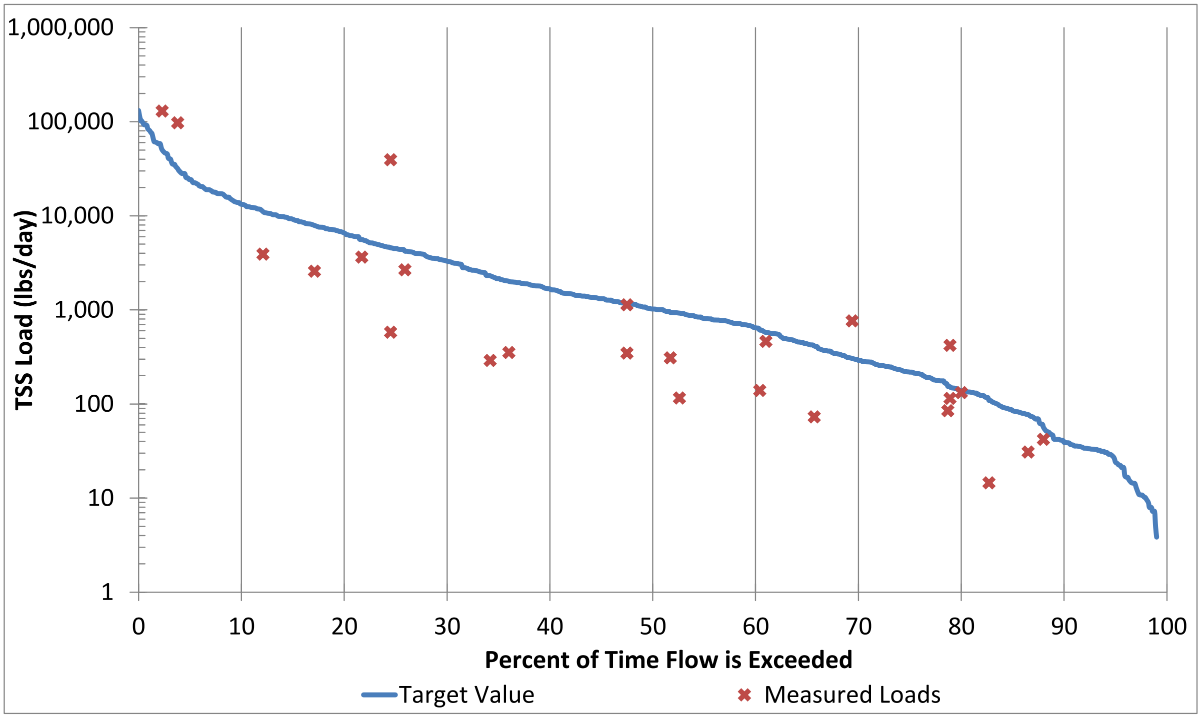


Figure 5.02-10 SC1 Total Suspended Solids Load Duration Curve

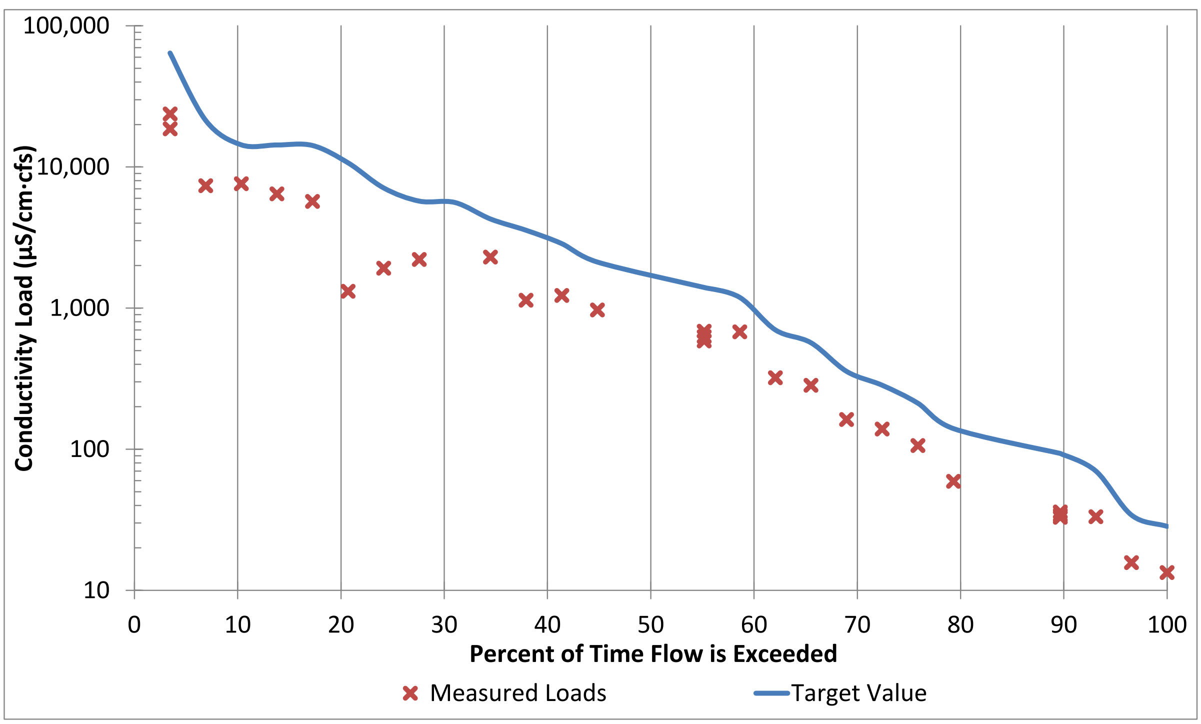


Figure 5.02-11 SC2 Conductivity Load Duration Curve

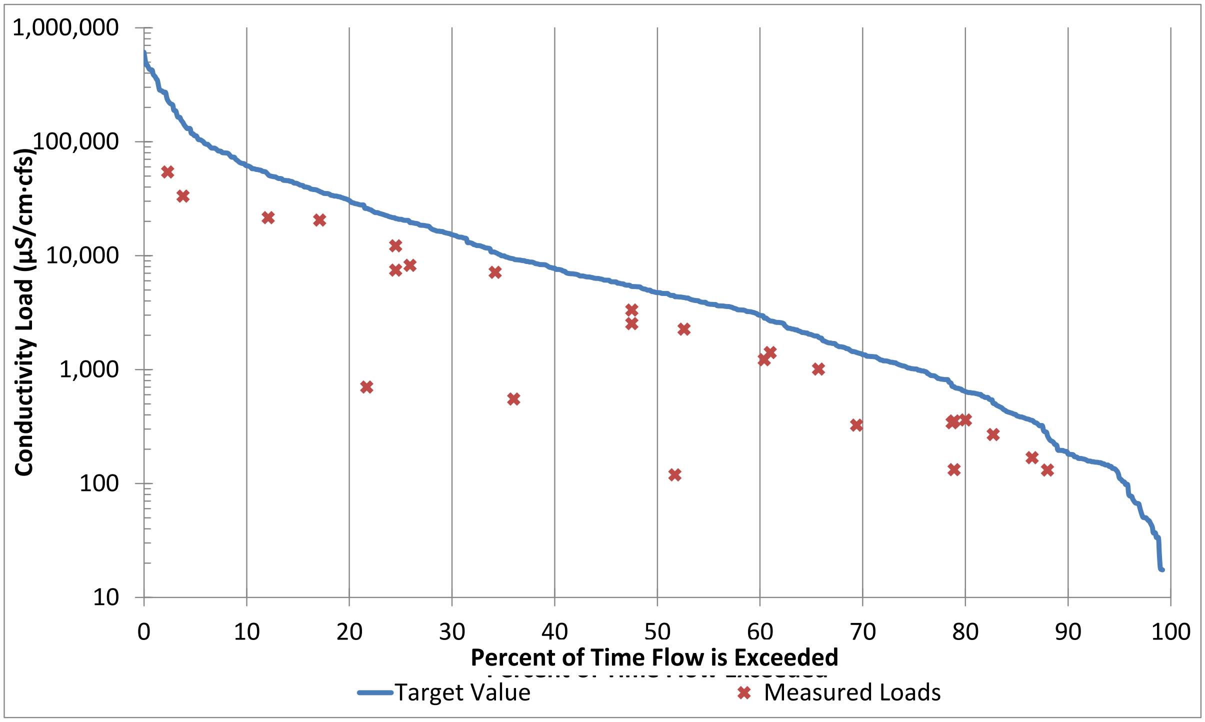


Figure 5.02-12 SC1 Conductivity Load Duration Curve

C. Asher's Run Subwatershed

Physical water quality sampling LDCs were developed for the following sites located in the Asher's Run subwatershed: AR1a and AR1. Figures 5.02-13 and 5.02-14 show the TSS LDCs for sites AR1a and AR1, respectively. Figures 5.02-15 and 5.02-16 show the conductivity LDCs for sites AR1a and AR1, respectively.

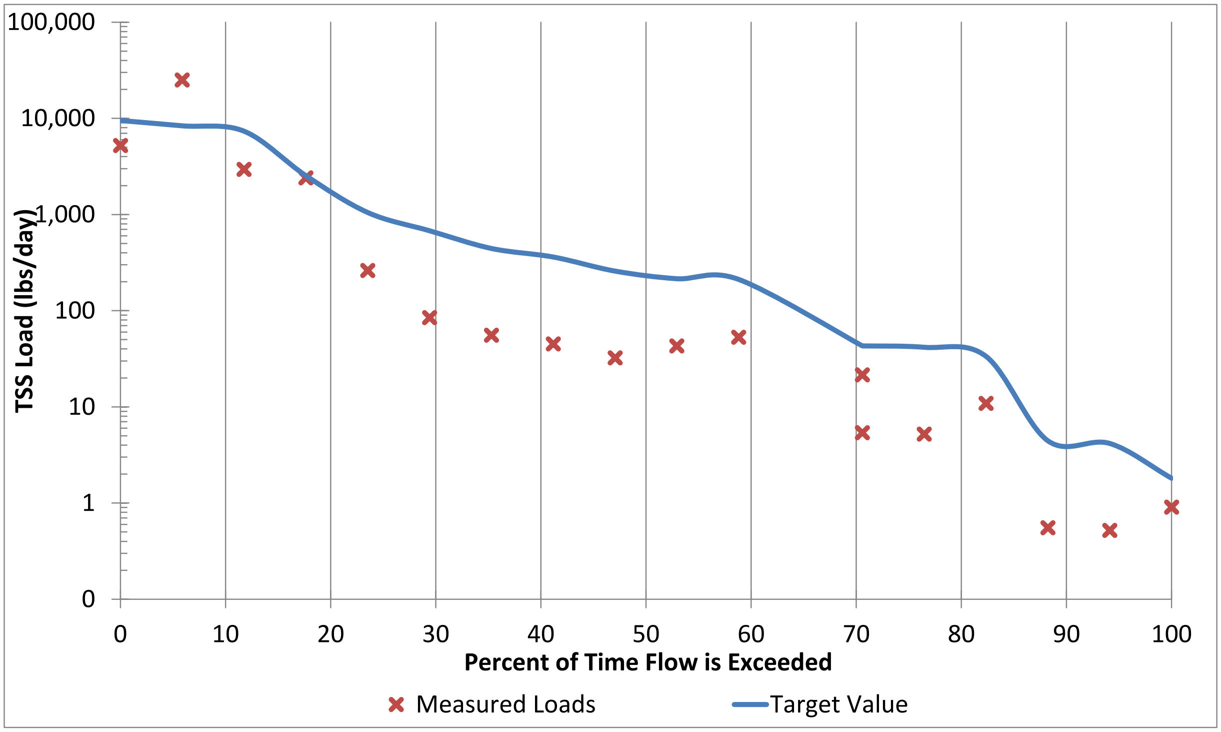


Figure 5.02-13 AR1a Total Suspended Solids Load Duration Curve

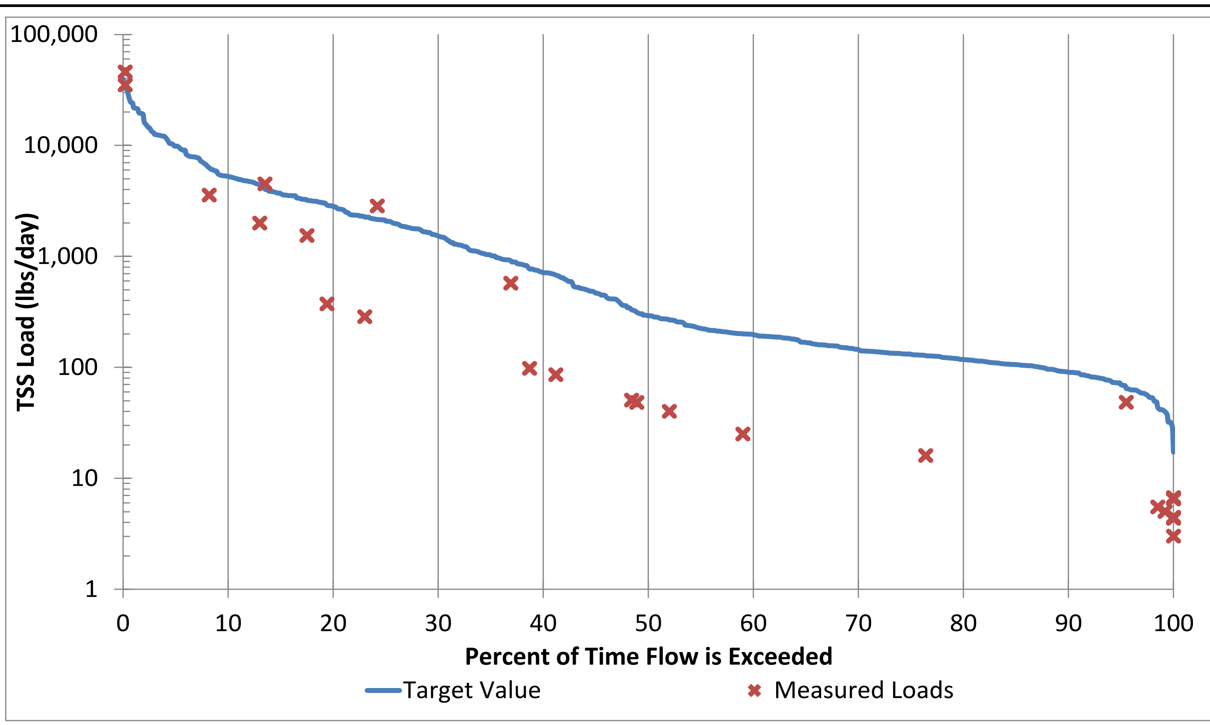


Figure 5.02-14 AR1 Total Suspended Solids Load Duration Curve

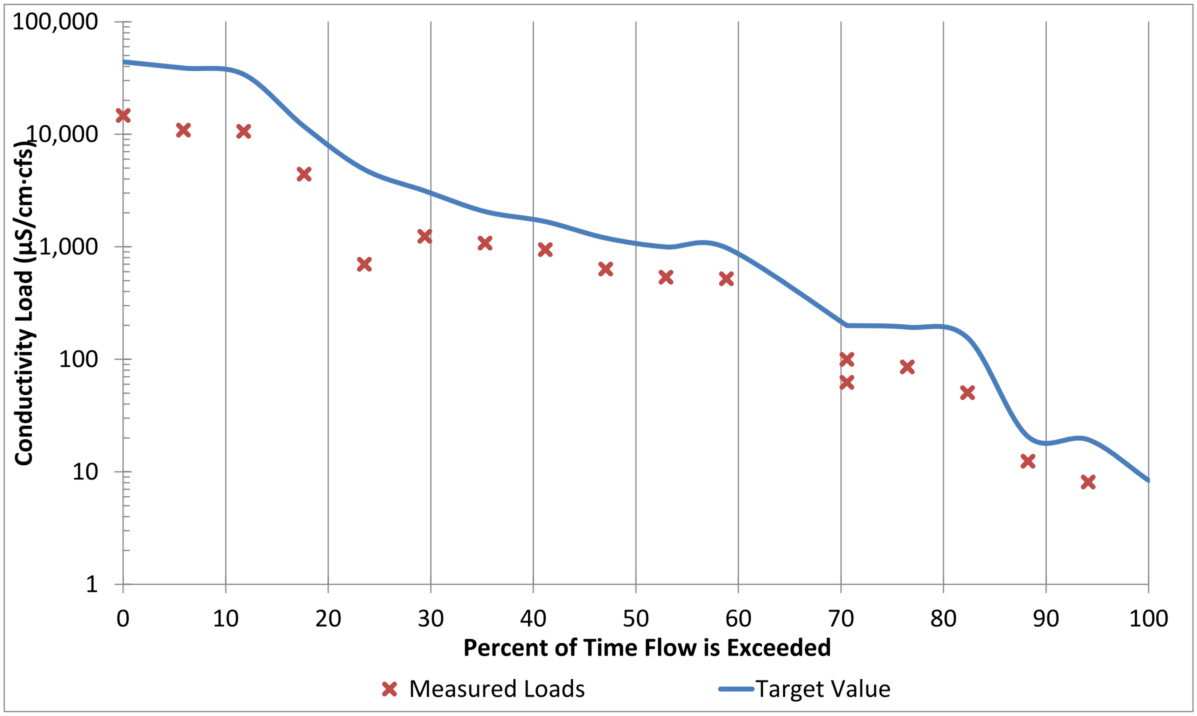


Figure 5.02-15 AR1a Conductivity Load Duration Curve

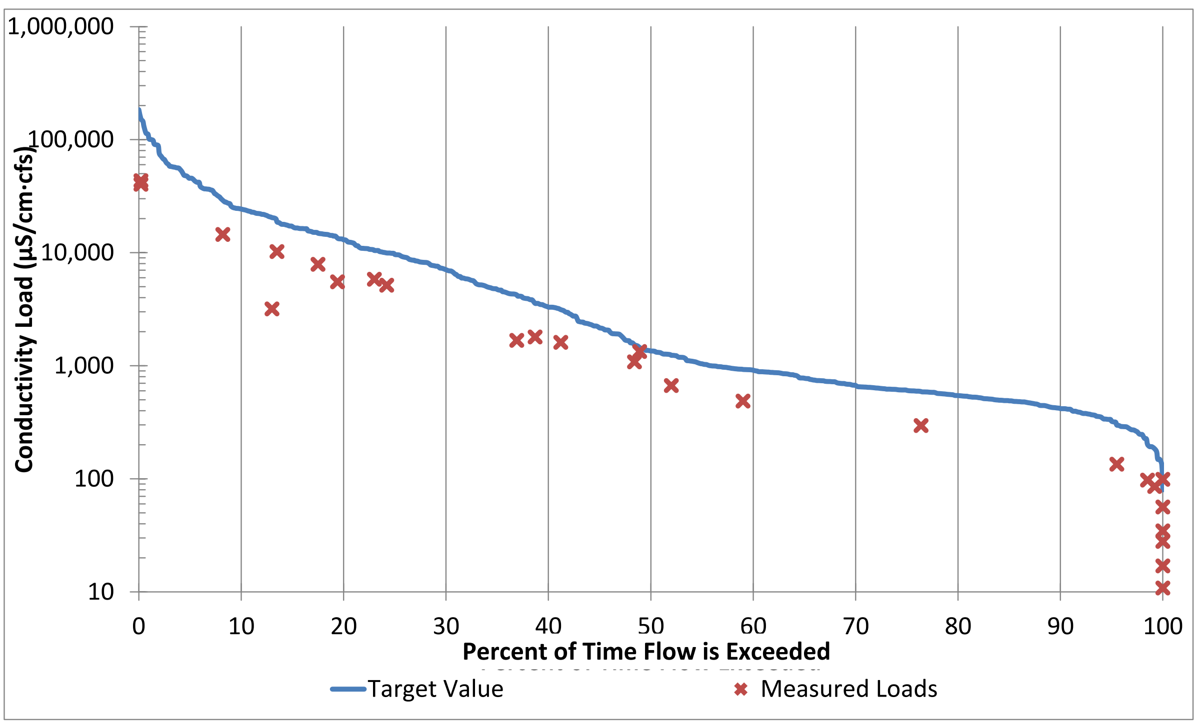


Figure 5.02-16 AR1 Conductivity Load Duration Curve

D. Curry's Fork Main Stem Subwatershed

Physical water quality sampling LDCs were developed for the following sites located in the Curry's Fork Main Stem subwatershed: CF3, CF2, and CF1. Figures 5.02-17, 5.02-18, and 5.02-19 show the TSS LDCs for sites CF3, CF2, and CF1, respectively. Figures 5.02-20, 5.02-21, and 5.02-22 show the conductivity LDCs for sites CF3, CF2 and CF1, respectively.

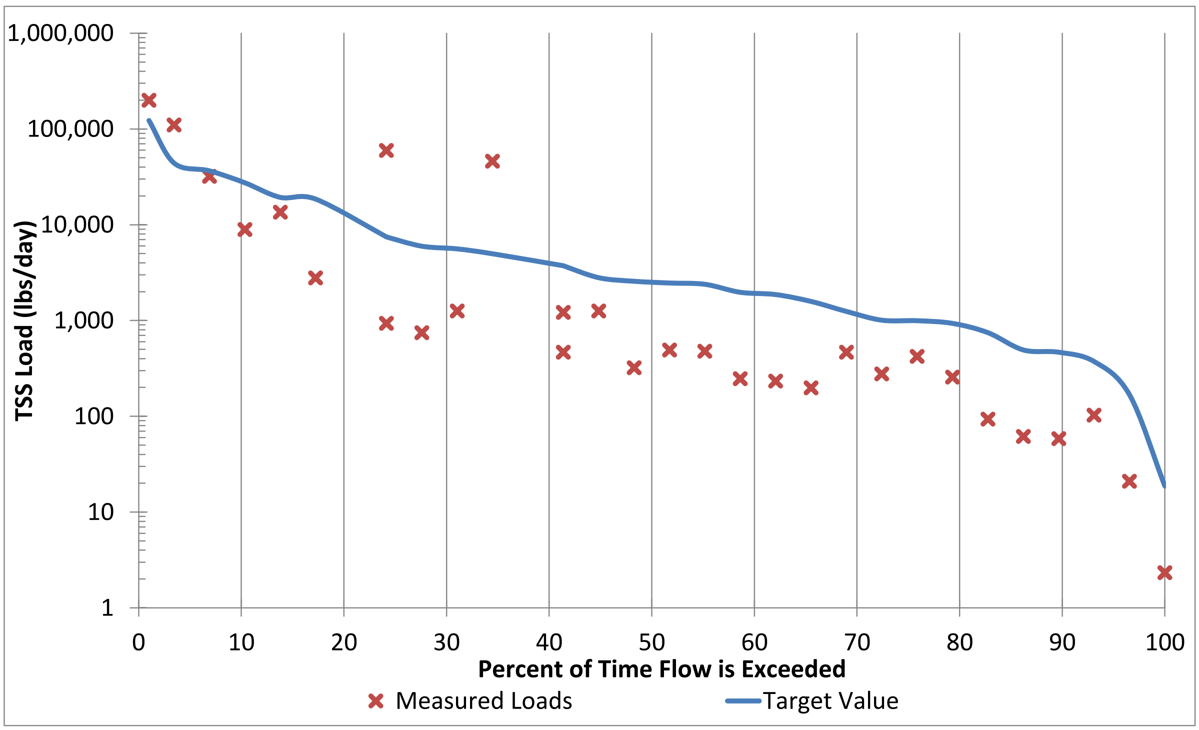


Figure 5.02-17 CF3 Total Suspended Solids Load Duration Curve

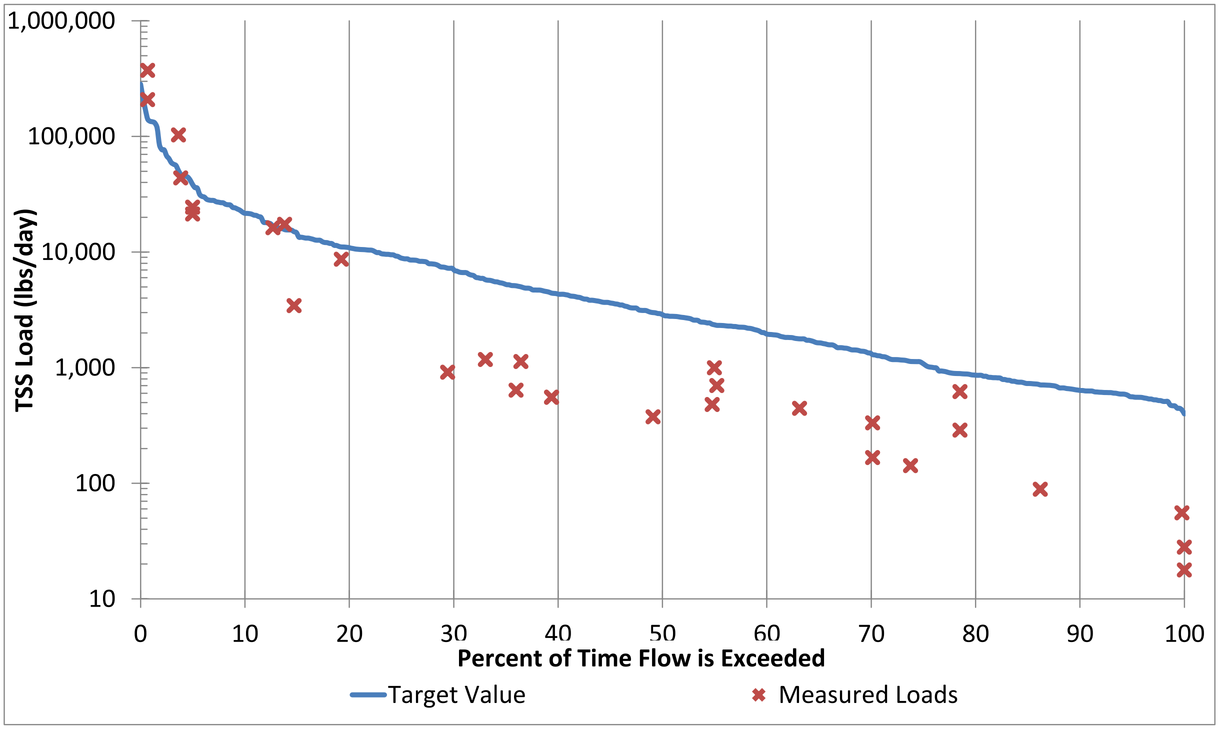


Figure 5.02-18 CF2 Total Suspended Solids Load Duration Curve

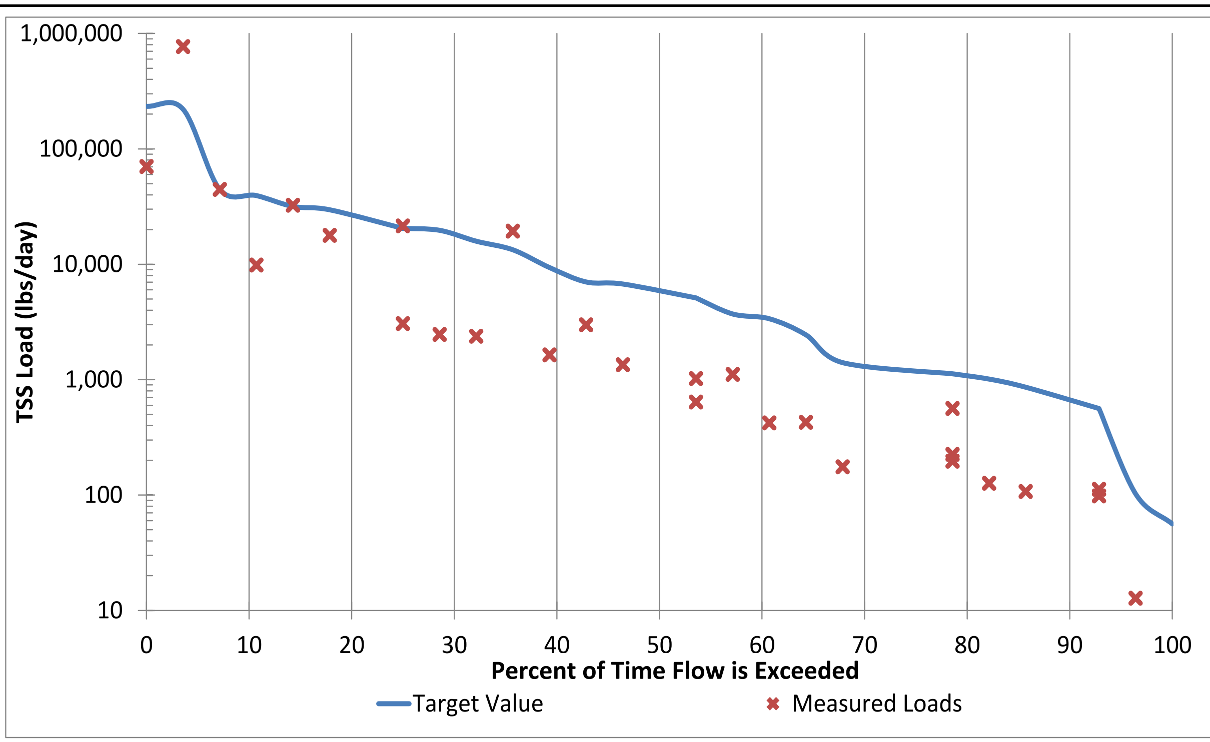


Figure 5.02-19 CF1 Total Suspended Solids Load Duration Curve

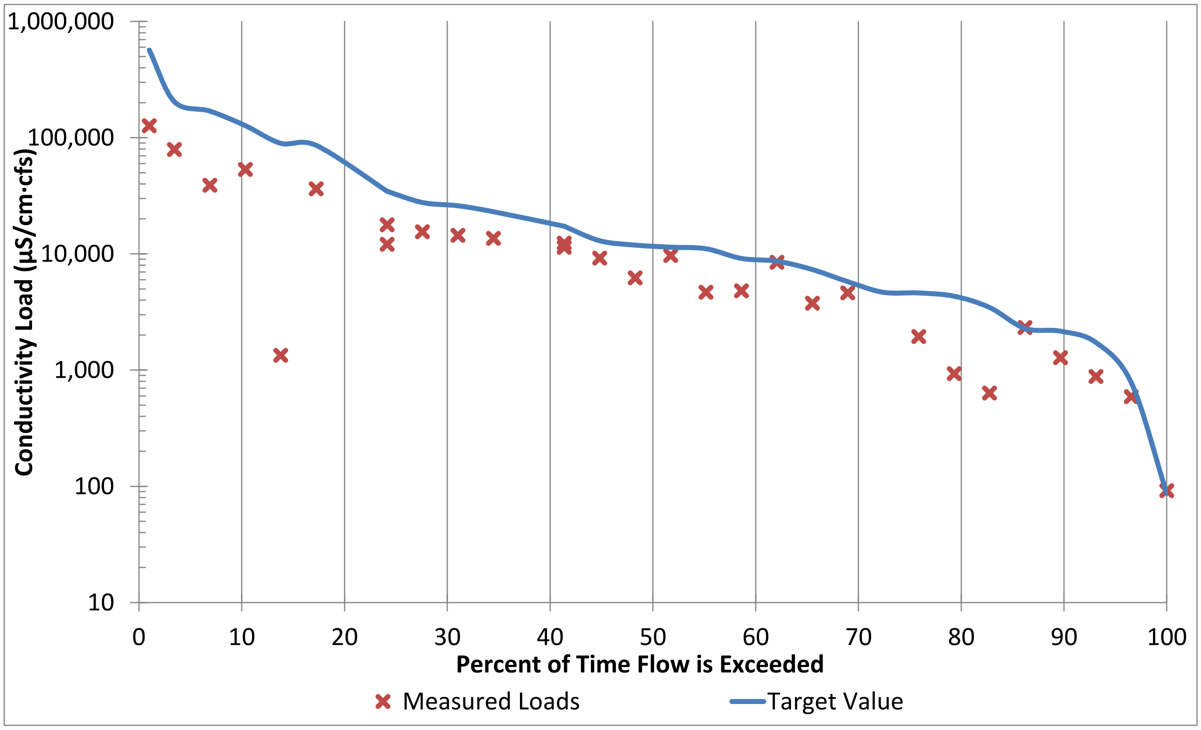


Figure 5.02-20 CF3 Conductivity Load Duration Curve

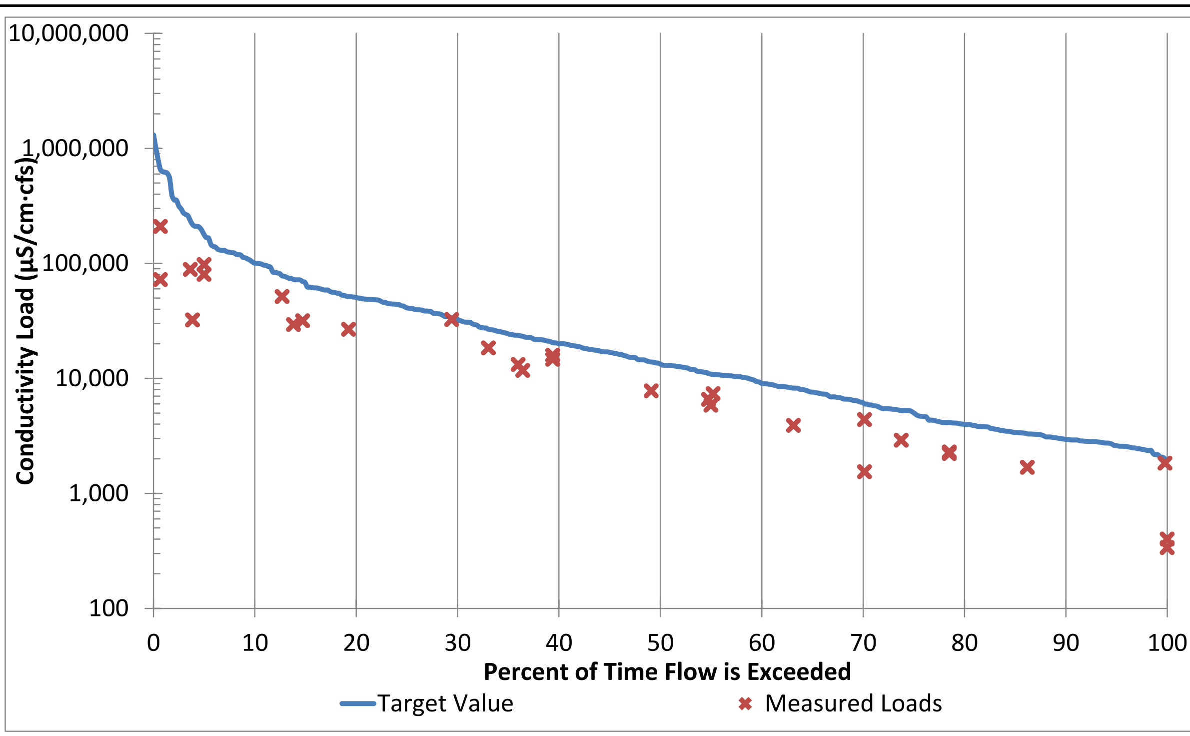


Figure 5.02-21 CF2 Conductivity Load Duration Curve

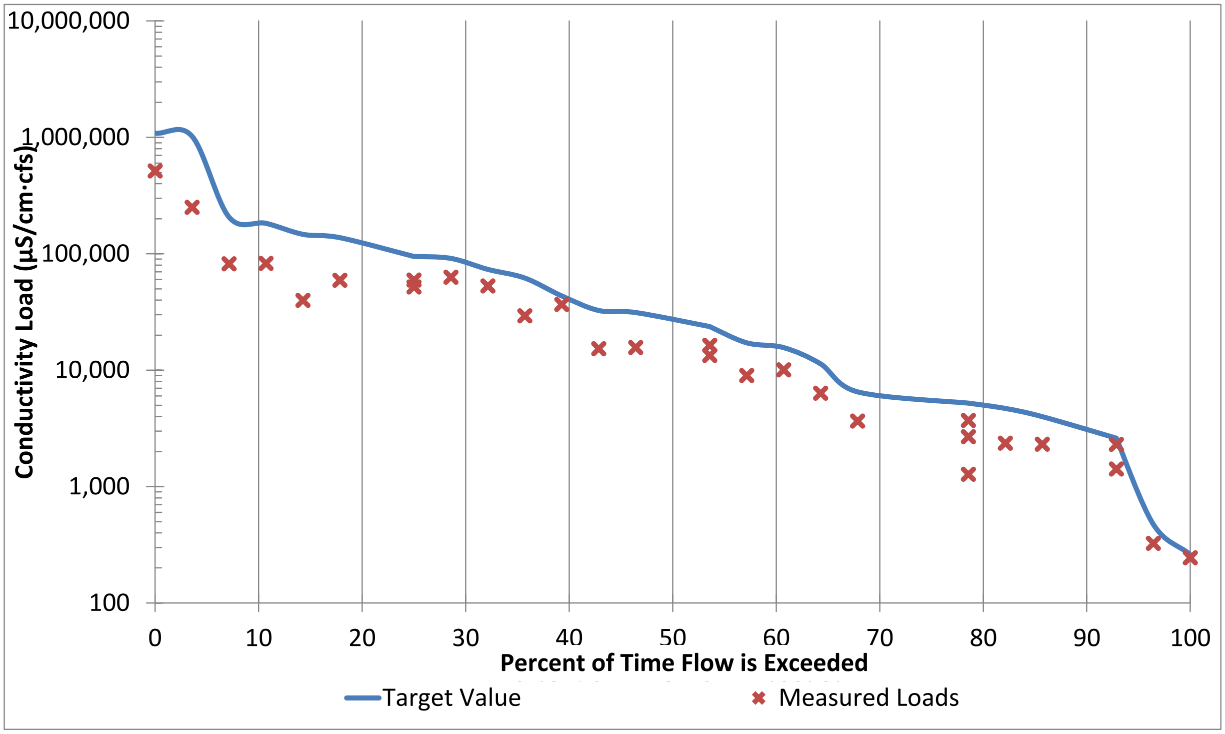


Figure 5.02-22 CF1 Conductivity Load Duration Curve

5.03 CHEMICAL WATER QUALITY SAMPLING LOAD DURATION CURVES

Table 5.03-1 summarizes the chemical water quality parameters and criterion used in the development of LDCs for WP sampling program.

Pollutant	Target Value	Basis
Total Nitrogen	Upper Bound: 1.4 mg/l	KDOW
	Lower Bound: 1.2 mg/l	KDOW
Phosphorus	Upper Bound: 0.1 mg/l	KDOW
	Lower Bound: 0.07 mg/l	KDOW
Fecal Coliform	Secondary Contact Recreation (Upper Bound): 2,000 colonies/100 mL	Water Quality Standard
	Primary Contact Recreation (Lower Bound): 400 colonies/100 mL	Water Quality Standard

Table 5.03-1 Chemical Water Quality Pollutant Target Values

The following figures showing chemical water quality sampling LDCs for the subwatersheds within the Curry's Fork watershed are organized to show the sampling site farthest upstream first and then the remaining sites moving downstream through the subwatershed.

A. North Curry's Fork Subwatershed

Chemical water quality sampling LDCs were developed for the following sites located in the North Curry's Fork subwatershed: NC2, NC1b, NC1a, and NC1. Figures 5.03-1, 5.03-2, 5.03-3, and 5.03-4 show the total nitrogen LDCs for sites NC2, NC1b, NC1a, and NC1, respectively. Figures 5.03-5 and 5.03-6 show the phosphorus LDCs for sites NC2 and NC1, respectively. Figures 5.03-7, 5.03-8, 5.03-9, and 5.03-10 show the fecal coliform LDCs for sites NC2, NC1b, NC1a, and NC1, respectively.

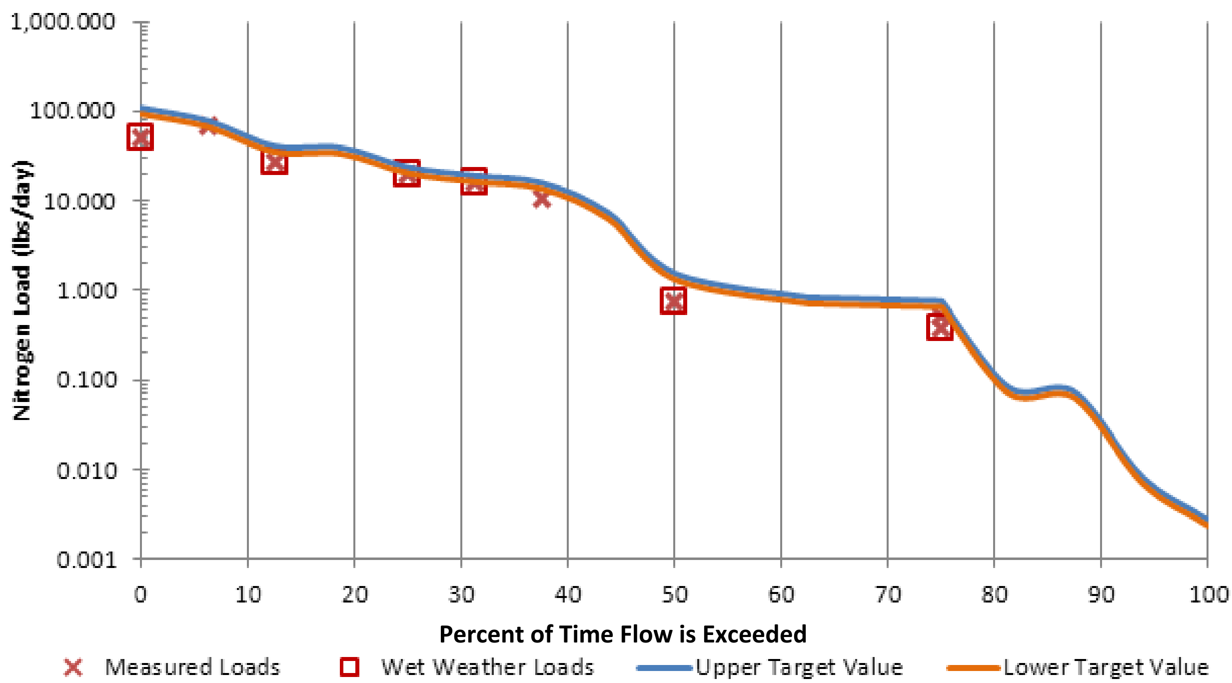


Figure 5.03-1 NC2 Total Nitrogen Load Duration Curve

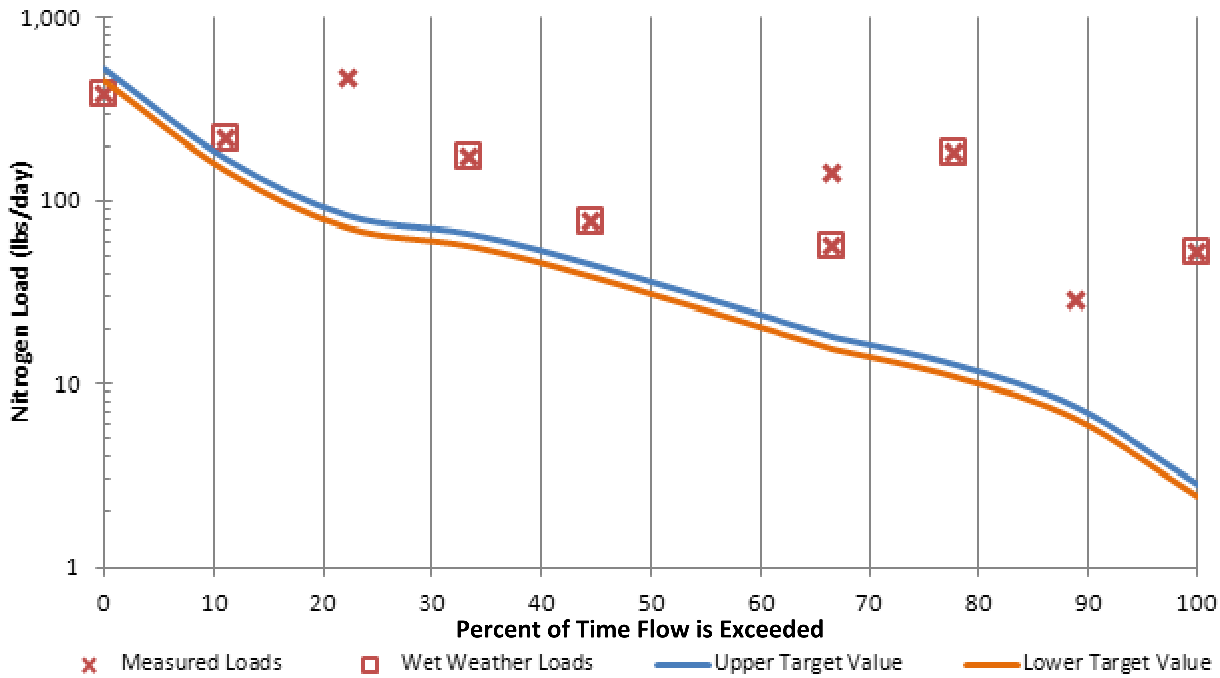


Figure 5.03-2 NC1b Total Nitrogen Load Duration Curve

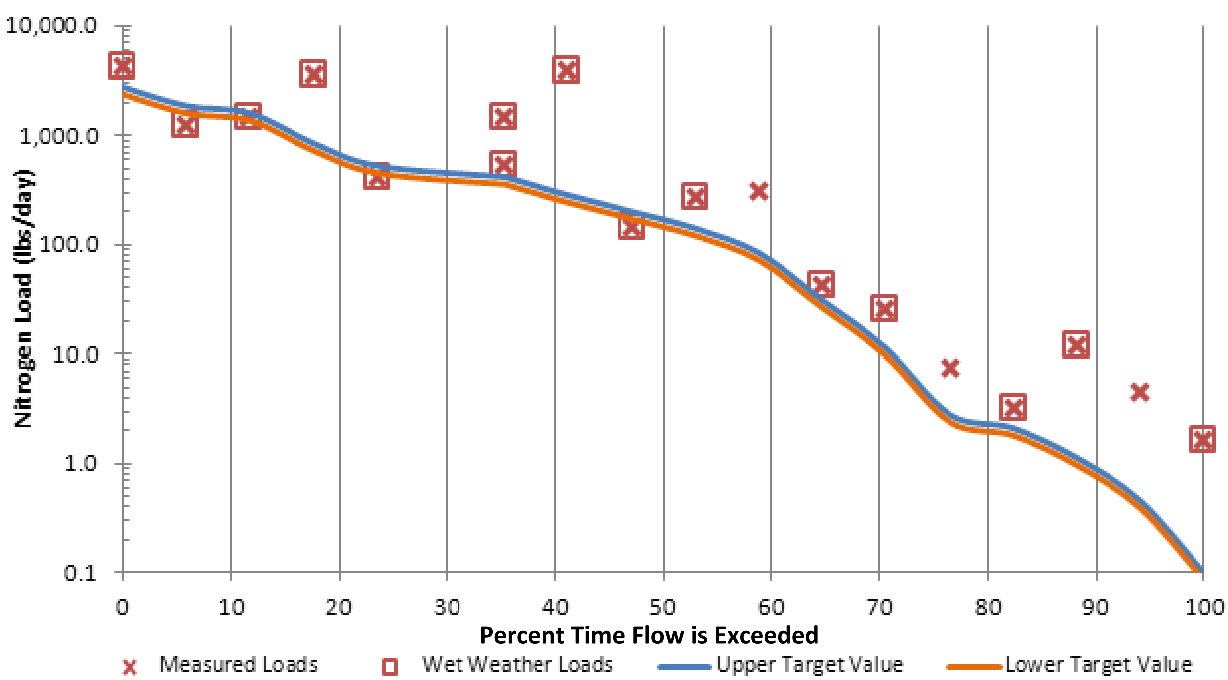


Figure 5.03-3 NC1a Total Nitrogen Load Duration Curve

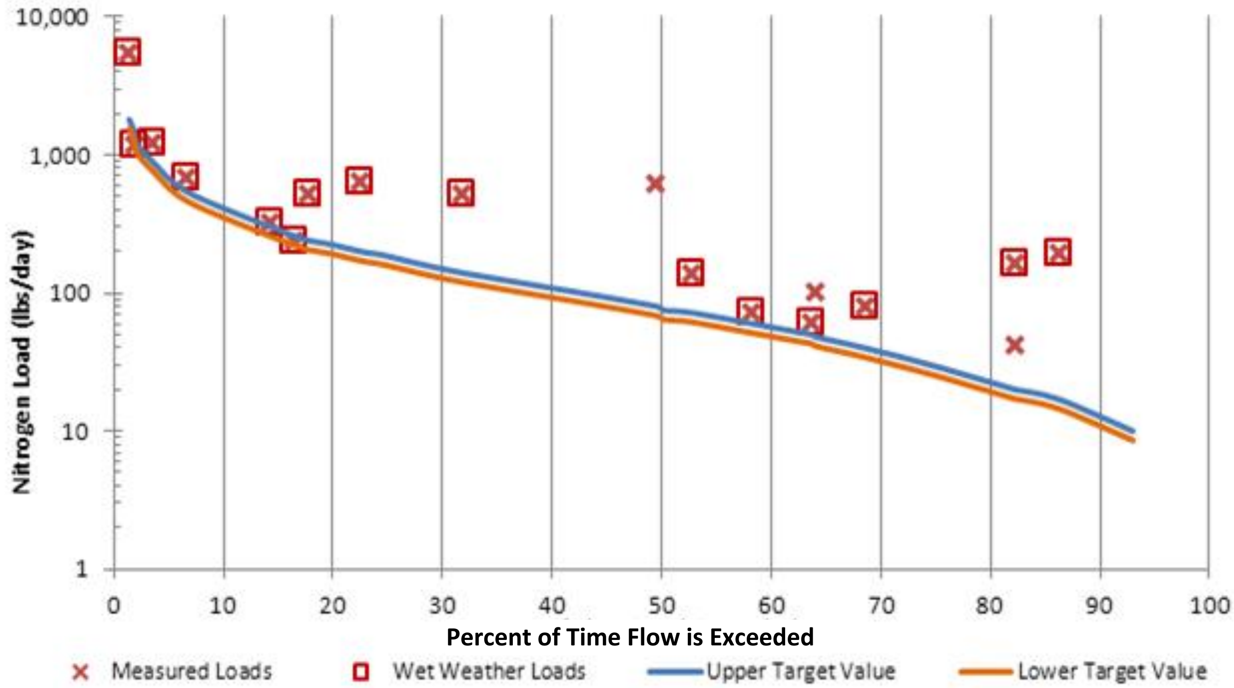


Figure 5.03-4 NC1 Total Nitrogen Load Duration Curve

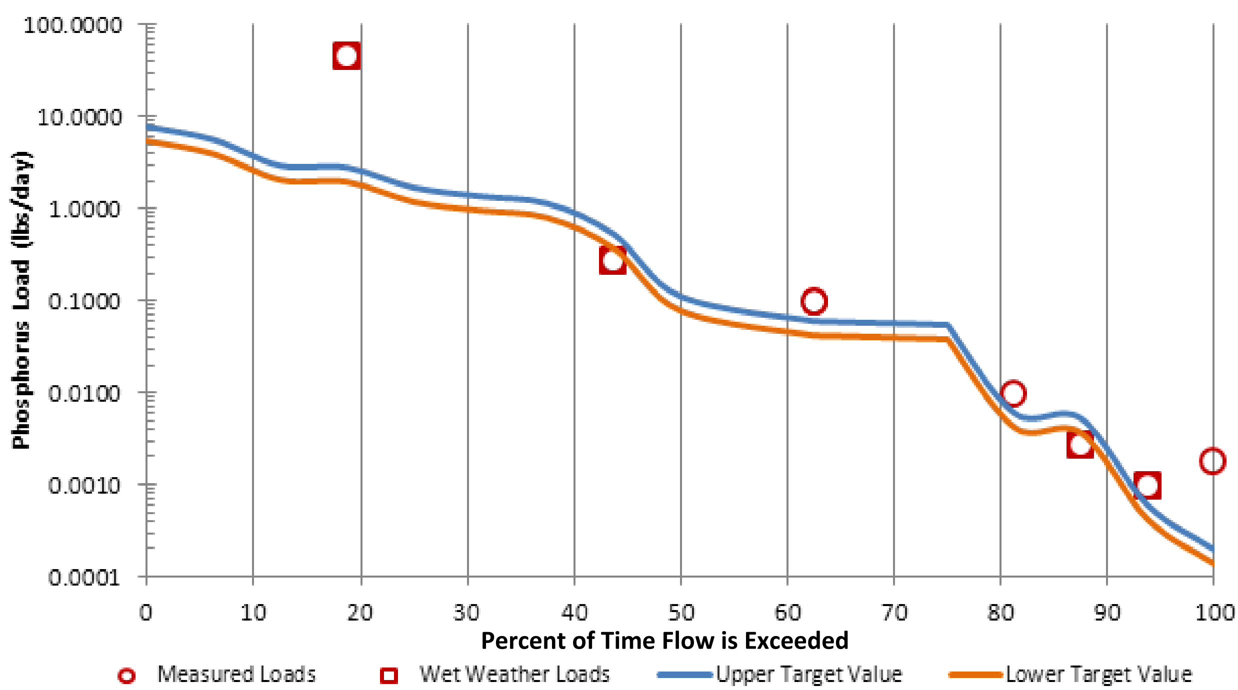


Figure 5.03-5 NC2 Phosphorus Load Duration Curve

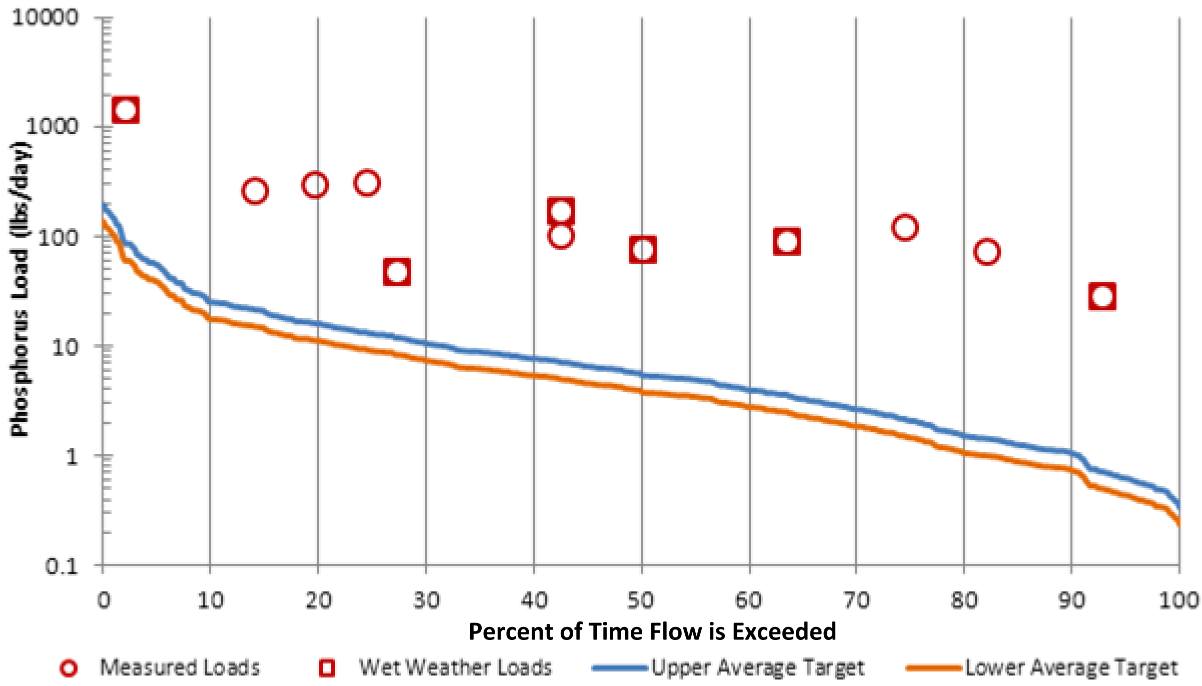


Figure 5.03-6 NC1 Phosphorus Load Duration Curve

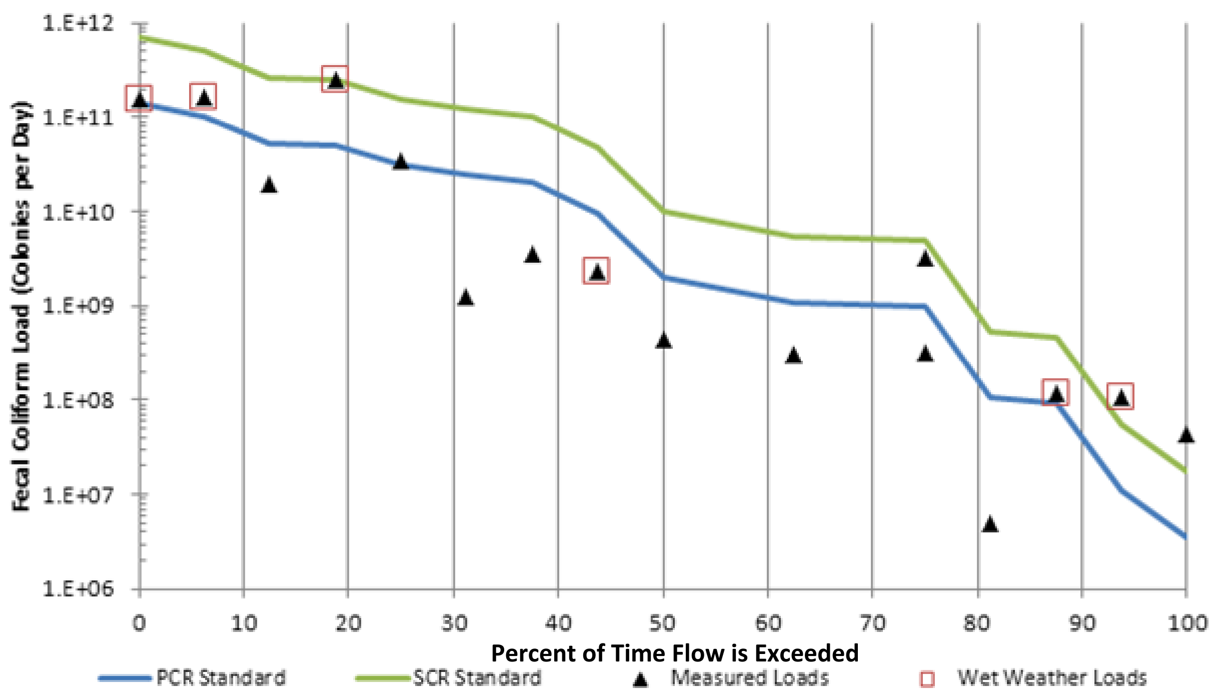


Figure 5.03-7 NC2 Fecal Coliform Load Duration Curve

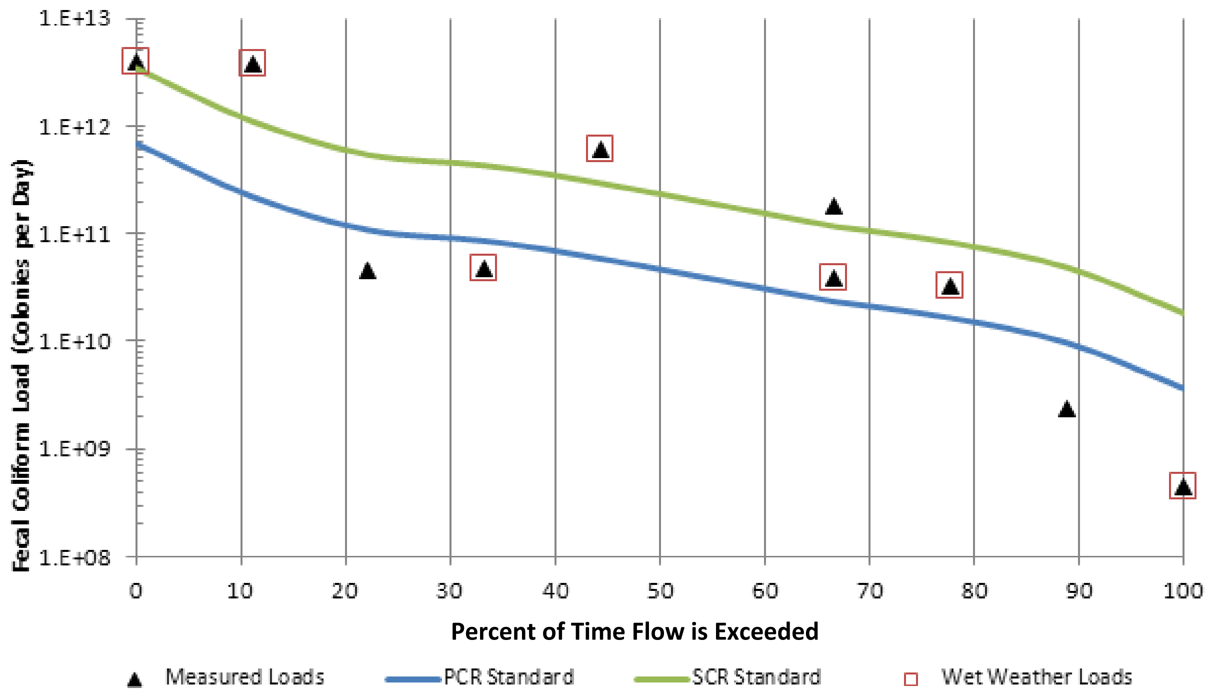


Figure 5.03-8 NC1b Fecal Coliform Load Duration Curve

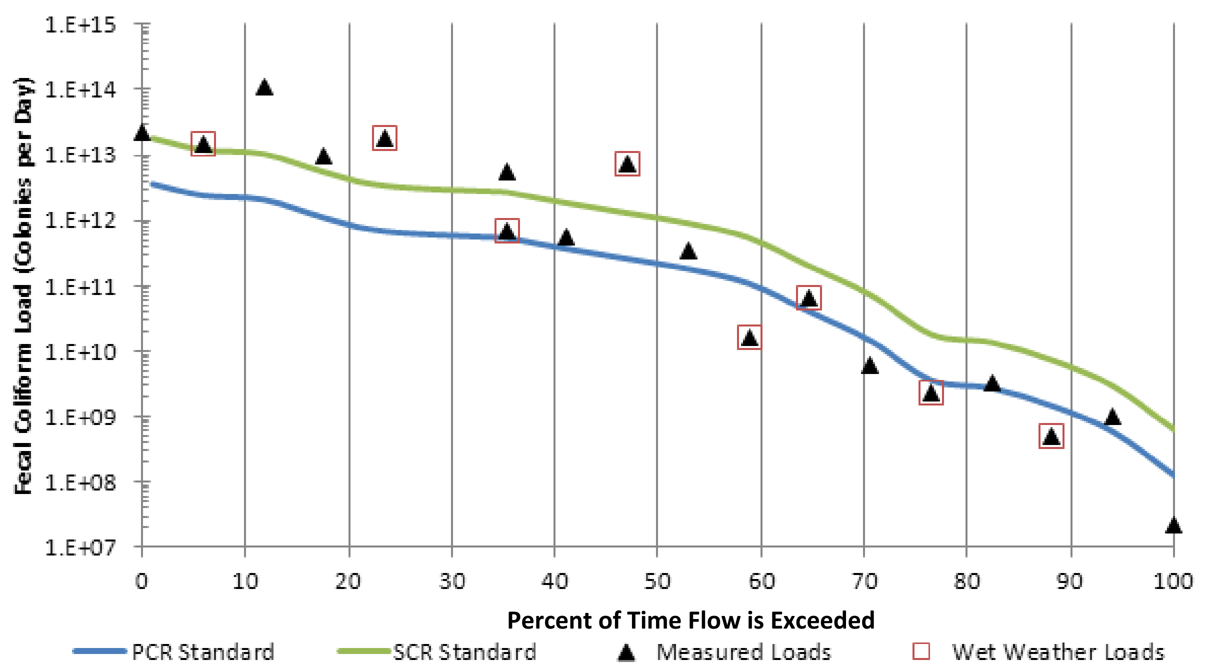


Figure 5.03-9 NC1a Fecal Coliform Load Duration Curve

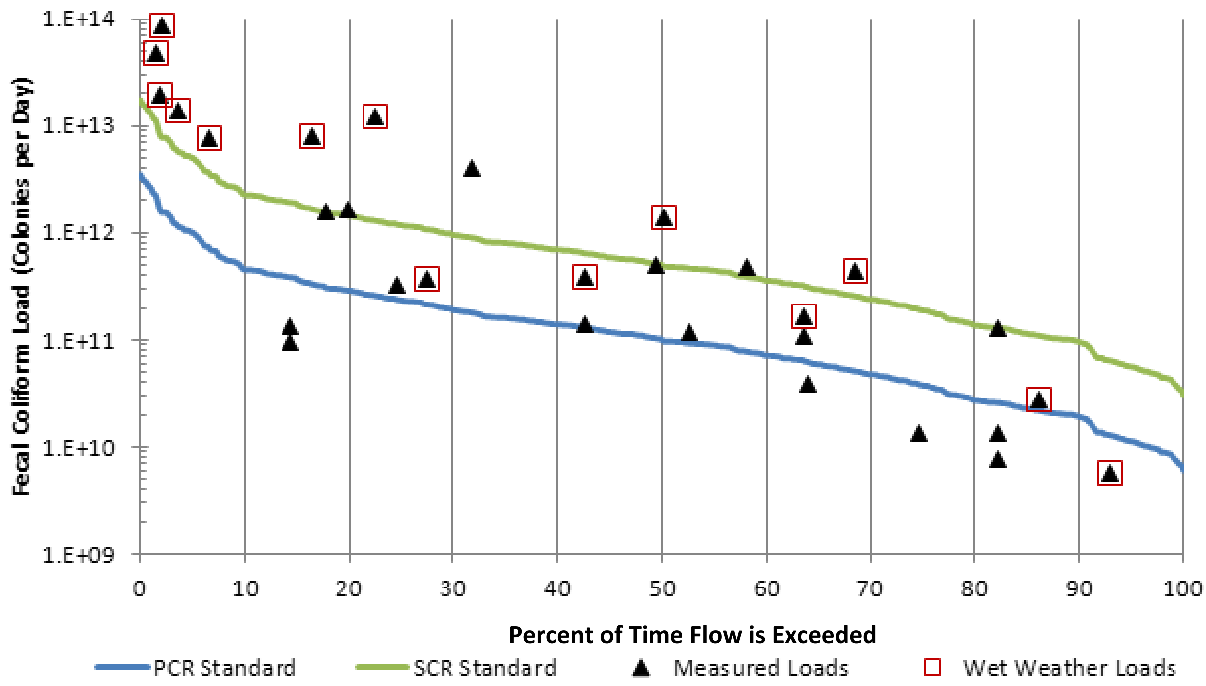


Figure 5.03-10 NC1 Fecal Coliform Load Duration Curve

B. South Curry's Fork Subwatershed

Chemical water quality sampling LDCs were developed for the following sites located in the South Curry's Fork subwatershed: SC2 and SC1. Figures 5.03-11 and 5.03-12 show the total nitrogen LDCs for sites SC2 and SC1, respectively. Figures 5.03-13 and 5.03-14 show the phosphorus LDCs for sites SC2 and SC1, respectively. Figures 5.03-15 and 5.03-16 show the fecal coliform LDCs for sites SC2 and SC1, respectively.

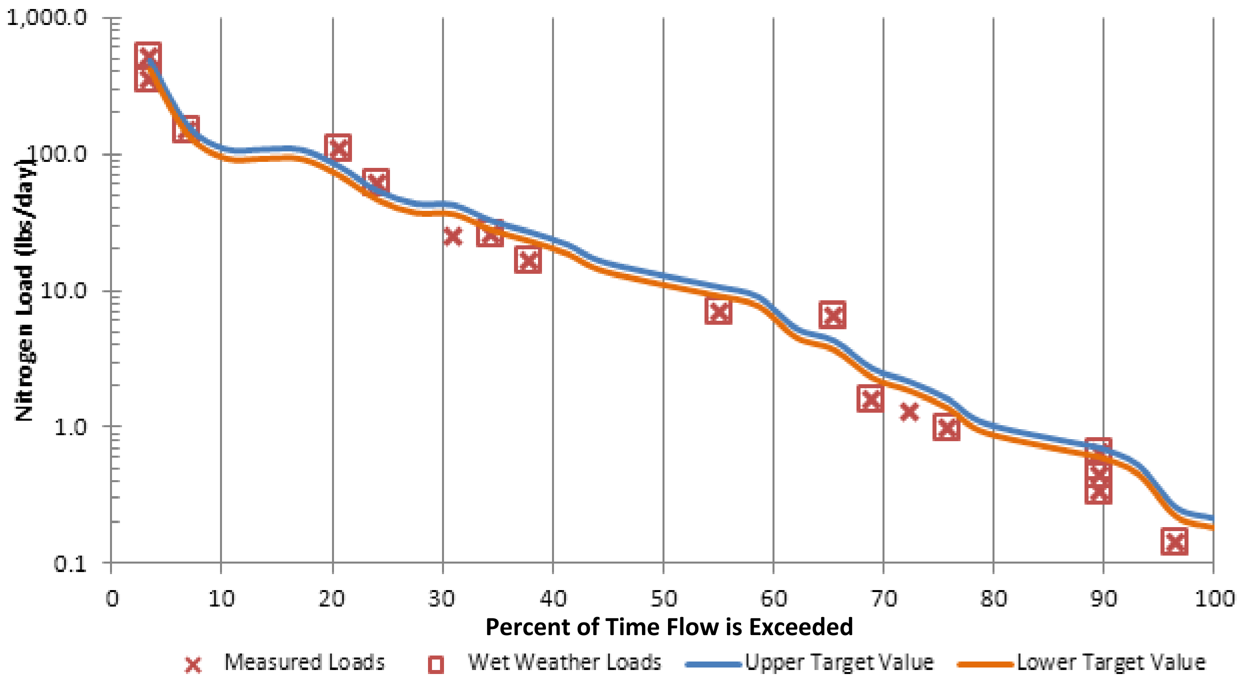


Figure 5.03-11 SC2 Total Nitrogen Load Duration Curve

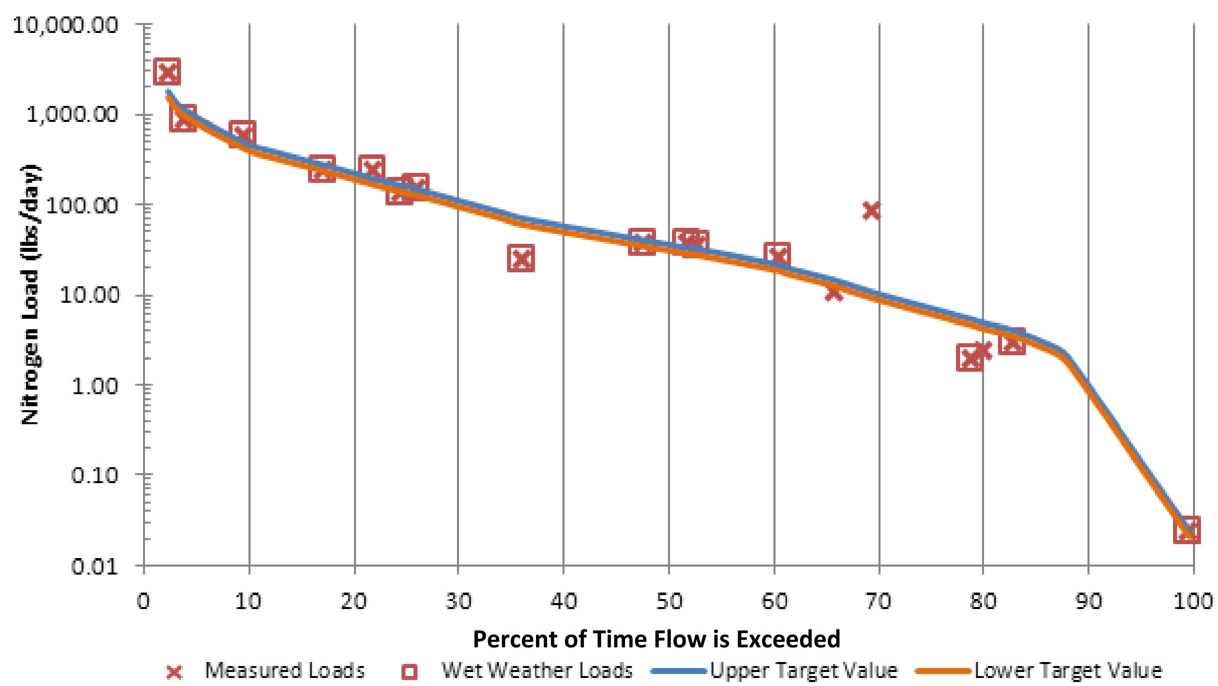


Figure 5.03-12 SC1 Total Nitrogen Load Duration Curve

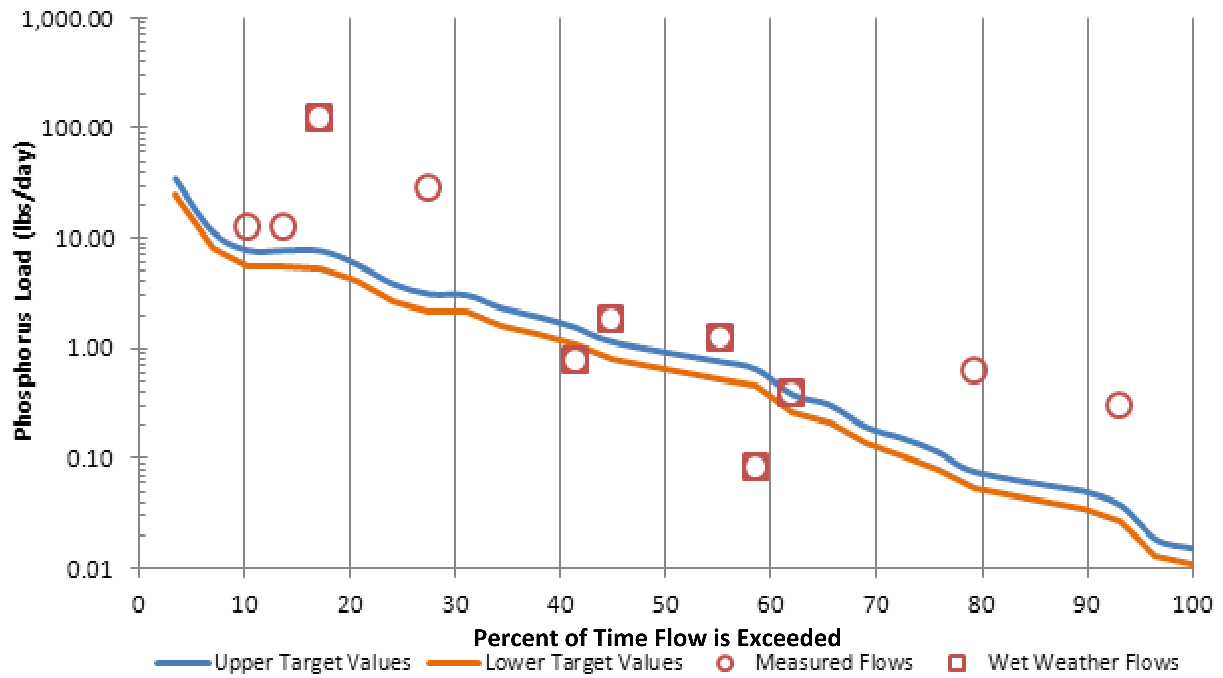


Figure 5.03-13 SC2 Phosphorus Load Duration Curve

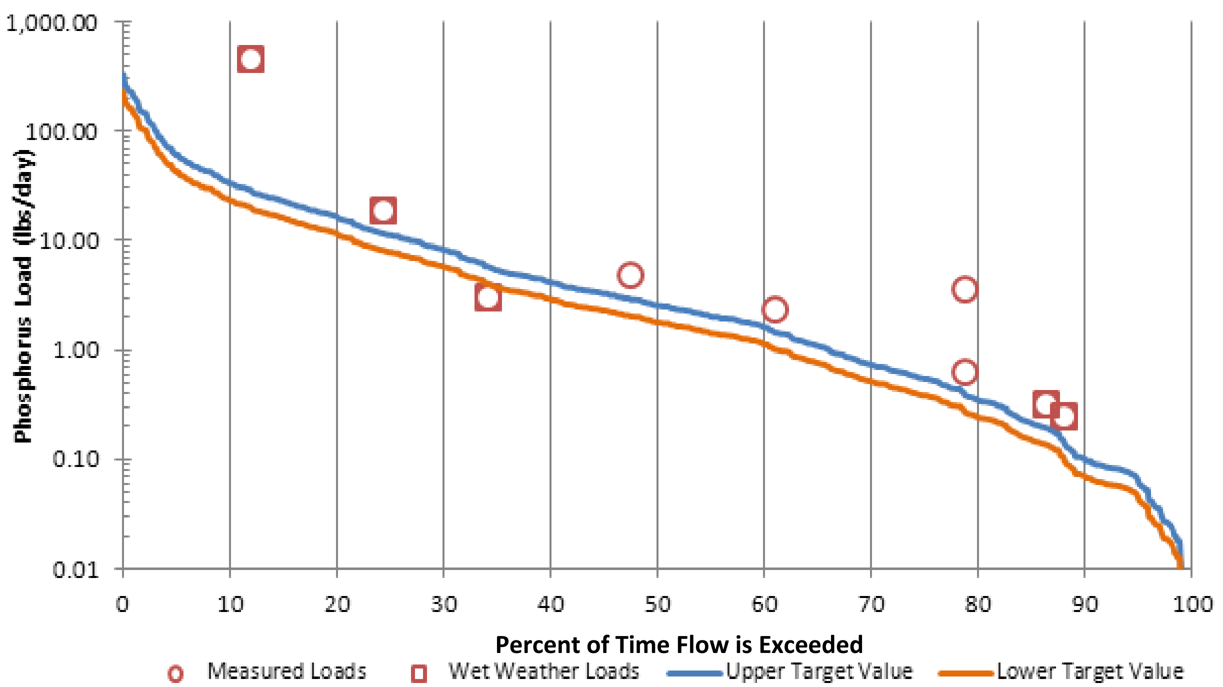


Figure 5.03-14 SC1 Phosphorus Load Duration Curve

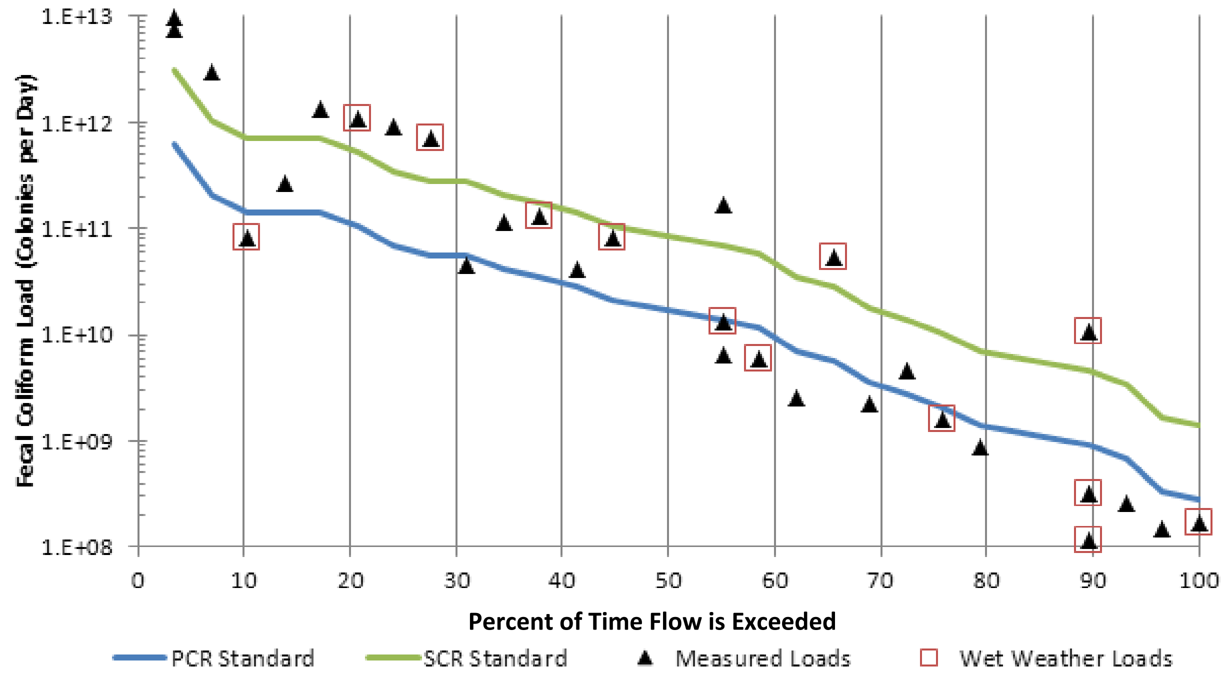


Figure 5.03-15 SC2 Fecal Coliform Load Duration Curve

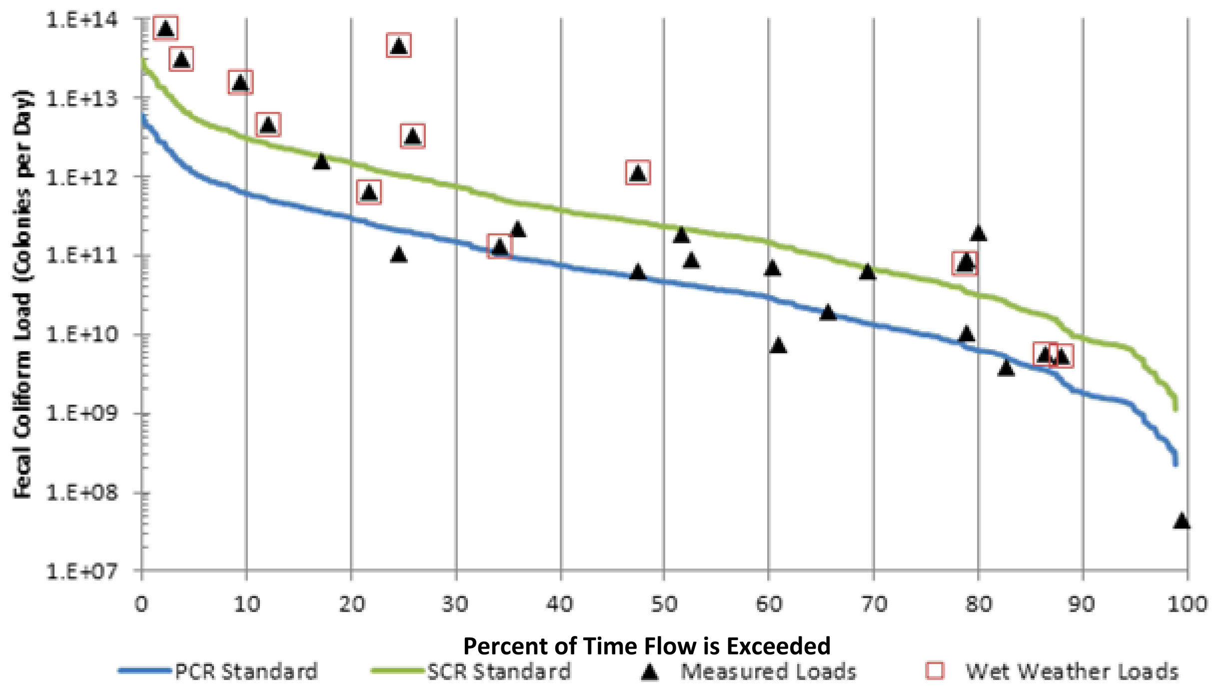


Figure 5.03-16 SC1 Fecal Coliform Load Duration Curve

C. Asher's Run Subwatershed

Chemical water quality sampling LDCs were developed for the following sites located in the Asher's Run subwatershed: AR1a and AR1. Figures 5.03-17 and 5.03-18 show the total nitrogen LDCs for sites AR1a and AR1, respectively. Figure 5.03-19 shows the phosphorus LDC for site AR1. Figures 5.03-20 and 5.03-21 show the fecal coliform LDCs for sites AR1a and AR1, respectively.

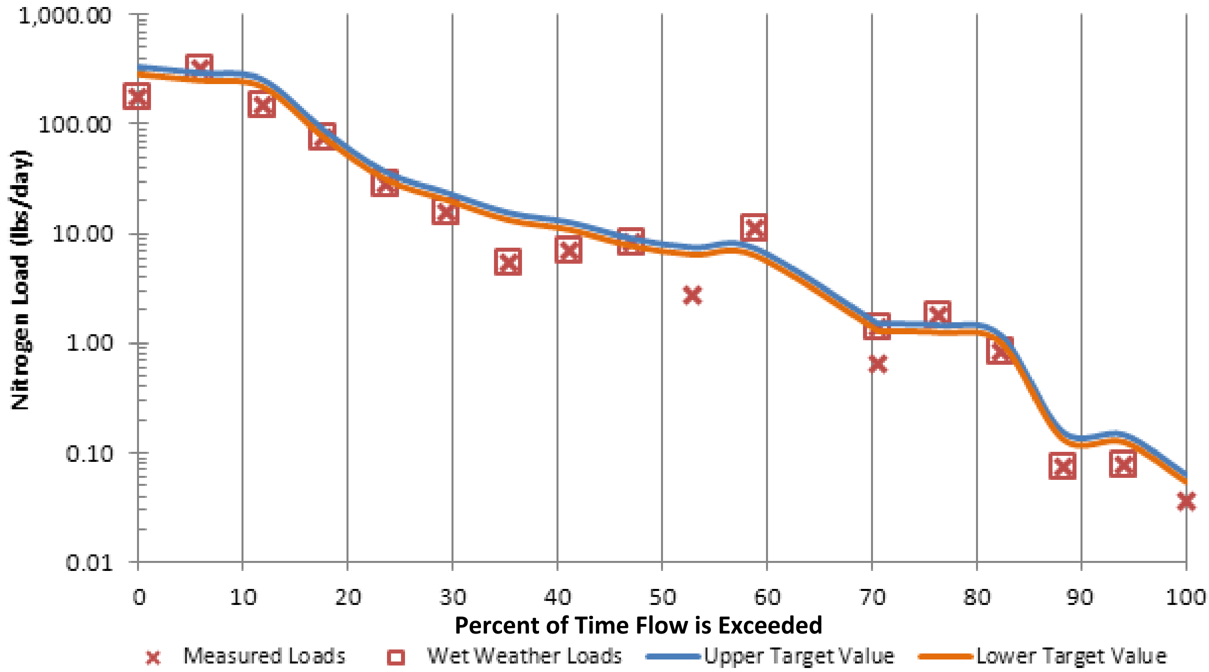


Figure 5.03-17 AR1a Total Nitrogen Load Duration Curve

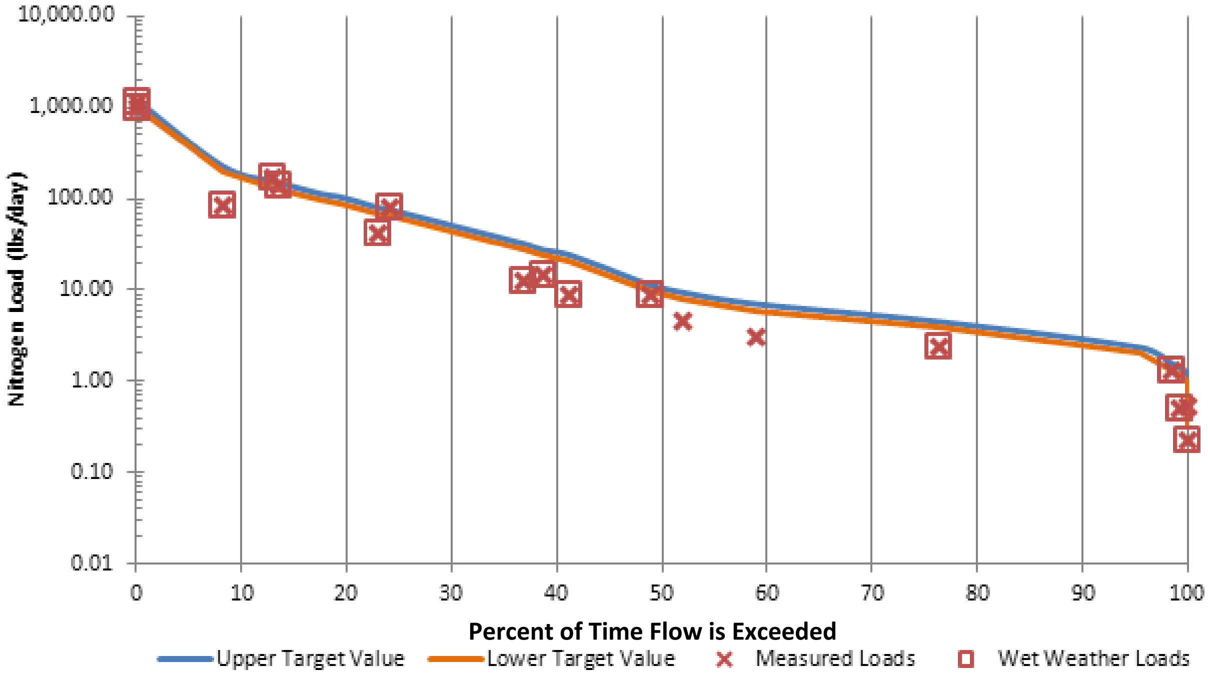


Figure 5.03-18 AR1 Total Nitrogen Load Duration Curve

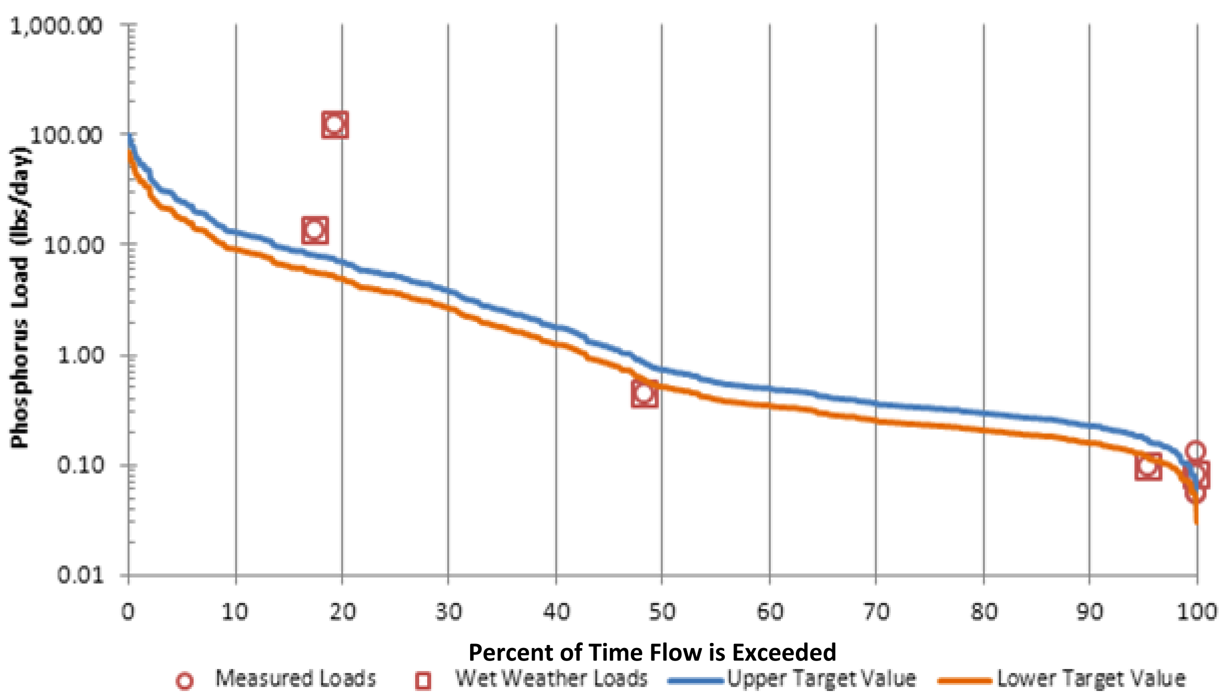


Figure 5.03-19 AR1 Phosphorus Load Duration Curve

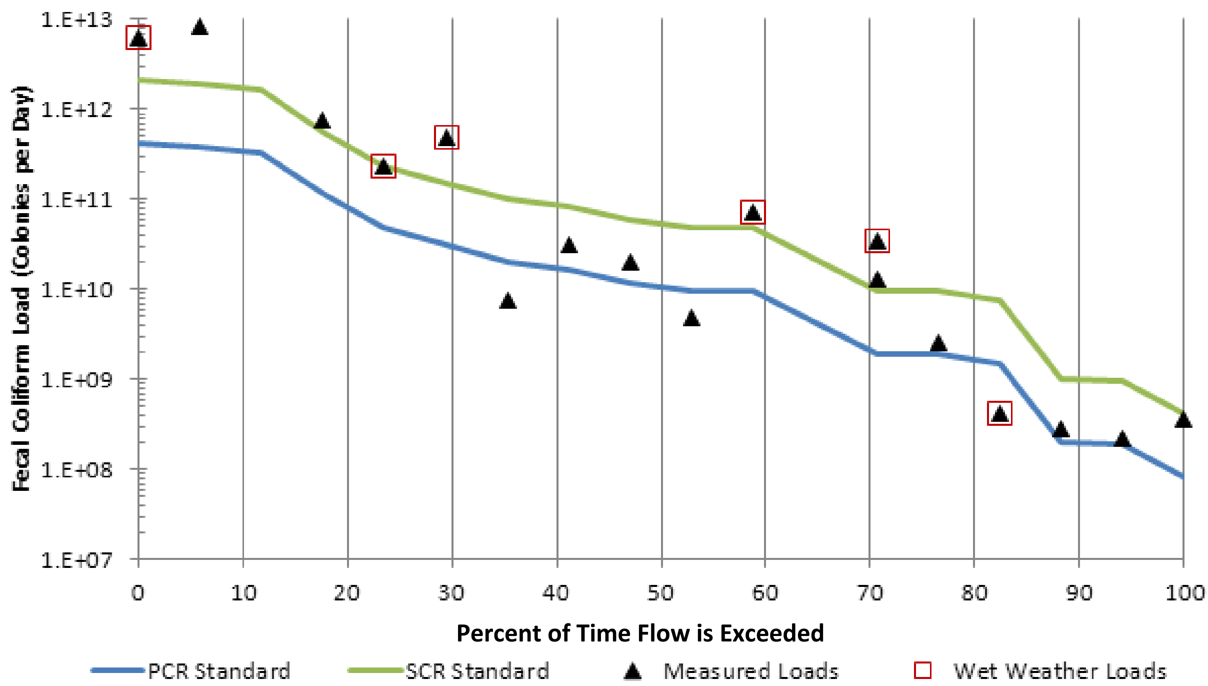


Figure 5.03-20 AR1a Fecal Coliform Load Duration Curve

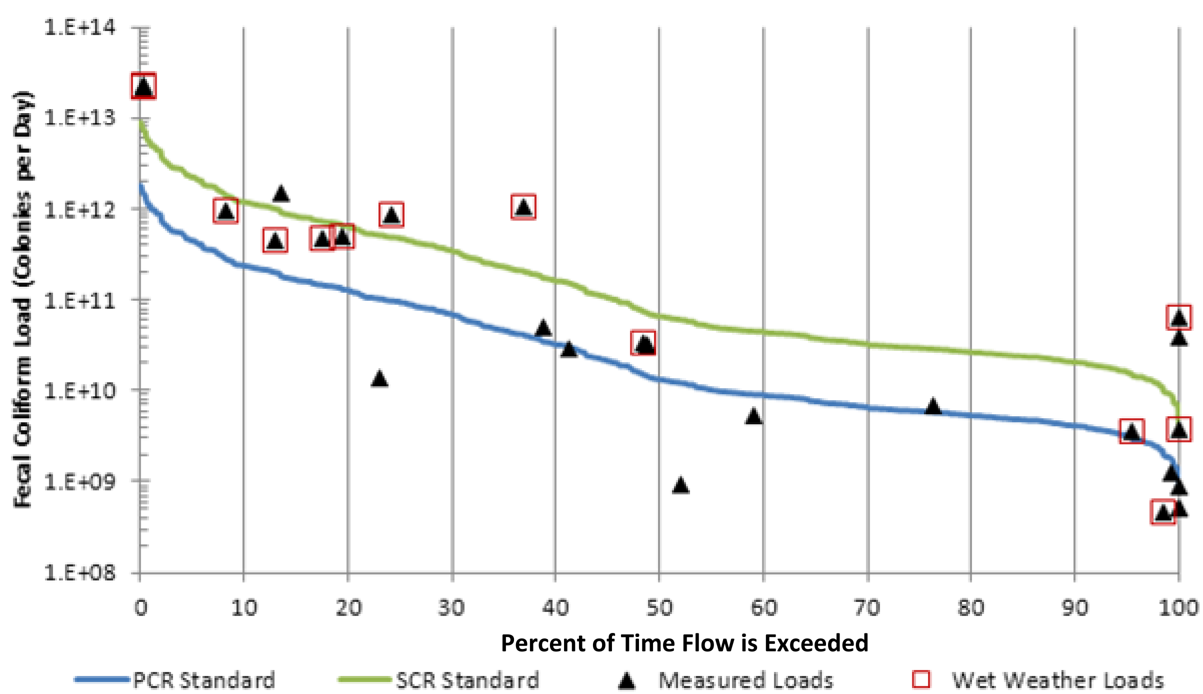


Figure 5.03-21 AR1 Fecal Coliform Load Duration Curve

D. Curry's Fork Main Stem Subwatershed

Chemical water quality sampling LDCs were developed for the following sites located in the Curry's Fork Main Stem subwatershed: CF3, CF2, and CF1. Figures 5.03-22, 5.03-23, and 5.03-24 show the total nitrogen LDCs for sites CF3, CF2, and CF1, respectively. Figures 5.03-25, 5.03-26, and 5.03-27 show the phosphorus LDCs for sites CF3, CF2 and CF1, respectively. Figures 5.03-28, 5.03-29, and 5.03-30 show the fecal coliform LDCs for sites CF3, CF2, and CF1, respectively.

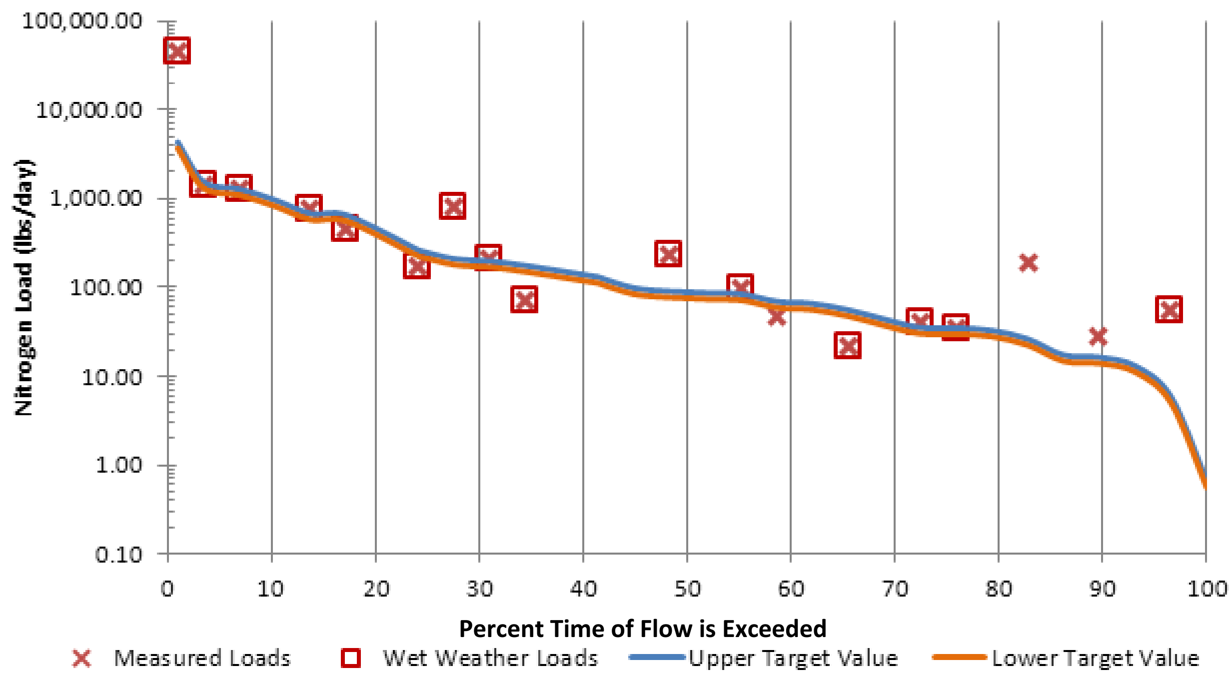


Figure 5.03-22 CF3 Total Nitrogen Load Duration Curve

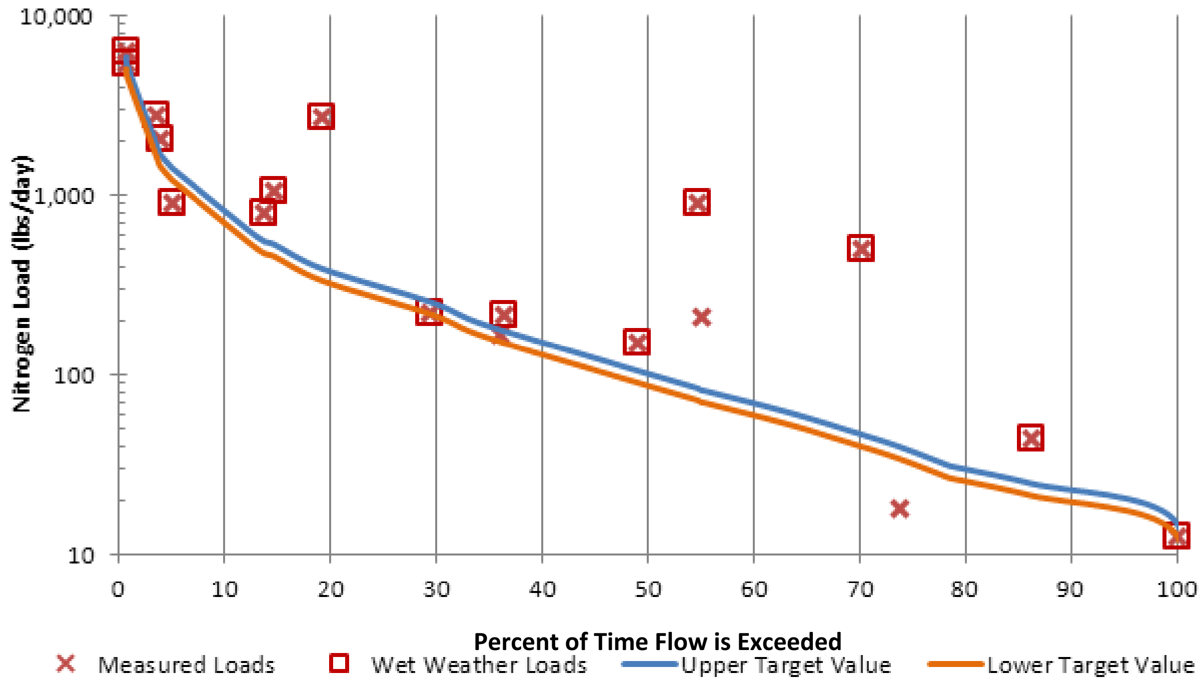


Figure 5.03-23 CF2 Total Nitrogen Load Duration Curve

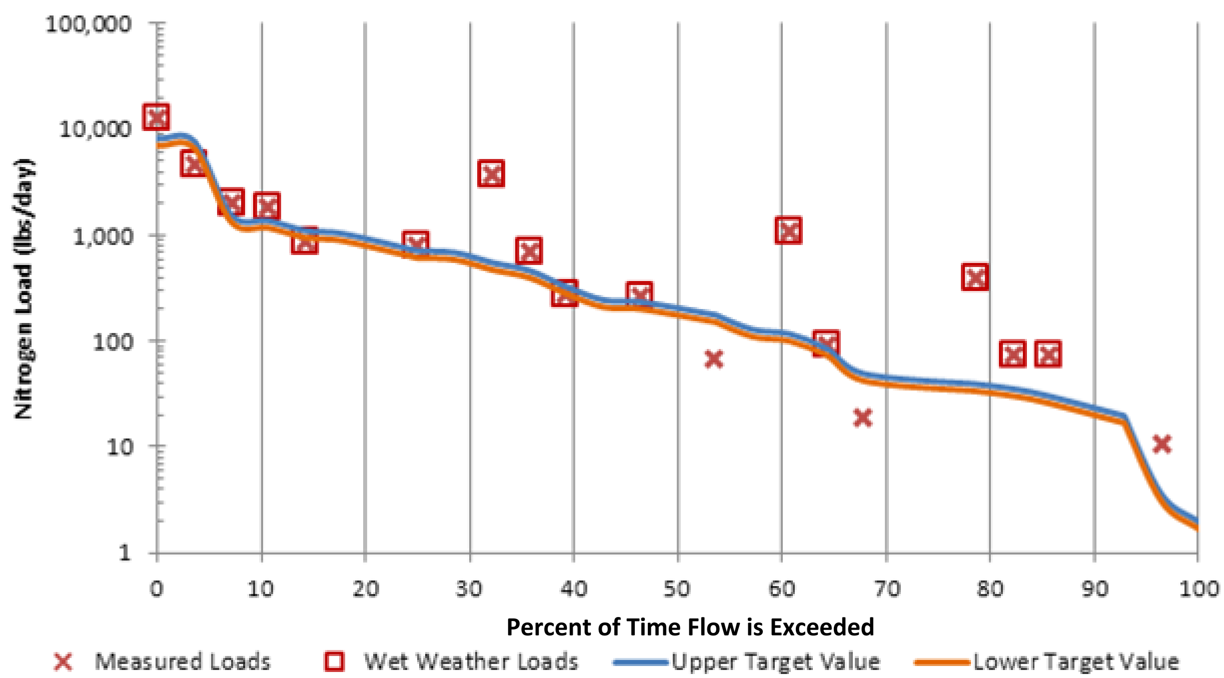


Figure 5.03-24 CF1 Total Nitrogen Load Duration Curve

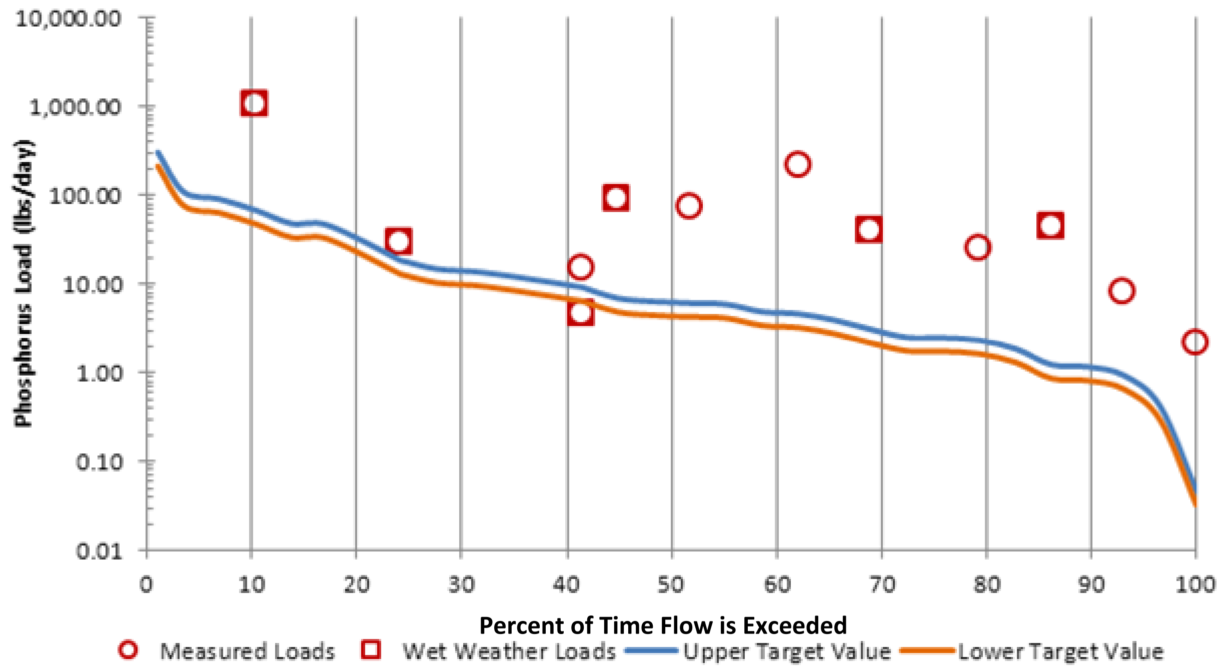


Figure 5.03-25 CF3 Phosphorus Load Duration Curve

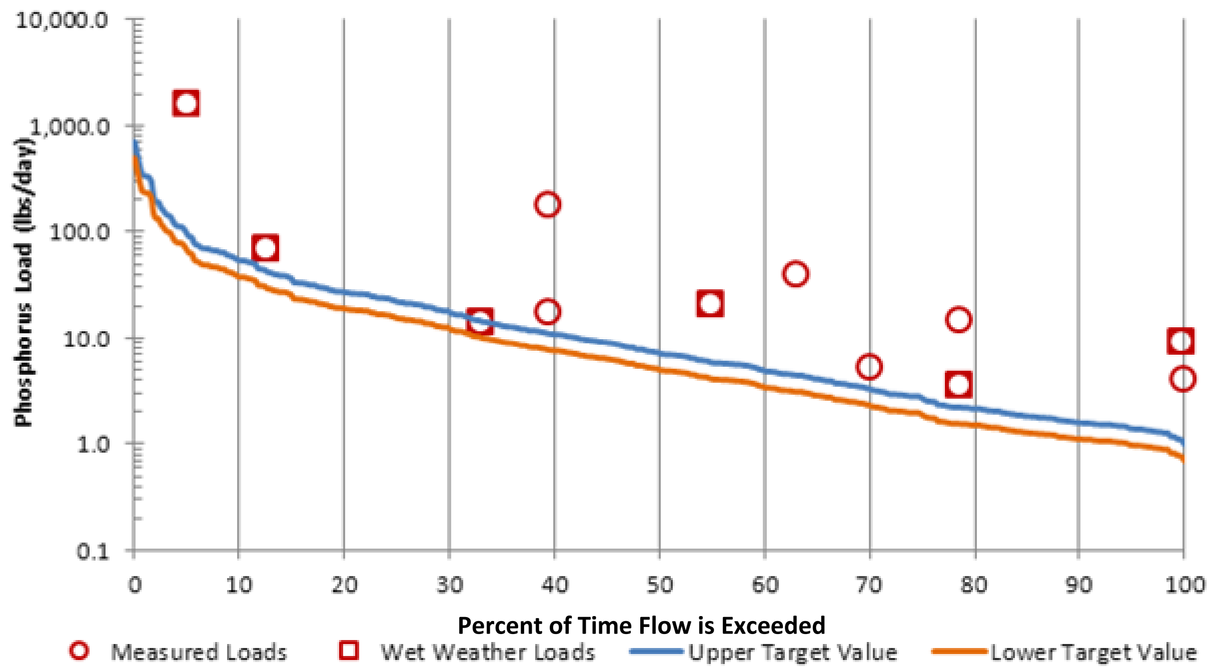


Figure 5.03-26 CF2 Phosphorus Load Duration Curve

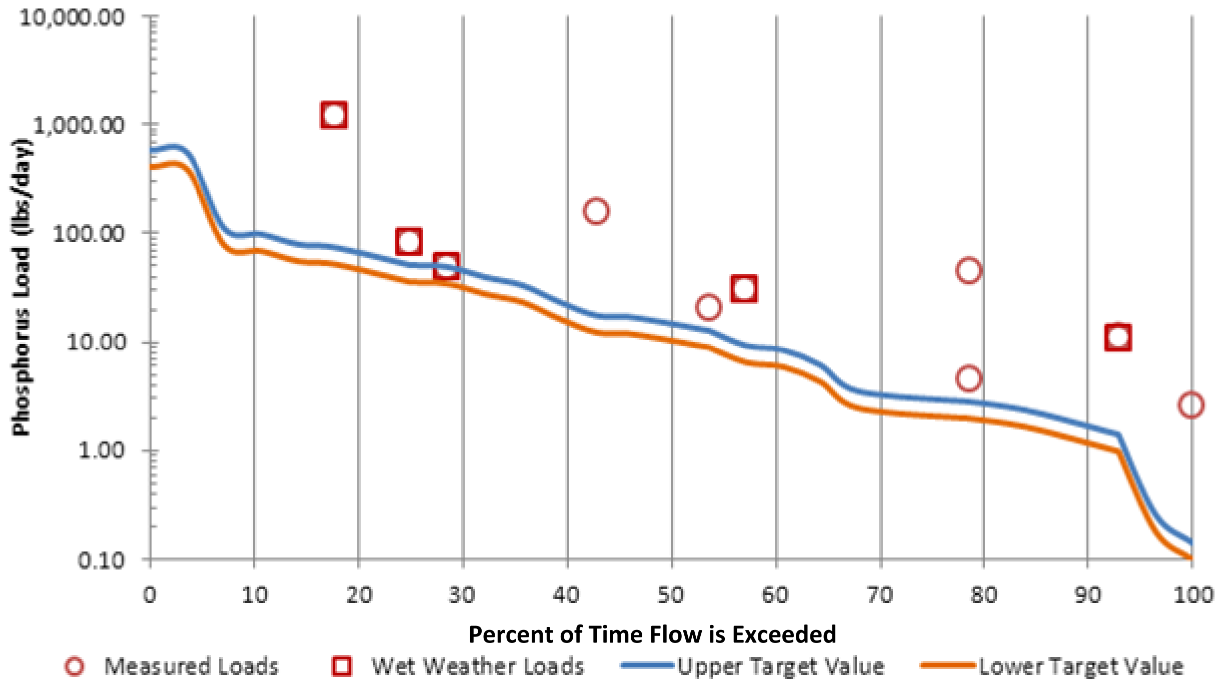


Figure 5.03-27 CF1 Phosphorus Load Duration Curve

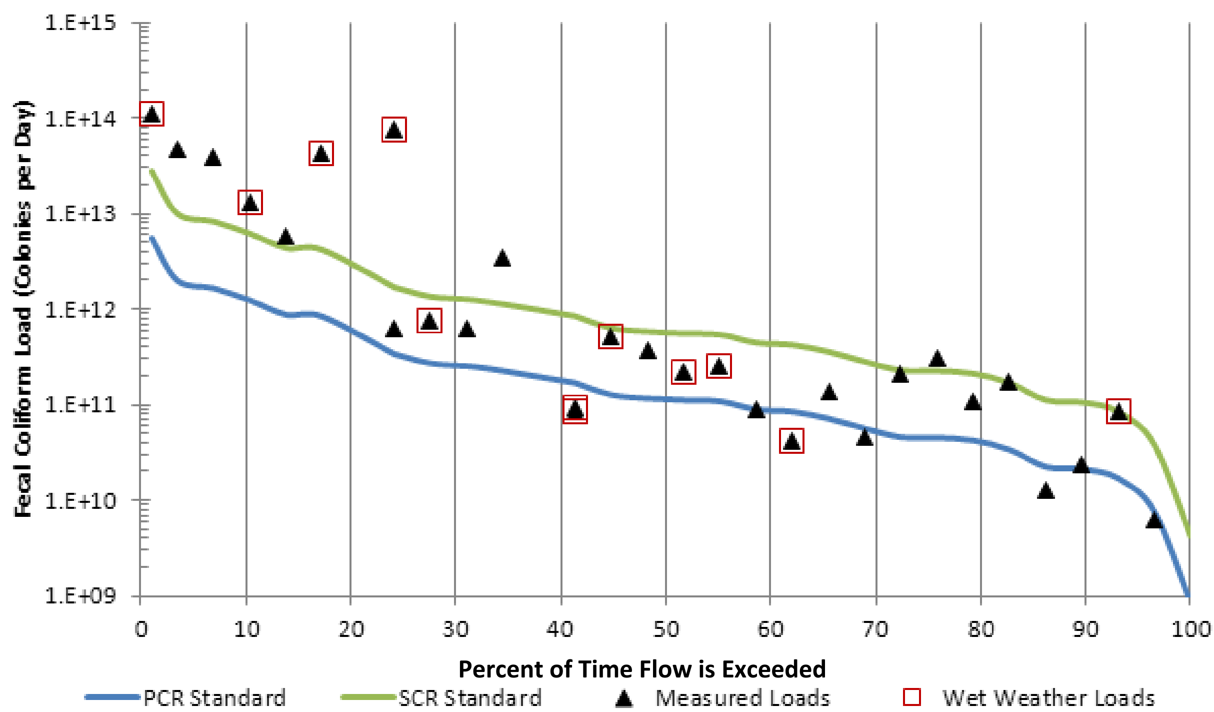


Figure 5.03-28 CF3 Fecal Coliform Load Duration Curve

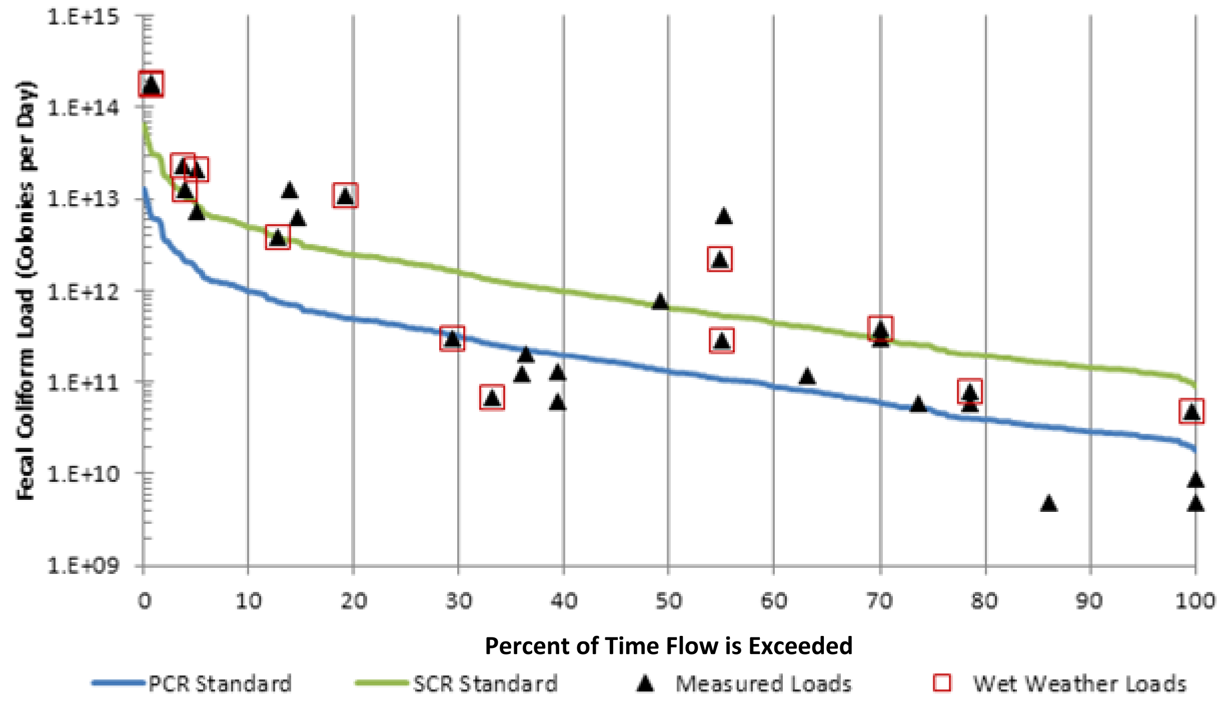


Figure 5.03-29 CF2 Fecal Coliform Load Duration Curve

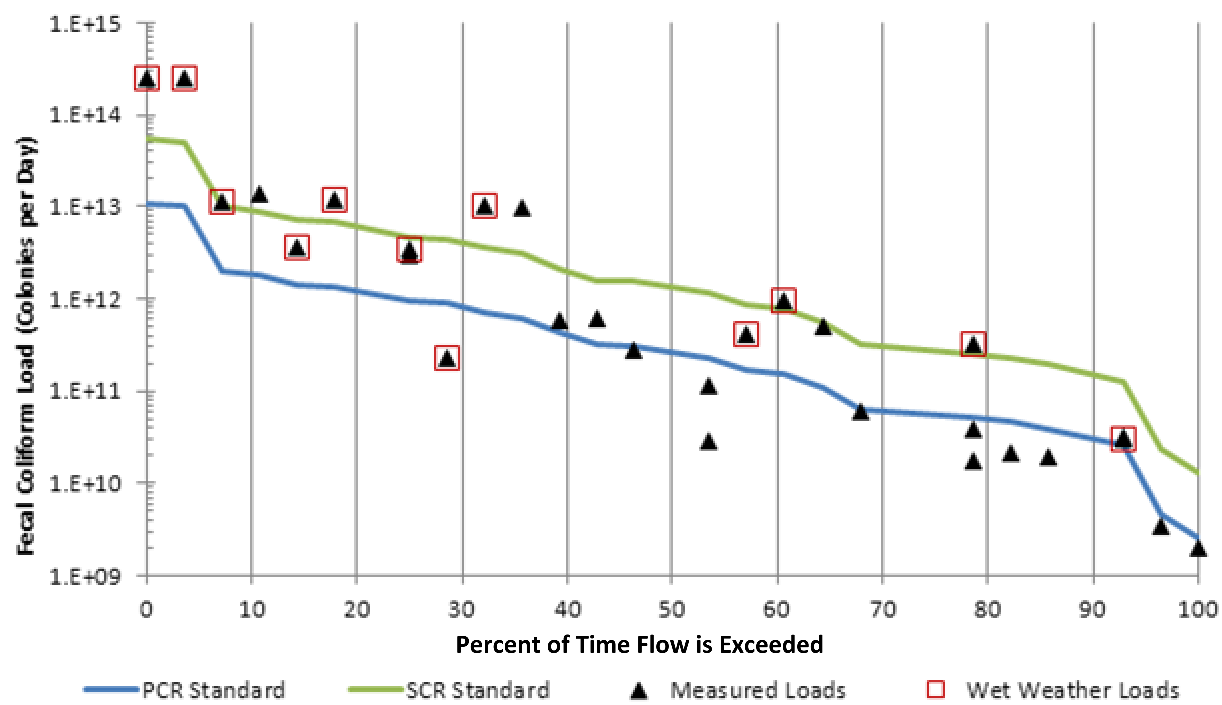


Figure 5.03-30 CF1 Fecal Coliform Load Duration Curve

APPENDIX A
CURRY'S FORK BIOLOGICAL DATA ASSESSMENT

Curry's Fork Biological Data Assessment

Curry's Fork Watershed Based Plan
Oldham County, KY

Prepared for
Strand Associates, Inc.

December 10, 2009

Prepared by
Third Rock Consultants, LLC
2526 Regency Road, Suite 180
Lexington, KY 40503
859.977.2000

Co-Authors:

Bert Remley

Tony Miller

Reviewed by:

Steve Evans

THIRD ROCK CONSULTANTS
www.thirdrockconsultants.com
Environmental Analysis & Restoration

Table of Contents

FIGURE

TABLES

EXHIBIT

APPENDIX

I. INTRODUCTION

Third Rock Consultants LLC, under contract to Strand Associates Inc. (Strand), sampled four stream reaches within the Curry's Fork watershed for aquatic macroinvertebrates, fish, and physical habitat during the summer of 2007. Sampling was conducted per the guidelines specified in the Kentucky Division of Water's *Standard Methods for Assessing Biological Integrity of Surface Waters in Kentucky* (KDOW 2002). This survey was in support of the development of a Watershed Based Plan (WBP) for the Curry's Fork watershed.

Curry's Fork is located in Oldham County, Kentucky and is part of the Salt River drainage. This area is within the Outer Bluegrass subsection of the Interior Plateau Ecoregion of the state. Sampled stream stations were identified by the Strand project team as part of the larger WBP sampling effort. These sites included North Fork of Curry's Fork (NC-1), South Fork of Curry's Fork (SC-1), Asher's Run (TB-1), and the main stem of Curry's Fork (CF-2). Exhibit 1, page 2, shows these selected sites in relation to the general project area. Per Kentucky Division of Water (KDOW) guidance, Asher Run is considered a headwater stream (<5 mi^2 watershed), and the other streams are wadeable.

Information provided in the following sections represents a thorough assessment of the collected data. The goal of the assessment was to identify potential stressors to the sampled biological communities. Multiple metrics and multivariate tests were performed to achieve these results.

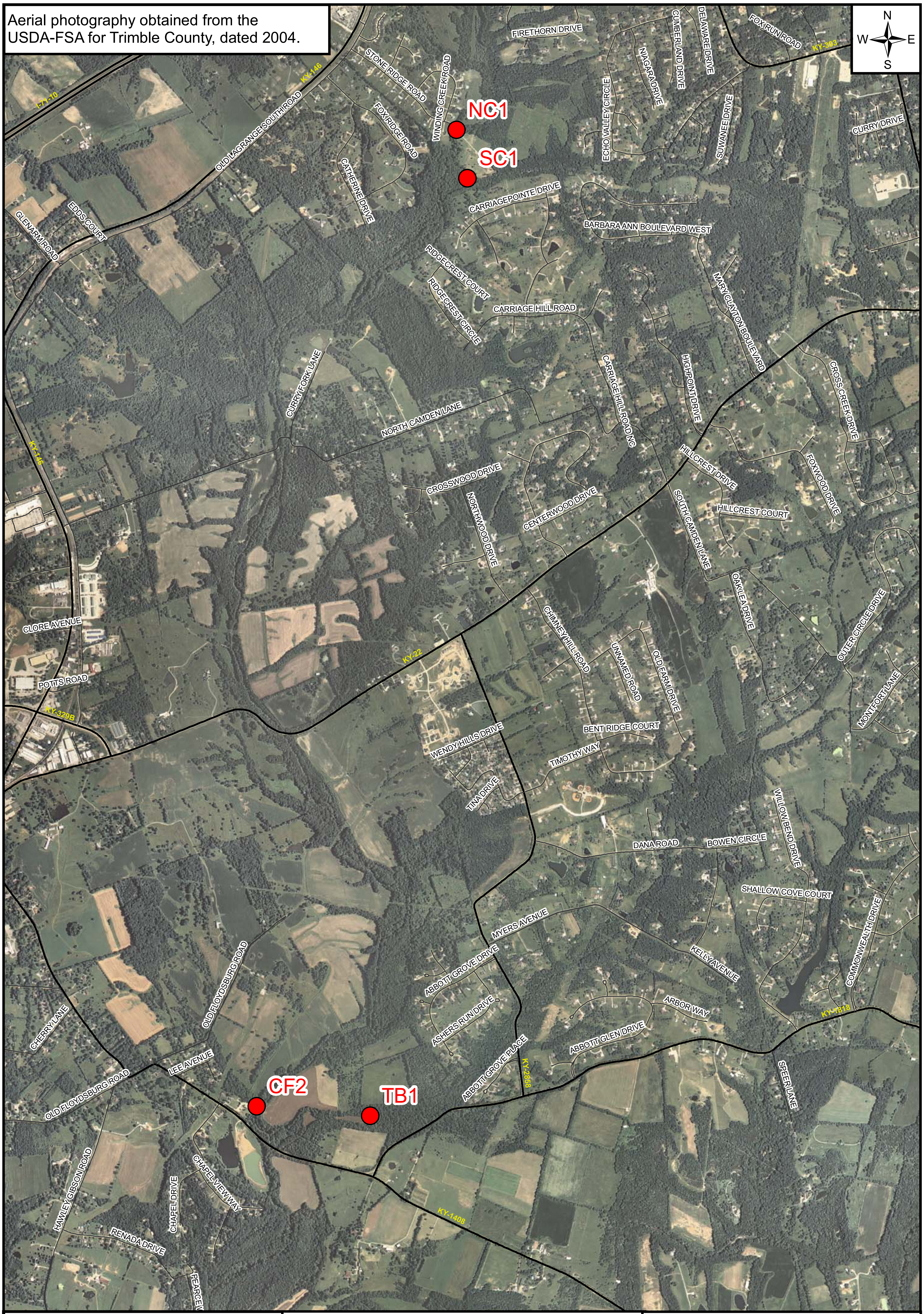
II. RESULTS

Results were evaluated using KDOW *Standard Methods for Assessing Biological Integrity of Surface Waters in Kentucky* (KDOW 2002) and supplemented with multivariate community assessment. Habitat assessment field data sheets, physiochemical results, macroinvertebrate sampling results, and fish sampling results are provided in Appendix A.

A. Metrics

1. Macroinvertebrates

Macroinvertebrate communities for each stream were evaluated through calculation of the Macroinvertebrate Biotic Index (MBI), as well as other metrics including functional feeding group abundances, and community similarity between stations. The 2008 edition of KDOW *Standard Methods for Assessing Biological Integrity of Surface Waters in Kentucky* was used for calculations as it became available after the survey. Core metric results and MBI ratings per station are included in Table 1, page 3. Regarding MBI score interpretations, Curry's Fork (CF-2) had the only "Good" rating, while NC-1 and SC-1 had "Fair" ratings, and TB-1 had a "Poor" rating.



1,600 800 0 1,600 Feet	Exhibit 1 Sampling Site Locations Biological Assessment of the Curry's Fork Watershed Oldham County, Kentucky	THIRDROCK CONSULTANTS

TABLE 1 – MACROINVERTEBRATE CORE METRIC RESULTS AND MBI RATINGS FOR CURRY'S FORK WATERSHED, 2007

Station	Taxa Richness (+)	EPT Richness (+)	MHBI (-)	%EPT (+)	% Mayflies (+)	% Midges + Worms (-)	% Clingers (+)	MBI Score (+)	MBI Rating
CF-2	41	11	5.44	20.4	5.3	3.9	86.6	63.9	Good
NC-1	29	6	6.11	28.4	7.2	13.1	73.1	56.9	Fair
SC-1	38	8	6.08	7.9	3.6	39.6	44.2	44.4	Fair
TB-1	27	3	5.99	7	6.7	13.5	42.2	37.8	Poor

Note: (+) or (-) indicates if metric will increase (+) or decrease (-) with improving water quality.

Taxa richness and mayfly-stonefly-caddisfly (EPT) richness are known to increase with improving water quality and with habitat diversity/suitability. Curry's Fork (CF-2) and South Fork of Curry's Fork (SC-1) had the largest taxa richness scores (41 and 38, respectively), and EPT richness scores (11 and 8, respectively) of all stations sampled. Physical stream integrity was found to correlate with these results as embeddedness was low, riffles were frequent, banks were stable, and riparian vegetation protection was good with these two stations. The physical characteristics for CF-2 and SC-1 could contribute to increased richness scores due to the availability of different habitat niches. Conversely, potential reasons for the slight community impairments at each station could be a result of the low scores for epifaunal substrate/available cover due to the ubiquitous bedrock-dominated substrate. At TB-1 and NC-1 the non-supportive total habitat scores, 113 and 104 respectively, are closely associated with the low taxa and EPT richness.

Another metric indicative of a specific pollutant is the Modified Hilsenhoff biotic index (mHBI). This metric's score ranges from 0-10 and is an indicator of organic pollution - the index score decreases with improving water quality. There was very little variation among stations for mHBI ranging from 5.44 (CF-2) to 6.11 (NC-1). Since these results are in the mid range of the mHBI (0-10) it would be difficult to determine if organic pollution is having a negative effect on the macroinvertebrate community or not.

Modified EPT abundance, which excludes the ubiquitous caddisfly *Cheumatopsyche*, ranged from 7 percent (TB-1) to 28.4 percent (NC-1). EPT are a relatively pollution sensitive group that will increase with improving water quality and habitat conditions. CF-2 and NC-1 had higher EPT abundances than the other stations with 20.4 and 28.4 percent, respectively. While NC-1 had a higher EPT abundance score, most of the EPT individuals were fairly common or tolerant species (*i.e., Baetis intercalaris*, *Hydropsyche betteni*, and *Hydroptila* sp.). Many physical habitat parameters (i.e. frequency of riffles, bank stability, vegetative protection) scored within the marginal or poor categories for NC-1. Therefore the EPT abundance score for NC-1 maybe a result of the presence of common EPT species rather than improved habitat availability. The relative abundance of mayflies indicates the impacts of metals and high conductivity on the macroinvertebrate community. The abundance of mayflies was low for all stations ranging from 3.6 percent (SC-1) to 7.2 percent (NC-1). Specific conductance levels, which can indicate metal contamination or other forms of water pollution, were similar amongst all stations ranging from 402 µS (TB-1) to 485 µS (SC-1).

Midges (Chironomidae) and aquatic worms (Oligochaeta) are generally pollution tolerant organisms and their abundance should increase with decreasing water quality conditions. Midges and worms were not abundant at CF-2 (3.9 percent), NC-1 (13.1 percent), and TB-1 (13.5 percent). However, midges and worms were fairly abundant at SC-1 comprising 39.6 percent of the community.

Clingers are organisms that require hard, silt free substrates to "cling" to. A decline in clingers could indicate sedimentation of substrates, or unstable substrates. Percent clingers at CF-2 and NC-1 were fairly high comprising 86.6 percent and 73.1 percent, respectively. Embeddedness does not appear to be a problem for the macroinvertebrate communities of CF-2 and NC-1 as indicated by the relative abundance of clingers and optimal habitat scores for embeddedness for both streams.

While embeddedness habitat scores for SC-1 and TB-1 were in the sub-optimal range, sediment deposition scores were in the marginal range. This, and lower clinger abundances (44.2 and 42.2 percent, respectively), could indicate unstable substrates.

Highly redundant macroinvertebrate communities, dominated by a few taxa, may reflect a degraded condition. The percent contribution of the five most dominant taxa for all four stations was high ranging from 66.7 percent (NC-1) to 80.1 percent (CF-2), indicating highly redundant community for all stations. Communities with a good biotic condition should have a high proportion of EPT taxa compared to chironomidae taxa. The EPT/Chironomidae ratio was low for NC-1 (4.1 percent), SC-1 (0.5 percent), and TB-1 (0.6 percent). However, CF-2 had a much higher EPT/Chironomidae ratio with 18.4 percent.

The Jaccard Coefficient of Community Similarity and Percent Community Similarity were utilized to assess the community similarities between stations. Jaccard Coefficient of Community Similarity measures the degree of taxonomic similarity based on taxon presence or absence with values ranging from 0 to 1.0, while Percent Community Similarity uses relative abundance of similar taxa ranging from 0 to 100 percent. Table 2 shows the Jaccard Coefficient of Community Similarity between the stations, and Table 3 shows the Percent Community Similarity between the stations.

TABLE 2 – JACCARD COEFFICIENT OF COMMUNITY SIMILARITY BETWEEN STATIONS, CURRY'S FORK WATERSHED, 2007

Station*	CF-2	NC-1	SC-1	TB-1
CF-2	N/A	0.42	0.37	0.34
NC-1	0.42	N/A	0.5	0.35
SC-1	0.37	0.5	N/A	0.4
TB-1	0.34	0.35	0.4	N/A

** (0-not similar to 1.0 – most similar)*

TABLE 3 – PERCENT COMMUNITY SIMILARITY BETWEEN STATIONS, CURRY'S FORK WATERSHED, 2007

Station*	CF-2	NC-1	SC-1	TB-1
CF-2	N/A	54	31	7
NC-1	54	N/A	50	30
SC-1	31	50	N/A	40
TB-1	7	30	40	N/A

** (0%-not similar to 100% – most similar)*

According to the Jaccard Coefficient of Community Similarity stations NC-1 and SC-1 were the most similar (0.5 coefficient value) and stations CF-2 and TB-S1 were the most dissimilar (0.34 coefficient value). Percent Community Similarity was the greatest between stations CF-2 and NC-1 (54 percent), and the least between stations CF-2 and TB-1.

Functional feeding group information can provide insight into the balance of feeding strategies and trophic dynamics within the benthic community (Barbour *et al*., 1999). Functional feeding group designations, based on Merritt and Cummins (2008), include predators, shredders, collector-gatherers, collector-filterers, piercers, and scrapers. If food dynamics (and/or physical habitat) are not stable within a stream, an imbalance in functional feeding groups may occur, indicating a stressed community. In a healthy stream, specialized feeders (*i.e.,* scrappers, shredders, piercers) should be well represented. However, generalist organisms, that have a much broader range of acceptable food materials (i.e. collector-gathers, collector-filterers), should be more tolerant to changes in the availability of food materials caused by pollution. Therefore, generalist taxa should be more dominant in impaired streams. Functional feeding group information for each station is provided in Table 4.

TABLE 4 – PERCENT FUNCTIONAL FEEDING GROUP PER STATION, CURRY'S FORK WATERSHED, 2007

Functional Feeding Group*	Station (% Functional Feeding Group)			
	CF2	NC1	SC1	TB1
Predator	4.9	13.4	4.1	1.3
Collector-Gatherer	9.8	16.4	34.1	35.4
Shredder	2.5	0.7	0.2	0.0
Scraper	21.1	25.8	28.6	55.4
Collector-Filterer	61.7	43.7	32.9	7.8

** No piercers were collected in samples.*

Collector-filterers are the dominant functional feeding group of CF-2 (61.7 percent) and NC-1 (43.7 percent), and make up a large proportion of SC-1 (32.9 percent). However, they are relatively uncommon for TB-1 (7.8 percent). Filter feeders are sensitive to low flow conditions, which may occur at TB-1 since it is a headwater stream. Generalists (*i.e.,* collector filterers, collector-gatherers) were more dominant than specialists (*i.e.,* scrapers, shredders) at all stations except

TB-1 in which scrapers were dominant (55.4 percent). Scrapers were also common at all other stations comprising 21.1 percent (CF-2) to 28.6 percent (SC-1) of the community. Scrapers feed on attached algae on substrates, therefore the presence of scrapers indicates the occurrence of attached algae at all stations. Shredders, which feed on living or decomposing vascular plant material, are almost entirely absent from all streams comprising 0 percent (TB-1) to 2.5 percent (CF-2) of the community.

2. Fish

Fish communities for each stream were evaluated through calculation of the Index of Biotic Integrity (IBI), as well as community similarity between stations. Core metric results and IBI ratings per station are included in Table 5. SC-1 had a "Fair" rating, Curry's Fork (CF-2) had a "Poor" IBI rating, while NC-1 and TB-1 both had "Very Poor" ratings. TB-1 had no fish, and NC-1 had very low numbers of individuals (30 individuals), which required metrics values to be set a zero, which resulted in "Very Poor" ratings.

TABLE 5 – FISH CORE METRIC RESULTS AND IBI RATINGS, CURRY'S FORK WATERSHED, 2007

Station	Native Species Richness (+)	Darter, Madtom, Sculpin Richness (+)	% Facultative Headwater Individuals (-)	% Tolerant Individuals (-)	Intolerant Species Richness (+)	% Insectivore Individuals (+)	Simple Lithophile Richness (+)	IBI Score (+)	IBI Rating
CF-2	11	2	85	70	0	29	2	28	Poor
NC-1*	0 (5)	0 (3)	0 (77)	0 (50)	0 (0)	0 (50)	0 (2)	0 (24)	Very Poor (Poor)
SC-1	8	2	81	86	0	14	1	32	Fair
TB-1	0	0	0	0	0	0	0	0	Very Poor

** NC-1 only had 30 individuals encountered during the fish survey. According to KDOW protocols id fewer than 50 individuals are collected then metrics are scored as zero. Numbers in () are actual values collected.*
*** (+) or (-) indicates if metric will increase (+) or decrease (-) with improving water quality.*

TB-1 is a headwater stream that is either too intermittent or too impaired to support a fish community. NC-1 had a very poor fish community, with only 30 individuals collected during the survey. With so few individuals collected, conclusions on habitat affecting the fish community cannot be evaluated for NC-1. CF-2 had a "Poor" IBI rating due to high proportions of facultative headwater individuals, tolerant individuals, low darter-madtom-sculpin richness, and absence of intolerant species. Additionally, omnivore individuals (generalist feeders) comprised approximately 68 percent of the fish community for CF-2 while insectivore individuals comprised only 29 percent. While SC-1 had similar metric scores to CF-2, the watershed size for SC-1 was smaller than CF-2 (9.26 mi^2 and 24.9 mi^2, respectively), which resulted in a "Fair" IBI rating for SC-1. Generalist feeders (omnivores) were even more dominant over specialist feeders (insectivores) for SC-1, comprising 85 percent of the fish community. Both CF-2 and SC-1 have bedrock-dominated substrates (80 percent and 85 percent, respectively) which may be contributing to low IBI scores due to lack of cover and reduced niche space for aquatic insects. Percent Community Similarity between CF-2 and SC-1 was 79 percent, and the Jaccard Coefficient of Community Similarity was 0.73.

3. *Multivariate Analysis*

Macroinvertebrate data from the four sites was compared through multivariate ordination to the measured environmental variables to determine potential correlations that exhibited ecological significance. Fish data was determined to be too incomplete for this analysis.

The ordination method used to determine the potential for significant correlations was Redundancy Analysis (RDA). Specifically, the macroinvertebrate and environmental data were compared in a step-wise manner within RDA in the software application CANOCO. Those environmental variables that were deemed significantly associated through Monte-Carlo permutations ($P \leq 0.1$) with fluctuations in the macroinvertebrate data (numbers of individuals and species across sites) were used in explanation of the data. An acceptable P value of 0.1 was used instead of the traditional 0.05 level of significance. This is due to the nature of the type of analysis, which sought to discover relationships between species and environmental variables; not direct cause and effect. All environmental variables used in the analysis are included in Appendix A. Species data was log transformed to reduce potential noise in the analysis caused by high numbers of individuals. Environmental variables were relativized by maximum to account for the various units of measure.

Figure 1 below shows the results of the RDA. The entire model was determined to be significant at the $P \leq 0.1$ level of significance through Monte-Carlo permutation. Only two variables were found to be significantly correlated with the macroinvertebrate communities at $P \leq 0.1$, watershed size and stream flow. As seen graphically, watershed size and flow are positively correlated with the only station having a "good" MBI score. Specifically, it appears from the association that the larger the watershed and the greater the flow, the greater the diversity and abundance of taxa collected. The sites having less flow and smaller watersheds had poorer MBI scores.

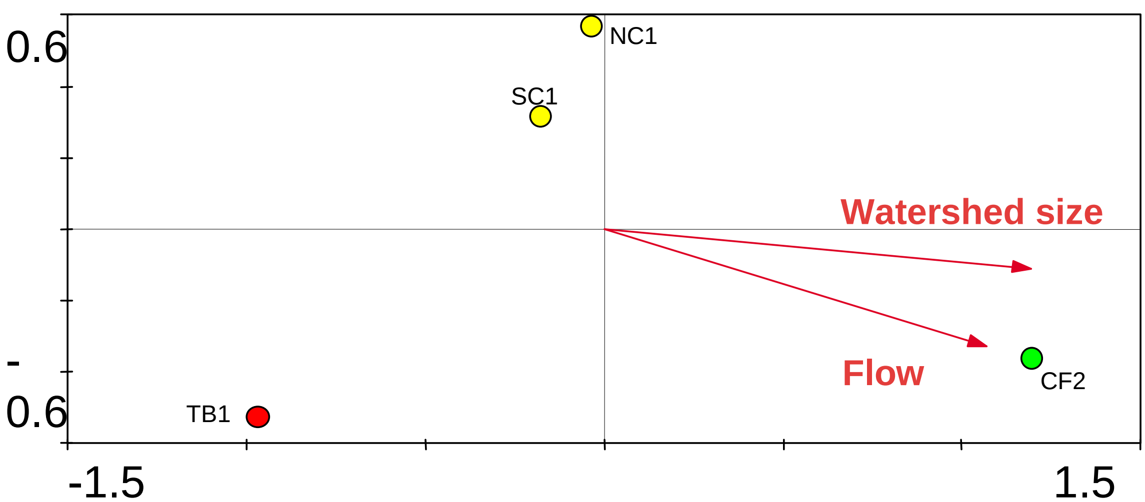


FIGURE 1 – REDUNDANCY ANALYSIS (RDA) OF SAMPLED MACROINVERTEBRATE COMMUNITIES AT STATIONS SC-1, TB-1, NC-1, AND CF-2 OF CURRY'S FORK WATERSHED

In Figure 1, the color dots represent sampling stations – their color relates to their MBI score (red equals "poor", yellow equals "fair", green equals "good"). The red arrow represents the only significantly correlated environmental variables, and its direction indicates its relationship to stations and taxa.

III. DISCUSSION

The analysis of the biological samples from the stream stations within the Curry's Fork watershed yielded results indicative of moderate impairment. It appears that the found impairments could be more indicative of a lack of available habitat (including stream flow) and substrate than altered water chemistry.

In the macroinvertebrate and fish metric analyses, the calculated metrics generally indicated that some type of physical impairment was affecting the stream communities at all stations. Indications of community impacts pertaining to watershed size and stream permanence were observed with the functional feeding group analysis. Fish data also indicated that stream permanence affected the present communities, though the correlation was not as apparent as with the macroinvertebrates. The results from the multivariate analysis of the macroinvertebrate and environmental data further supported this evidence through correlation between watershed size/stream flow and macroinvertebrate community diversity.

With regards to flow in streams, an adequate hydrologic continuum is important for a diversity of aquatic species. Though it is common for un-altered, intermittent streams in mountainous regions to have diverse and healthy macroinvertebrate communities, these streams have an abundance and diversity of cover habitat that is pivotal for species to tolerate low-flow conditions. The physical degradation of the sampled stream reaches from Curry's Fork did not exhibit a diversity of habitat, as bedrock was the common substrate found. As observed in the field, stream flow permanency was intermittent in the smaller streams of Curry's Fork during drier conditions. It is therefore believed that within the Curry's Fork watershed, the primary stressor to the biological communities is a combination of a lack of flow and habitat cover.

The source of the observed low-flows in the smaller tributaries and the general absence of available habitat cover are directly related to adjacent land use. In intact forested watersheds, rainfall slowly percolates into the topsoil and gradually releases into the streams, creating a consistent flow in even small streams. Tree clearing and increases in impervious cover in the watershed result in less water soaking into the topsoil and more direct runoff into streams. As a result, streams become flashy from the direct inputs and incised as a result of the increased flow. Consequently, the stream incision reduces the groundwater level even further since it is forced to meet the new stream flow elevation. The incision and flashy flows are also responsible for the reduction in stream habitat through scour and sedimentation. In the case of the majority of the streams in Curry's Fork, excessive runoff has commonly incised the streams to bedrock, which offers little habitat for macroinvertebrates and fish.

Remediation efforts should focus on a reduction of surface runoff through BMPs that promote infiltration. Focused efforts for stream restoration are recommended in conjunction with infiltration BMPs.

APPENDIX A – DATA SHEETS

Habitat Assessment Field Data Sheets
Physical Characterization/Water Quality Field Data Sheets
Macroinvertebrate Sampling Results
Fish Sampling Results
Multivariate Environmental Variables

HABITAT ASSESSMENT FIELD DATA SHEET — HIGH GRADIENT STREAMS (FRONT)

STREAM NAME: Curry's Fork		LOCATION: Near KY 1408
STREAM WDTH (FT):	DEPTH (FT):	PERENNIAL ☐ INTERMITTENT ☐ EPHEMERAL ☐
STATION #: CF-2	RIVERMILE:	COUNTY: Oldham STATE: KY
LAT:	LONG:	RIVER BASIN:
CLIENT: Strand Associates, Inc.		PROJECT NO. 7144-07
INVESTIGATORS/CREW: Sam Lee and Ed Hartowicz		
FORM COMPLETED BY: Ed Hartowicz	DATE: 6/21/07 TIME: 2:10 p.m.	REASON FOR SURVEY: Watershed Survey

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient.	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE:	20 19 18 17 16	15 14 13 12 11	**10** 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE:	20 19 **18** 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 **8** 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE:	20 19 18 17 16	15 14 13 12 **11**	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE:	20 19 18 17 **16**	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET — HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE:	20 19 18 **17** 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.
SCORE:	20 19 18 17 **16**	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE: (LB)	Left Bank 10 9	**8** 7 6	5 4 3	2 1 0
SCORE: (RB)	Right Bank 10 **9**	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE: (LB)	Left Bank 10 9	**8** 7 6	5 4 3	2 1 0
SCORE: (RB)	Right Bank 10 9	**8** 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE: (LB)	Left Bank **10** 9	8 7 6	5 4 3	2 1 0
SCORE: (RB)	Right Bank 10 9	8 7 6	5 4 3	**2** 1 0

TOTAL SCORE: 141

HABITAT ASSESSMENT FIELD DATA SHEET — HIGH GRADIENT STREAMS (FRONT)

STREAM NAME: North Fork Curry's Fork	LOCATION: Off Winding Creek Road
STREAM WDTH (FT): DEPTH (FT):	PERENNIAL ☐ INTERMITTENT ☐ EPHEMERAL ☐
STATION #: NC-1 RIVERMILE:	COUNTY: Oldham STATE: KY
LAT: LONG:	RIVER BASIN:
CLIENT: Strand Associates, Inc.	PROJECT NO. 7144-07
INVESTIGATORS/CREW: Sam Lee and Ed Hartowicz	

FORM COMPLETED BY: Ed Hartowicz	DATE: 6/21/07 TIME: 1:15 p.m.	REASON FOR SURVEY: Watershed Survey

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 **8** 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE:	20 19 18 **17** 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE:	20 19 18 17 16	15 14 **13** 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE:	20 19 18 17 16	15 **14** 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE:	20 19 18 17 16	15 14 **13** 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET — HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE:	20 19 18 17 **16**	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 **9** 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE: (LB)	Left Bank 10 9	8 7 6	5 4 **3**	2 1 0
SCORE: (RB)	Right Bank 10 9	8 7 6	5 4 **3**	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE: (LB)	Left Bank 10 9	8 7 6	5 4 3	**2** 1 0
SCORE: (RB)	Right Bank 10 9	8 7 6	5 4 3	**2** 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE: (LB)	Left Bank 10 9	8 7 6	5 4 3	**2** 1 0
SCORE: (RB)	Right Bank 10 9	8 7 6	5 4 3	**2** 1 0

TOTAL SCORE: 104

HABITAT ASSESSMENT FIELD DATA SHEET — HIGH GRADIENT STREAMS (FRONT)

STREAM NAME: South Fork Curry's Fork	LOCATION: Off Carriage Point Drive
STREAM WDTH (FT): DEPTH (FT):	PERENNIAL ☐ INTERMITTENT ☐ EPHEMERAL ☐
STATION #: SC-1 RIVERMILE:	COUNTY: Oldham STATE: KY
LAT: LONG:	RIVER BASIN:
CLIENT: Strand Associates, Inc.	PROJECT NO. 7144-07
INVESTIGATORS/CREW: Sam Lee and Ed Hartowicz	

FORM COMPLETED BY: Ed Hartowicz	DATE: 6/21/07 TIME: 3:45 p.m.	REASON FOR SURVEY: Watershed Survey

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient.	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 **7** 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE:	20 19 18 17 16	**15** 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 **8** 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 **6**	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE:	20 19 18 17 **16**	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET — HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE:	20 19 18 17 **16**	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.
SCORE:	20 19 18 **17** 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE: (LB)	Left Bank 10 9	**8** 7 6	5 4 3	2 1 0
SCORE: (RB)	Right Bank 10 9	8 **7** 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE: (LB)	Left Bank 10 9	**8** 7 6	5 4 3	2 1 0
SCORE: (RB)	Right Bank 10 9	**8** 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE: (LB)	Left Bank **10** 9	8 7 6	5 4 3	2 1 0
SCORE: (RB)	Right Bank **10** 9	8 7 6	5 4 3	2 1 0

TOTAL SCORE: 136

HABITAT ASSESSMENT FIELD DATA SHEET — HIGH GRADIENT STREAMS (FRONT)

STREAM NAME: Ashers Run		LOCATION: Near KY 1408	
STREAM WDTH (FT):	DEPTH (FT):	PERENNIAL ☐ INTERMITTENT ☐ EPHEMERAL ☐	
STATION #: TB-1	RIVERMILE:	COUNTY: Oldham	STATE: KY
LAT:	LONG:	RIVER BASIN: Floyds Fork	
CLIENT: Strand Associates, Inc.		PROJECT NO. 7144-07	
INVESTIGATORS/CREW: Chelsey Olson			
FORM COMPLETED BY: Chelsey Olson	DATE: 6/21/07 TIME: 12:30 p.m.	REASON FOR SURVEY: Watershed Survey	

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient.	40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE:	20 19 18 17 16	15 14 13 **12** 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE:	20 19 18 17 16	15 14 **13** 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE:	20 19 18 17 16	15 14 **13** 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 **9** 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 **9** 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET — HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE:	20 19 18 17 16	15 **14** 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25.
SCORE:	20 19 18 17 16	**15** 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE: (LB)	Left Bank 10 9	8 **7** 6	5 4 3	2 1 0
SCORE: (RB)	Right Bank 10 9	8 **7** 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE: (LB)	Left Bank 10 9	8 7 6	**5** 4 3	2 1 0
SCORE: (RB)	Right Bank 10 9	8 7 6	**5** 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE: (LB)	Left Bank 10 9	8 7 6	5 4 3	**2** 1 0
SCORE: (RB)	Right Bank 10 9	8 7 6	5 4 3	**2** 1 0

TOTAL SCORE: 113

PHYSICAL CHARACTERIZATION / WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME: Curry's Fork	LOCATION: Near KY 1408
STREAM WIDTH (FT): DEPTH (FT):	PERENNIAL ___X___ INTERMITTENT _____ EPHEMERAL _____
STATION #: CF-2 RIVERMILE:	COUNTY: Oldham STATE: KY
LAT: LONG:	RIVER BASIN: Floyds Fork
CLIENT: Strand Associates, Inc.	PROJECT NO. 7144-07
INVESTIGATORS/CREW: Sam Lee and Ed Hartowicz	

FORM COMPLETED BY: Ed Hartowicz	DATE: 6/21/07 TIME: 2:00 p.m.	REASON FOR SURVEY: Watershed Survey

WEATHER CONDITIONS	Now / Past 24 Hours ☐ storm (heavy rain) ☐ ☐ rain (steady rain) ☐ ☐ showers (intermittent) ☐ ____% ☐ % cloud cover ☐____% ☒ clear/sunny ☒ Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No Air Temperature __83____°F Other__________
STREAM CHARACTERIZATION	Stream Type ☐ Coldwater ☒ Warmwater Catchment Area_________km² Stream Origin ☐ Glacial ☐ Non-glacial montane ☐ Swamp and bog ☐ Spring-fed ☐ Mixture of origins ☒ Other________
WATERSHED FEATURES	Predominant Surrounding Landuse ☐ Forest ☐ Field/Pasture ☐ Agricultural ☒ Residential ☐ Commercial ☐ Industrial ☐ Other ________ Local Watershed NPS Pollution ☐ No evidence ☒ Some potential sources ☐ Obvious sources Local Watershed Erosion ☐ None ☐ Moderate ☐ Heavy
RIPARIAN ZONE	Indicate the dominant type and record the dominant species present ☐ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous Dominant species present green ash, sycamore, Osage orange Canopy Cover ☐ None ☐ Partly open (25-50%) ☐ Partly shaded (50-75%) ☒ Shaded (75-100%)
INSTREAM FEATURES	Estimated Reach Length 160________m Estimated Stream Width: Pools:____--______ Runs:_____20'_____ Riffles:__6-8'_______ High Water Mark __________m Estimated Stream Depth: Pools:_____--_____ Runs:______4"____ Riffles:____2"_____ Proportion of reach represented by Stream Morphology Types ☐ Riffle__30_____% ☐ Run ___70_____% ☐ Pool _____0___% Surface Velocity ___1______m/sec (at thalweg) Channelized ☐ Yes ☐ No Stream Flow: ☐ Flooding ☐ Bankful ☐ High ☒ Normal ☐ Low ☐ Pooled ☐ Dry Erosion: ☐ Heavy ☒ Moderate ☐ Slight ☐ None Dam Present ☐ Yes ☒ No

AQUATIC VEGETATION	Indicate the dominant type and record the dominant species present ☐ Rooted emergent ☐ Rooted submergent ☐ Rotted floating ☐ Free floating ☐ Floating Algae ☒ Attached Algae Dominant species present ____diatoms____ Portion of the reach with aquatic vegetation ____100____%
WATER QUALITY	Temperature___72.6_______°F Specific Conductance______423_________µS/cm Dissolved Oxygen_____9.14__________mg/L pH____8.02___________ (Standard Units) Turbidity ____________ WQ Instrument Used____Hydrolab S4A___________ ☐ YSI 54A (DO) ☐ Hanna 9024 (pH) ☐ Hanna 9033 (Cond.) ☐ Other______________ Water Odors ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other __________ Water Surface Oils ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ______________________________ Turbidity (if not measured) ☐ Clear ☒ Slightly Turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other _________
SEDIMENT/ SUBSTRATE	Odors ☒ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ________________________________ Oils ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse Deposits ☐ Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Relict Shells ☐ Other _______________ Looking at stones which are not deeply embedded, are the undersides black in color? ☐ Yes ☐ No Sedimentation: ☐ Heavy ☒ Moderate ☐ Slight ☐ None Imbeddedness: ☐ Complete ☐ 75% ☒ 50% ☐ 25% ☐ None

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		80
Boulder	> 256 mm (10")	5
Cobble	64-256 mm (2.5"-10")	15
Gravel	2-64 mm (0.1"-2.5")	
Sand	0.06-2 mm (gritty)	
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	
Detritus	Sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	Black, very fine organic (FPOM)	
Marl	Grey, shell fragments	

TYPE OF SAMPLING

☒ Physiochemical

☐ Sediment

☒ Periphyton

☒ Macroinvertebrates

☒ Fish

☐ Other ____Hydrolab and RBP____________

Macroinvertebrate Sampling	Quantitative Methods: ☐ Surber ☒ Travelling-Kick ☐ Hester-Dendy Multiplates ☐ Other # Reps_____ Qualitative Methods: ☒ Multihabitat ☐ Qualitative Search ☐ Other ___________________ Habitats Sampled (Qual. Methods): ☐ Riffles ☐ Rootwads ☐ Marginal vegetation ☐ *Justicia* beds ☐ Bedrock/slabrock ☐ Leaf packs ☐ Silt (depositional areas) ☐ Woody debris
Fish Sampling	Method: ☒ Backpack Electrofishing ☐ Long-Line Electrofishing ☒ Seining ☐ Other _____________________ Electrofishing time period: ___761_______ seconds

Notes:

PHYSICAL CHARACTERIZATION / WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME: North Fork Curry's Fork	LOCATION: Off Winding Creek Road
STREAM WIDTH (FT): DEPTH (FT):	PERENNIAL __X__ INTERMITTENT ____ EPHEMERAL ____
STATION #: NC-1 RIVERMILE:	COUNTY: Oldham STATE: KY
LAT: LONG:	RIVER BASIN: Floyds Fork
CLIENT: Strand Associates, Inc.	PROJECT NO. 7144-07
INVESTIGATORS/CREW: Sam Lee and Ed Hartowicz	

FORM COMPLETED BY: Ed Hartowicz	DATE: 6/21/07 TIME: 1:10 p.m.	REASON FOR SURVEY: Watershed Survey

WEATHER CONDITIONS	Now / Past 24 Hours: ☐ storm (heavy rain) ☐ ☐ rain (steady rain) ☐ ☐ showers (intermittent) ☐ ____% ☐ % cloud cover ☐____% ☒ clear/sunny ☒ Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No Air Temperature _____°C Other________________
STREAM CHARACTERIZATION	Stream Type ☐ Coldwater ☒ Warmwater Catchment Area________km² Stream Origin ☐ Glacial ☐ Spring-fed ☐ Non-glacial montane ☐ Mixture of origins ☐ Swamp and bog ☒ Other________
WATERSHED FEATURES	Predominant Surrounding Landuse ☐ Forest ☐ Commercial ☐ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other __________ ☒ Residential Local Watershed NPS Pollution ☐ No evidence ☒ Some potential sources ☐ Obvious sources Local Watershed Erosion ☐ None ☒ Moderate ☐ Heavy
RIPARIAN ZONE	Indicate the dominant type and record the dominant species present ☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous Dominant species present boxelder, green ash Canopy Cover ☐ None ☐ Partly open (25-50%) ☒ Partly shaded (50-75%) ☐ Shaded (75-100%)
INSTREAM FEATURES	Estimated Reach Length 220____m Estimated Stream Width: Pools:__18___ Runs:___15___ Riffles:___12___ High Water Mark ______m Estimated Stream Depth: Pools:___2'___ Runs:______ Riffles:___2-3___ Proportion of reach represented by Stream Morphology Types ☐ Riffle__15___% ☐ Run __35____% ☐ Pool __50____% Surface Velocity ____1____m/sec (at thalweg) Channelized ☐ Yes ☐ No Stream Flow: ☐ Flooding ☐ Bankful ☐ High ☒ Normal ☐ Low ☐ Pooled ☐ Dry Erosion: ☐ Heavy ☒ Moderate ☐ Slight ☐ None Dam Present ☐ Yes ☒ No

AQUATIC VEGETATION	Indicate the dominant type and record the dominant species present ☐ Rooted emergent ☐ Rooted submergent ☐ Rotted floating ☐ Free floating ☐ Floating Algae ☒ Attached Algae Dominant species present ______diatoms______ Portion of the reach with aquatic vegetation ___100____%
WATER QUALITY	Temperature____70.5______°F Specific Conductance______431_________S/cm Dissolved Oxygen________8.62_______mg/L pH________7.85_______ (Standard Units) Turbidity ____________ WQ Instrument Used___Hydrolab S4A____________ ☐ YSI 54A (DO) ☐ Hanna 9024 (pH) ☐ Hanna 9033 (Cond.) ☐ Other______________ Water Odors ☐ Normal/None ☐ Sewage ☐ Petroleum ☒ Chemical ☐ Fishy ☐ Other __________ Water Surface Oils ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ______________________________ Turbidity (if not measured) ☐ Clear ☒ Slightly Turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other _________
SEDIMENT/ SUBSTRATE	Odors ☒ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ________________________________ Deposits ☐ Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Relict Shells ☐ Other _______________ Oils ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse Looking at stones which are not deeply embedded, are the undersides black in color? ☐ Yes ☒ No Sedimentation: ☐ Heavy ☒ Moderate ☐ Slight ☐ None Imbeddedness: ☐ Complete ☐ 75% ☐ 50% ☒ 25% ☐ None

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		75
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	20
Gravel	2-64 mm (0.1"-2.5")	5
Sand	0.06-2 mm (gritty)	
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	
Detritus	Sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	Black, very fine organic (FPOM)	
Marl	Grey, shell fragments	

TYPE OF SAMPLING

☒ Physiochemical

☐ Sediment

☒ Periphyton

☒ Macroinvertebrates

☐ Fish

☐ Other ___________________________________

Macroinvertebrate Sampling	Quantitative Methods: ☐ Surber ☒ Travelling-Kick ☐ Hester-Dendy Multiplates ☐ Other # Reps_____ Qualitative Methods: ☒ Multihabitat ☐ Qualitative Search ☐ Other ___________________ Habitats Sampled (Qual. Methods): ☒ Riffles ☒ Rootwads ☐ Marginal vegetation ☐ *Justicia* beds ☒ Bedrock/slabrock ☐ Leaf packs ☒ Silt (depositional areas) ☒ Woody debris
Fish Sampling	Method: ☒ Backpack Electrofishing ☐ Long-Line Electrofishing ☒ Seining ☐ Other _____________________ Electrofishing time period: ____680______ seconds

Notes:

PHYSICAL CHARACTERIZATION / WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME: South Fork Curry's Fork	LOCATION: Off Carriage Point Drive
STREAM WIDTH (FT): DEPTH (FT):	PERENNIAL ___X___ INTERMITTENT _____ EPHEMERAL _____
STATION #: SC-1 RIVERMILE:	COUNTY: Oldham STATE: KY
LAT: LONG:	RIVER BASIN: Floyds Fork
CLIENT: Strand Associates, Inc.	PROJECT NO. 7144-07

INVESTIGATORS/CREW: Ed Hartowicz, Sam Lee

FORM COMPLETED BY: Ed Hartowicz	DATE: 6/21/07 TIME: 2:25 p.m.	REASON FOR SURVEY: Watershed Survey

WEATHER CONDITIONS

Now		Past 24 Hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
____% ☐	% cloud cover	☐____%
☒	clear/sunny	☒

Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature __83____°F

Other____________________________________

STREAM CHARACTERIZATION

Stream Type ☐ Coldwater ☒ Warmwater Catchment Area__________km²

Stream Origin
- ☐ Glacial
- ☐ Non-glacial montane
- ☐ Swamp and bog
- ☐ Spring-fed
- ☐ Mixture of origins
- ☒ Other_________

WATERSHED FEATURES

Predominant Surrounding Landuse
- ☒ Forest
- ☐ Field/Pasture
- ☐ Agricultural
- ☐ Residential
- ☐ Commercial
- ☐ Industrial
- ☐ Other _______________

Local Watershed NPS Pollution
- ☐ No evidence ☒ Some potential sources
- ☐ Obvious sources

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN ZONE

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

Dominant species present Sycamore, boxelder, American elm

Canopy Cover
☐ None ☐ Partly open (25-50%) ☒ Partly shaded (50-75%) ☐ Shaded (75-100%)

INSTREAM FEATURES

Estimated Reach Length 100_________m

Estimated Stream Width:

Pools:____30'______ Runs:____25'______ Riffles:_____20'_____ High Water Mark _2.5________m

Estimated Stream Depth:

Pools:____6"______ Runs:____4"______ Riffles:____2"______

Proportion of reach represented by Stream Morphology Types

☐ Riffle__40_____% ☐ Run ___30_____% ☐ Pool ____30____%

Surface Velocity ___>1_______m/sec (at thalweg) Channelized ☐ Yes ☐ No

Stream Flow:
☐ Flooding ☐ Bankful ☐ High ☒ Normal
☐ Low ☐ Pooled ☐ Dry

Erosion:
☐ Heavy ☒ Moderate ☐ Slight ☐ None

Dam Present ☐ Yes ☒ No

AQUATIC VEGETATION	Indicate the dominant type and record the dominant species present ☐ Rooted emergent ☐ Rooted submergent ☐ Rotted floating ☐ Free floating ☐ Floating Algae ☒ Attached Algae Dominant species present ____diatoms____ Portion of the reach with aquatic vegetation __100_____%
WATER QUALITY	Temperature____75.0______°F Specific Conductance_____484.5__________µS/cm Dissolved Oxygen________9.76_______mg/L pH_____8.18__________ (Standard Units) Turbidity ____________ WQ Instrument Used_______________ ☐ YSI 54A (DO) ☐ Hanna 9024 (pH) ☐ Hanna 9033 (Cond.) ☐ Other______________ Water Odors ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other __________ Water Surface Oils ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ______________________________ Turbidity (if not measured) ☐ Clear ☒ Slightly Turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other _________
SEDIMENT/ SUBSTRATE	Odors ☒ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ________________________________ Oils ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse Deposits ☐ Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Relict Shells ☐ Other _______________ Looking at stones which are not deeply embedded, are the undersides black in color? ☐ Yes ☐ No Sedimentation: ☒ Heavy ☐ Moderate ☐ Slight ☐ None Imbeddedness: ☐ Complete ☐ 75% ☐ 50% ☐ 25% ☐ None

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		85
Boulder	> 256 mm (10")	5
Cobble	64-256 mm (2.5"-10")	20
Gravel	2-64 mm (0.1"-2.5")	
Sand	0.06-2 mm (gritty)	
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	
Detritus	Sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	Black, very fine organic (FPOM)	
Marl	Grey, shell fragments	

TYPE OF SAMPLING

☒ Physiochemical

☐ Sediment

☒ Periphyton

☒ Macroinvertebrates

☐ Fish

☐ Other ___________________________________

Macroinvertebrate Sampling	Quantitative Methods: ☐ Surber ☐ Travelling-Kick ☐ Hester-Dendy Multiplates ☐ Other # Reps_____ Qualitative Methods: ☐ Multihabitat ☐ Qualitative Search ☐ Other ___________________ Habitats Sampled (Qual. Methods): ☒ Riffles ☒ Rootwads ☐ Marginal vegetation ☐ *Justicia* beds ☒ Bedrock/slabrock ☐ Leaf packs ☒ Silt (depositional areas) ☒ Woody debris
Fish Sampling	Method: ☐ Backpack Electrofishing ☐ Long-Line Electrofishing ☐ Seining ☐ Other _____________________ Electrofishing time period: __________ seconds

Notes:

PHYSICAL CHARACTERIZATION / WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME: Ashers Run	LOCATION: Near KY 1408
STREAM WIDTH (FT): DEPTH (FT):	PERENNIAL __X___ INTERMITTENT __X___ EPHEMERAL _____
STATION #: TB-1 RIVERMILE:	COUNTY: Oldham STATE: KY
LAT: LONG:	RIVER BASIN: Floyds Fork
CLIENT: Strand Associates, Inc.	PROJECT NO. 7144-07
INVESTIGATORS/CREW: Chelsey Olson	

FORM COMPLETED BY:	DATE: 6/21/07	REASON FOR SURVEY:
Chelsey Olson	TIME: 12:30 p.m.	Watershed Survey

WEATHER CONDITIONS

Now		Past 24 Hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
____% ☐	% cloud cover	☐ ____%
☒	clear/sunny	☒

Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature __80____°F

Other____

STREAM CHARACTERIZATION

Stream Type ☐ Coldwater ☒ Warmwater

Catchment Area_____1_____km²

Stream Origin
- ☐ Glacial
- ☐ Non-glacial montane
- ☐ Swamp and bog
- ☐ Spring-fed
- ☒ Mixture of origins
- ☐ Other_________

WATERSHED FEATURES

Predominant Surrounding Landuse
- ☒ Forest
- ☐ Field/Pasture
- ☒ Agricultural
- ☐ Residential
- ☐ Commercial
- ☐ Industrial
- ☐ Other _______________

Local Watershed NPS Pollution
- ☐ No evidence ☒ Some potential sources
- ☐ Obvious sources

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN ZONE

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

Dominant species present boxelder

Canopy Cover
☐ None ☐ Partly open (25-50%) ☐ Partly shaded (50-75%) ☒ Shaded (75-100%)

INSTREAM FEATURES

Estimated Reach Length 100________m

Estimated Stream Width:

Pools:____30______ Runs:____20______ Riffles:____20______ High Water Mark _2________m

Estimated Stream Depth:

Pools:___15"_______ Runs:_____4"_____ Riffles:_____2"_____

Proportion of reach represented by Stream Morphology Types

☐ Riffle__40_____% ☐ Run ___30_____% ☐ Pool ___30_____%

Surface Velocity __< 0.5_______m/sec (at thalweg) Channelized ☐ Yes ☐ No

Stream Flow:
☐ Flooding ☐ Bankful ☐ High ☐ Normal
☒ Low ☐ Pooled ☐ Dry

Erosion:
☐ Heavy ☒ Moderate ☐ Slight ☐ None

Dam Present ☐ Yes ☒ No

AQUATIC VEGETATION	Indicate the dominant type and record the dominant species present ☐ Rooted emergent ☐ Rooted submergent ☐ Rotted floating ☐ Free floating ☐ Floating Algae ☒ Attached Algae Dominant species present ____diatoms Portion of the reach with aquatic vegetation ____100____%
WATER QUALITY	Temperature_____71.7_____°F Specific Conductance___402____________µS/cm Dissolved Oxygen_______7.67________mg/L pH_____7.26__________ (Standard Units) Turbidity ____________ WQ Instrument Used_______________ ☐ YSI 54A (DO) ☐ Hanna 9024 (pH) ☐ Hanna 9033 (Cond.) ☒ Other__Datasonde____________ Water Odors ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other __________ Water Surface Oils ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ______________________________ Turbidity (if not measured) ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other _________
SEDIMENT/ SUBSTRATE	Odors ☒ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ________________________________ Oils ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse Deposits ☐ Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Relict Shells ☐ Other _______________ Looking at stones which are not deeply embedded, are the undersides black in color? ☐ Yes ☒ No Sedimentation: ☐ Heavy ☒ Moderate ☐ Slight ☐ None Imbeddedness: ☐ Complete ☐ 75% ☒ 50% ☐ 25% ☐ None

INORGANIC SUBSTRATE COMPONENTS
(should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	60
Gravel	2-64 mm (0.1"-2.5")	30
Sand	0.06-2 mm (gritty)	
Silt	0.004-0.06 mm	10
Clay	< 0.004 mm (slick)	
Detritus	Sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	Black, very fine organic (FPOM)	
Marl	Grey, shell fragments	

TYPE OF SAMPLING

☒ Physiochemical

☐ Sediment

☒ Periphyton

☒ Macroinvertebrates

☒ Fish

☐ Other ___________________________________

Macroinvertebrate Sampling	Quantitative Methods: ☐ Surber ☒ Travelling-Kick ☐ Hester-Dendy Multiplates ☐ Other # Reps_____ Qualitative Methods: ☒ Multihabitat ☐ Qualitative Search ☐ Other ___________________ Habitats Sampled (Qual. Methods): ☒ Riffles ☒ Rootwads ☒ Marginal vegetation ☐ *Justicia* beds ☐ Bedrock/slabrock ☒ Leaf packs ☒ Silt (depositional areas) ☒ Woody debris
Fish Sampling	Method: ☒ Backpack Electrofishing ☐ Long-Line Electrofishing ☐ Seining ☐ Other _____________________ Electrofishing time period: ______761____ seconds

Notes:

MACROINVERTEBRATE SAMPLING RESULT

STRAND AND ASSOCIATES
Currys Fork
Oldham County, Kentucky

Collection Date:6-18-07
TRC Project Number: 7144-07

	CF2		NC1		SC1		TB1	
	Station 1		Station 2		Station 3		Station 4	
COMMUNITY METRICS	S-1	QUAL	S-1	QUAL	S-1	QUAL	S-1	QUAL
Per Replicate								
Number of Individuals	3792		837		1676		446	
Taxa Richness	29	35	23	24	30	26	16	21
EPT Richness	10	11	6	5	8	2	3	1
EPT Index (% EPT Taxa)	34	31	26	21	27	8	19	5
Number of EPT Individuals	2644		442		320		33	
Percent EPT Individuals	70		53		19		7	
Chironomidae Richness	6	13	8	9	7	9	2	9
Chironomidae Index (% Chironomidae Taxa)	21	37	35	38	23	35	12	43
Number of Chironomidae Individuals	144		108		660		60	
Percent Chironomidae Individuals	4		13		39		13	
EPT/Chironomidae Abundance	18.36		4.09		0.48		0.55	
Per Station								
Number of Individuals	3792		837		1676		446	
Taxa Richness*	41		29		38		27	
EPT Richness*	11		6		8		3	
EPT Index (% EPT Taxa)*	28		23		21		11	
Number of EPT Individuals	2644		442		320		33	
Percent EPT Individuals	20.4		28.4		7.9		7	
Chironomidae Richness*	15		13		10		9	
Chironomidae Index (% Chironomidae Taxa)*	35		42		26		33	
Number of Chironomidae Individuals	144		108		660		60	
Percent Chironomidae Individuals	4		13		39		13	
EPT/Chironomidae Abundance	18.36		4.09		0.48		0.55	
Modified Hilsenhoff Biotic Index	5.44		6.11		6.08		5.99	
MHBI Water Quality Rating**	Good		Good-Fair		Good		Excellent	
Contribution of Dominant Taxa5	80		66		69		72	

*Values were obtained from both quanititative (S) and qualitative (QUAL) samples at each station.
**MHBI Water Quality Ratings include Excellent (<5.24), Good (5.25-5.95), Good/Fair (5.96-6.67), Fair (6.68-7.7), and Poor (>7.7).

MACROINVERTEBRATE SAMPLING RESULTS

STRAND AND ASSOCIATES
Currys Fork
Oldham County, Kentucky

Collection Date:06-18-07
TRC Project Number: 7144-07

			CF2		NC1		SC1		TB1	
			Station 1		Station 2		Station 3		Station 4	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL	S-1	QUAL
ANNELIDA										
Glossiphoniidae gen. sp.	P	8.2					4			
Tubificidae gen. sp.	CG	9	4	X	2	X		X		
AMPHIPODA										
Crangonyx sp.	SH-d	8						X		
Synurella sp.	SH-d	7.7								X
ISOPODA										
Caecidotea sp.	CG	9.1	12	X	21	X	184	X	33	X
Lirceus fontinalis Rafinesque	CG	7.9			2	X	24	X	8	X
DECAPODA										
Orconectes sp.	CG	5.5	12	X	6	X	20	X	83	X
EPHEMEROPTERA										
Acerpenna pygmaeus (Hagen)	CG	3.9	4	X						
Baetis flavistriga McDunnough	CG	6.6	4	X	2					
Baetis intercalaris McDunnough	CG	4.99	140	X	24		8			
Caenis diminuta group sp.	CG	7.4		X		X	16	X		
Centroptilum sp.	CG	6.6		X						
Maccaffertium sp.	SC	4.1	16							
Stenacron interpunctatum (Say)	CG	6.9	36	X			12		5	
Stenonema femoratum (Say)	SC	7.2			34	X	24		25	
ODONATA										
Calopteryx maculata (Beauvois)	P	7.8						X		
TRICHOPTERA										
Ceratopsyche morosa group sp.	CF	3.2	143	X						
Cheumatopsyche sp.	CF	6.2	1871	X	204	X	188	X	3	X
Chimarra obscura (Walker)	CF	2.8	120	X						
Hydropsyche betteni Ross	CF	7.8	186	X	82	X	28			
Hydroptila sp.	P	6.2	124	X	96	X	24			
Neophylax sp.	SC	2.2					20			
COLEOPTERA										
Berosus sp.	P	8.4						X		
Dryopidae gen. sp.	SC	5						X		
Dubiraphia sp.	SC	5	8	X			8			
Ectopria sp.	SC	4.2					4		7	

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

STRAND AND ASSOCIATES
Currys Fork
Oldham County, Kentucky

Collection Date:06-18-07
TRC Project Number: 7144-07

			CF2		NC1		SC1		TB1	
			Station 1		Station 2		Station 3		Station 4	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL	S-1	QUAL
Helichus sp.	SC	4.6								X
Hydrophilidae gen. sp. (imm.)	P	6.3				X				
Neoporus sp.	P	8.9		X					5	X
Peltodytes sp.	P	8.7					12	X		
Psephenus herricki (DeKay)	SC	2.4	84	X	82	X	156	X	133	
Stenelmis sp.	SC	5.1	684	X	94	X	220	X	15	X
Tropisternus natator (d'Orchymont)	CG	9.7					4			
DIPTERA (Chironomidae)										
Ablabesmyia mallochi (Walley)	P	7.2				X				
Cricotopus (C.) bicinctus (Meigen)	SH-d	8.5		X						
Cricotopus / Orthocladius sp.	CG	7.1			4		4			
Cryptochironomus sp.	P	6.4		X						
Dicrotendipes neomodestus (M.)	CG	8.1		X						
Microtendipes pedellus group sp.	CF	5.5		X	60		284	X	31	X
Nanocladius sp.	CG	7.1				X				
Natarsia sp.	P	10								X
Paramerina sp.	P	4.3	4							
Paratanytarsus sp.	CG	8.5		X	2	X	8	X		
Paratendipes albimanus (Meigen)	CG	9.2		X		X		X		X
Polypedilum fallax group sp.	SH-d	6.4		X						
Polypedilum flavum (Joh.)	SH-d	5.3	92	X	6		4	X		
Polypedilum illinoense group sp.	SH-d	9				X		X		X
Procladius sp.	P	9.1		X						X
Rheocricotopus robacki (Beck & Beck)	CG	7.7	4							
Rheotanytarsus exiguus group sp.	CF	6.4	4	X	18		48	X		X
Stenochironomus sp.	CG	6.5		X		X				X
Stictochironomus sp.	CG	6.5	4	X	2	X	288	X	29	X
Tanytarsus sp.	CF	6.7			2	X		X		
Thienemannimyia group sp.	P	5.9	36	X	14	X	24	X		X
DIPTERA (Other)										
Bezzia / Palpomyia grp. sp.	P	6.9					4			
Hemerodromia sp.	P	8.1	8		2					
Hexatoma sp.	P	4.3	12							
Simulium sp. (imm.)	CF	4	8							

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

MACROINVERTEBRATE SAMPLING RESULTS

STRAND AND ASSOCIATES

Currys Fork

Oldham County, Kentucky

Collection Date:06-18-07

TRC Project Number: 7144-07

			CF2		NC1		SC1		TB1	
			Station 1		Station 2		Station 3		Station 4	
TAXA	FFG*	TV**	S-1	QUAL	S-1	QUAL	S-1	QUAL	S-1	QUAL
Tipula (Yamatotipula) sp.	SH-d	7.3								X
Tipula sp.	SH-d	7.3	4							
MOLLUSCA										
Corbicula fluminea (Muller)	CF	6.1	8				4	X		
Elimia sp.	SC	2.5	8	X	6	X	36	X	43	X
Ferrissia sp.	SC	6.9					8			
Physella sp.	SC	8.8		X					24	X
Pisidium	CF	6.1						X	1	
Sphaerium sp.	CF	7.6		X						X
OTHER TAXA										
Corixidae gen. sp.	P	9				X				
Nepa apiculata Ulmer	P	9							1	
Turbellaria gen. sp.	NA	7.2	152	X	72	X	8	X		

*FFG = Functional Feeding Group: Collector-filterer (CF), Collector-gatherer (CG), Predator (P), Scraper (SC), Shredder-detritivore (SH-d); and Piercer-herbivore (PH); NA = Not available.
**TV = Tolerance Values range from 0 (pollution intolerant organism) - 10 (pollution tolerant organism) and are used in calculation of the Modified Hilsenhoff Biotic Index of Lenat (1993).

FISH SAMPLING RESULTS
Currys Fork
Oldham County, KY

Sample Date - 7/3/07										
Species	**NT**	**FG**	**T**	**FH**	**SS**	**BG**	**TB1**	**CF2**	**SC1**	**NC1**
Ericymba bucca, silverjaw minnow	X	O		X	P			1		
Lythrurus fasciolaris scarletfin shiner	X	I		X				7	8	
Pimephales notatus , bluntnose minnow	X	O	T	X	P			90	87	14
P. promelas , fathead minnow	X	O	T	X	P			3	1	
Semotilus atromaculatus , creek chub	X	O	T		P			10	20	1
Moxostoma erythrurum , golden redhorse	X	I				SL		1		
Ameiurus natalis , yellow bullhead	X	O	T	X				1		
Lepomis cyanellus , green sunfish	X		T	X	P			4	1	
L. megalotis , longear sunfish	X	I		X				1	1	
Etheostoma blennoides , greenside darter	X	I		X		SL		24	5	9
E. flabellare , fantail darter	X	I			H			12	4	5
E. spectabile , orangethroat darter	X	I			P	SL				1
	Total						0	154	127	30
Metrics							**TB1**	**CF2**	**SC1**	**NC1***
Native Species Richness							0	11	8	5
Darter, Madtom, Sculpin Richness							0	2	2	3
Intolerant Species Richness							0	0	0	0
Proportion of Facultative Headwater Individuals							0	85	81	77
Proportion of Tolerant Individuals							0	70	86	50
Proportion of Omnivore Individuals							0	68	85	50
Proportion of Insectivore Individuals							0	29	14	50
Number of Individuals							0	154	127	30
Simple Lithophile Species Richness							0	2	1	2
Drainage Area (mi^2)							3.38	24.9	9.26	10.1
Sampling Effort (seconds)							680	761	602	680
Fish Capture/Sampling Effort							0.00	0.20	0.21	0.04
IBI SCORE							0	28	32	24/0
IBI CLASS / RATING							Very Poor	Poor	Fair	Poor/Very poor

IBI Classes: Very Poor (VP, 0-15), Poor (P, 16-30), Fair (F, 31-46), Good (G, 47-51), & Excellent (E, > 51)

Feeding Guild (FG): C = Carnivore, I = Insectivore, O = Omnivore; Tolerance (T): I = Intolerant, T = Tolerant; FH = Facultative headwater individuals; Stream Size (SS): H = Headwater, P = Pioneer; Breeding Guild (BG):SL = Simple Lithophiles.

* NC1 had less than 50 individulas collected. Therefore according to KDOW protocols all metrics should be scored as 0, thus resulting in a Very Poor IBI rating. Calculation using actual results are also included which resulted in a Poor IBI rating.

Multivariate Environmental Variables

Currys Fork

Oldham County, KY

Strand calculations										
	Barren %	**Crops %**	**Forest %**	**Developed %**	**Wetland %**	**Grassland %**	**Water %**	**Pasture %**	**Flow (cfs)**	**Watershed size (ac.)**
TB1	0.10	3.20	37.50	9.30	0.50	1.70	0.60	46.90	39.80	2168
CF2	0.16	4.65	46.00	17.25	0.46	2.21	0.96	28.32	1563.00	15987
SC1	0.10	2.70	46.60	12.60	0.40	3.70	0.80	33.20	70.70	5931
NC1	0.30	3.50	46.20	25.00	0.40	1.10	1.30	22.20	20.26	6433
Max	0.30	4.65	46.60	25.00	0.50	3.70	1.30	46.90	1563.00	15987

Lab analysis									
	BOD_5 (mg/l)	**TSS (mg/l)**	**Ammonia (mg/l)**	**Unionized Ammonia (mg/l)**	**Phosph. (mg/l)**	**Nitrite (mg/l)**	**Nitrate (mg/l)**	**Sulfate (mg/l)**	**Fecal (N/100 ml)**
TB1	13.89	13.11	0.20	0.01	0.38	0.37	0.56	25.11	661.47
CF2	5.08	13.92	0.23	0.01	0.71	0.46	3.72	57.50	693.90
SC1	8.11	65.33	0.20	0.01	0.39	0.37	1.03	35.78	1327.49
NC1	4.92	14.42	1.34	0.03	2.41	0.58	14.05	72.25	733.79
Max	13.89	65.33	1.34	0.03	2.41	0.58	14.05	72.25	1327.49

Field Measurements											
	Dissolved Oxygen (mg/l)	**Temp (°F)**	**Conduct. (mS)**	**pH**	**Velocity (ft/s)**	**% bedrock**	**% boulder**	**% cobble**	**% gravel**	**% silt**	**Depth (ft)**
TB1	7.67	71.70	402.00	7.26	0.32			60.00	30.00	10.00	0.62
CF2	9.14	72.60	423.00	8.02	0.47	80.00	5.00	15.00			1.10
SC1	9.76	75.00	484.50	8.18	0.71	85.00	5.00	20.00			0.43
NC1	8.62	70.50	431.00	7.85	0.78	75.00		20.00	5.00		0.98
Max	9.76	75.00	484.50	8.18	0.78	85.00	5.00	60.00	30.00	10.00	1.10

Rapid Bioassessment Protocol scores											
	Total Habitat score	**Epfaunal substrate**	**Embed-dedness**	**Velocity/depth**	**Sediment deposition**	**Flow status**	**Channel alteration**	**Riffle frequency**	**Bank stability**	**Vegetative protection**	**Riparian Zone**
TB1	113.00	12.00	13.00	13.00	9.00	9.00	14.00	15.00	14.00	10.00	4.00
CF2	141.00	10.00	18.00	8.00	11.00	16.00	17.00	16.00	17.00	16.00	12.00
SC1	136.00	7.00	15.00	8.00	6.00	16.00	16.00	17.00	15.00	16.00	20.00
NC1	104.00	8.00	17.00	13.00	14.00	13.00	16.00	9.00	6.00	4.00	4.00
Max	141.00	12.00	18.00	13.00	14.00	16.00	17.00	17.00	17.00	16.00	20.00

TRC Calculations		
	% riparian disturance	**Stream order**
TB1	29.24	3.00
CF2	24.33	4.00
SC1	31.11	4.00
NC1	33.11	3.00
Max	33.11	4.00

APPENDIX B
THIRD ROCK CONSULTANTS TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM

To: Strand Associates, Inc.

From: Tony Miller

Re: Further Subwatershed Analysis and Comparison for BMPs
Currys Fork Watershed Based Plan, Oldham County, KY

Date: February 9, 2010

The following discussion is an addendum to the "Curry's Fork Biological Data Assessment" (2009) based on the biological (fish and benthic macroinvertebrates), physical and physio-chemical taken from four sites in the Currys Fork watershed from June 2007. This informal summary provides a re-iteration of the information presented in the referenced report, with a focus on the sampled subwatersheds, which addresses potential sources of impairment in the biological community. For those not familiar with the specific data results presented here, a more thorough discussions of the topics can be found in the above referenced document. The information provided here is primarily intended for water quality professionals to assist with the selection of best management practice (BMP) implementation.

CF2 – Currys Fork near KY 1408

The benthic MBI was calculated as "Good." Specifically, the data showed high taxa richness and a fair number of Ephemeroptera-Plecoptera-Trichoptera taxa (EPT - 11) with a low percentage of midges and worms. Despite a fair number of EPT taxa, the site had a low abundance of mayflies (5.3% of individuals) potentially a result of consistently elevated conductivities. Collector-filterers were abundant (61.7%) but there were low number of collector-gatherers (9.8%) and the highest percentage of scrapers (21.1%), while the abundance of shredders was low (2.5%). The fish survey resulted in a "Poor" IBI score. This was mainly a result of an abundance of tolerant individuals (70%), absence of intolerant taxa, and low darter-madtom-sculpin richness (2). Increases in tolerant individuals can be correlated to impaired physical habitat (*i.e.,* embeddedness, sediment deposition), and with increased specific conductance, ammonia (NH_3), and nitrogen (TKN). Intolerant species richness is positively correlated with good physical habitat conditions and negatively correlated with impaired water chemistry with the exception of nitrogen. Darter-madtom-sculpin richness is negatively impacted by declining physical habitat and increasing specific conductance, NH_3, and total Kjeldahl nitrogen (TKN).

Branch Office
511 Union Street, Suite 1850
Nashville, TN 37219
Phone: 615-313-3994

Main Office
2526 Regency Road, Suite 180
Lexington, KY 40503
Phone: 859-977-2000
www.thirdrockconsultants.com

Branch Office
401 North Court Street
Marion, IL 62959
Phone: 618-751-1048

This site had the highest RBP score (141) and was "partially supporting." At the time of survey, some sediment deposition was apparent, but embeddedness was moderate (high clinger percentage correlated with that). Erosion was moderate. Shading from the riparian zone was only 50% within the sampling reach though there was moderate riparian protection. Riffles were found to be frequent though bedrock was the dominant substrate. As a result there was a low velocity depth regime RBP score.

During the survey it was noted that a significant amount of residential development was adjacent to the site. Strand's land use report indicated that 22% of the watershed area is in developed subdivision. Reports from Strand indicate that bacteria, sediment, nutrients, and TDS are the primary pollutants of concern.

Highlights:

- Lack of available habitat for benthics
- Potential specific conductance issues
- High proportion of tolerant fish individuals
- Lots of development (impervious areas)

TB1 – Ashers Run Near KY 1408

This site has a "Poor" MBI rating coming from the low taxa richness (27), low EPT taxa (3) and abundance (7%), though the abundance of midges and worms was not too large (13.5%). Interestingly, this station had the most scrapers and fewest collector-filterers (though it had the most collector-gatherers). Collector-filterer absence was probably due to low flow conditions. Low RBP scores were primarily in the sediment deposition, channel flow, bank stability, vegetation protection, and riparian zone width categories. No fish were found as would be expected due to the flow issues. Low clinger abundance indicates unstable substrate. The stream reach was on the border between intermittent/perennial-low flow during the field visit. The stream had good canopy cover (75-100%) and good riff/run/pool ratios. There was a fair amount of cobble/gravel, but silt was prevalent. According to Strand's land use analysis, 66% of this watershed is developed by subdivision and there are no sewer systems. Within this subwatershed, there is a dairy farm that applies the cattle waste to its fields. Bacteria and suspended solids are the primary pollutants of concern.

Highlights:

- Impaired physical habitat
- Frequent low-flow conditions
- Not enough non-embedded cover to cope with low flow conditions
- High percentage of impervious cover

NC1 – North Fork Currys Fork, Off Winding Creek Road

This site had a "Fair" MBI. It had the highest percentage of EPT (28.4%) with 6 EPT taxa. Looking at the functional feeding groups, the site was dominated by collector-filterers (43.7%) and had a fair amount of scrapers (25.8%) and a relatively low percentage of collector-gatherers (16.4%). Shredders were almost absent (0.7%). Low fish numbers were found in the stream, which resulted in a "Very Poor" IBI rating.

The RBP score indicated a poor physical habitat, but there was a fair embeddedness score (supported by the high abundance of primary clingers). Cover was bad as was bank stability and vegetative protection. Area land use was residential with some potential sources of NPS pollution (local erosion was moderate). Shading was less than optimal (50-75% canopy coverage). There was a chlorine odor indicating a treated water source nearby. Bedrock was the dominant substrate and therefore available in-stream cover was lacking.

According to the Strand analysis, approximately 36% of the watershed is developed by subdivisions. The primary pollutants of concern are bacteria, sediment, nutrients, and TDS. This subwatershed has double the developed area of any of the others. This subwatershed has the highest potential for NPS from urban areas. Specific conductance was elevated within this stream. Additionally, there are two package plants in the subwatershed having concerns of permit exceedances.

Highlights:

- Consistently elevated specific conductance
- Physical impairment
- Lots of potential for NPS runoff from highly developed areas.
- Package plant issues (potential organic loading)

SC1 – South Currys Fork, Off Carriage Point Drive

This site had a "Fair" MBI rating probably due to moderate taxa richness and a large abundance of midges and worms (39.6%). The mayfly abundance was also lowest at this stream (3.6%). There was a high abundance of collector-gatherers (34.1%) and collector-filterers (32.9%) though a good scraper population (28.6%). For fish, this was the best site with an IBI rating of "fair." This stream had similar fish results as Station CF2, but due to its smaller drainage area, the resulting IBI rating was "Fair" versus "Poor".

As indicated on the RBP sheet, there was low embeddedness at the site with frequent riffles and good riparian protection and this stream had a bedrock-dominated substrate. Overall, available instream cover was lacking and velocity/depth regime was not good either. Sediment deposition was prevalent. Bank stability was poor though vegetative protection and riparian zone width were fair. This could indicate excessive flows from upstream areas. Regardless, this reach had a good riffle/run/pool ratio. Specific conductance was elevated and pollutants of concern in this subwatershed are bacteria, DO, and sedimentation. This subwatershed had the highest bacteria levels in the entire watershed. Nutrients weren't excessively high so DO problems are probably an organic loading issue. There is limited buffer protection in the upper tributaries as 44% of the watershed is developed in subdivisions.

Highlights:

- Excessive flows and resultant physical instability are apparent
- Possibly an organic loading issue at this site based on DO issues from Strand monitoring and the abundant midges & worms
- Elevated specific conductance issues
- Lack of habitat (bedrock dominated)

The biological impacts found at the four Currys Fork stations were very similar and common to those found in other areas with a high degree of development in the watershed. Though metrics differed slightly between sites, all showed very apparent signs of impacts associated with development: physical instability, lack of habitat/substrate, sedimentation, and elevated conductivities. Inconsistencies in stream flow combined with a lack of available substrate/cover are very apparent impacts in the smaller streams. All station conductivities were found to be high enough to impact EPT diversity (especially mayflies) but probably doesn't solely explain the very low percentage of mayflies in the samples.

It is our opinion that the most successful 319(h)-funded BMPs for the Currys Fork watershed are those that would focus on preventing further physical degradation and those that would stabilize existing eroding areas. Primarily, the BMPs need to consistently promote stormwater infiltration and stream stability. There also appears to be a need to address water chemistry-related pollutants (primarily associated with elevated conductivities at three of the four stations, organic loadings at NC1 and DO problems at SC1). Increasing riparian zone width and installing bioinfiltration areas combined with stream stabilization in the worst areas would be the most beneficial use of grant-funded BMPs. Improvements associated with sewage overflows/collection could hopefully be funded through local government.

# # #

APPENDIX C
SEDIMENT AND GEOMORPHIC ASSESSMENT OF THE CURRY'S FORK WATERSHED

Companion Report to
Project Final Report

for

A Grant Awarded Through the
Section 319(h) Nonpoint Source
Implementation Program
Cooperative Agreement
#C9994861-06

under the

Section 319(h) Kentucky
Nonpoint Source Implementation
Grant Workplan "Curry's Fork
Comprehensive Watershed
Based Plan – Development and
Implementation"

Kentucky Division of
Water NPS 06-06
MOA PON2-129-0600002538

July 1, 2006 to
September 30, 2013

Sediment and Geomorphic Assessment of the Curry's Fork Watershed

UNIVERSITY OF LOUISVILLE
STREAM INSTITUTE

Michael A. Croasdaile
Arthur C. Parola, Jr.

of

The Stream Institute
Department of Civil and Environmental Engineering
University of Louisville
Louisville, Kentucky

The Energy and Environment Cabinet (EEC) and the University of Louisville Research Foundation, Inc., (a KRS164A.610 corporation) do not discriminate on the basis of race, color, national origin, sex, age, religion, or disability. The EEC and the University of Louisville Research Foundation, Inc., will provide, on request, reasonable accommodations including auxiliary aids and services necessary to afford an individual with a disability an equal opportunity to participate in all services, programs and activities. To request materials in an alternative format, contact the Kentucky Division of Water, 200 Fair Oaks Ln, Frankfort, KY 40601 or call (502) 564-3410, or contact the University of Louisville Research Foundation, Inc.

Funding for this project was provided in part by a grant from the US Environmental Protection Agency (USEPA) through the Kentucky Division of Water, Nonpoint Source Section, to Strand Associates, Inc., as authorized by the Clean Water Act Amendments of 1987, §319(h) Nonpoint Source Implementation Grant #C9994861-06. Mention of trade names or commercial products, if any, does not constitute endorsement. This document was printed on recycled paper.

Acknowledgements

Michael A. Croasdaile, PhD, Assistant Professor of Civil and Environmental Engineering (CEE) at the University of Louisville, was the principal investigator for this project and directed the collection and analysis of stream geomorphic data and the writing of the report.

Arthur C. Parola, Jr., PhD, PE, Professor of CEE and Director of the Stream Institute (ULSI), provided technical advice regarding data collection, analysis, and interpretation.

Clayton Mastin, MEng, ULSI Research Project Engineer, conducted the pond survey data collection.

CEE students J. Brandon Kolze, J. Duncan Gatenbee, Hannah Gill, Matthew Holthaus, and Michael Page assisted with data collection and GIS analysis. Dempsey Ballou assisted with data collection and conducted analysis of pond survey data. Danielle Dresch contributed to the data analysis.

Chandra Hansen, ULSI Research Technical Writer, edited drafts of the final report.

Contents

Figures and Tables

FIGURES

TABLES

Executive Summary

Siltation, or sedimentation, is one of the most common causes of stream impairment in the Commonwealth and within the United States. In Kentucky, Curry's Fork watershed is one of many listed as partial support for Warmwater Aquatic Habitat (WAH) and nonsupport for primary contact recreation (PCR). Sedimentation/siltation has been identified as one of the pollutant causes of this WAH impairment. The goal of this sediment assessment project was to assess and quantify water pollutant loads being contributed from different sources within the watershed. This assessment, which supplements the investigation by Strand Associates, Inc., ("Strand") of other pollutants cited for the Curry's Fork watershed, will support the development of watershed-scale management strategies to meet water pollution standards. The three objectives of the sediment assessment project were to estimate loads of fine sediment from each of four major subwatersheds, evaluate the relative contributions of different sediment sources, and interpret the possible links between the sediment loads and the WAH impairment. The project comprised three main activities: (1) sediment yield was measured as the mass of sediment leaving the subwatersheds over an annual period; (2) sediment production was measured as the mass of sediment eroded from stream banks, unmapped headwater channels, and upland surfaces; and (3) a geomorphic assessment was completed to identify other potential causes of WAH impairment.

The highest subwatershed sediment loads were measured in South Fork Curry's Fork; the lowest were measured in Asher's Run. The highest rates of sediment production from bank erosion were in the lower reaches of Curry's Fork subwatershed close to the confluence with Floyd's Fork where bank heights are over 10 ft. All blue line stream reaches had banks that were much higher than average in the vicinity of the confluence with larger receiving watercourse. The representativeness of reaches near confluences should be accounted for in biological/habitat sampling design.

Sediment production from upland surface erosion did not have clear spatial trends, reflecting the relative uniformity of geology, topography, soil types, and land use. Because of the lack of discrete areas with high upland surface erosion, consideration should be given to identifying potential locations for construction of storage areas or depositional zones to trap sediment eroded from the uplands. These storage areas could be constructed as wetlands at the base of hillsides or as small retention basins.

The vast majority of stream reaches in all subwatersheds were incised to bedrock, at least in pools, had a dearth of in-stream cover/submerged structures, and showed signs of channel straightening. Stream restoration projects to improve surface-groundwater connectivity, increase habitat diversity, reduce shear stress, reduce bank erosion, and create floodplain wetlands could be implemented in most stream reaches, with some reaches of North Fork Curry's Fork between the divided interstate being the main exception.

The availability of low-flow habitat is spatially variable and ecologically important in the Curry's Fork watershed. Water quantity can dramatically and directly impact water quality, especially when base flow discharge is low, temperatures rise, and mixing is reduced. Currently, wastewater treatment plant (WWTP) effluent is likely contributing water that maintains low-flow habitat downstream of discharge points. Future changes in WWTP effluent discharge quantities and locations may affect the availability of low flow.

In the Curry's Fork watershed, siltation generally did not occur as a result of large floods. Siltation tended to occur under much lower flow conditions, and fine sediment was in fact cleaned from the bed during large flood events that transported the highest total loads. A better understanding of the link between sediment production and the development of siltation as well as greater integration between sediment assessments and biological monitoring would improve the development of management strategies to reduce impairment associated with this nonpoint source pollutant.

Sediment and Geomorphic Assessment of the Curry's Fork Watershed

By Michael A. Croasdaile and Arthur C. Parola, Jr.

1. Introduction

Siltation, or sedimentation, is one of the most common causes of stream impairment in the Commonwealth (KDOW 2006) and within the United States (EPA 2000). Siltation affects aquatic communities by choking spawning gravels, impairing food sources, and reducing habitat complexity. Sediment impairment can be a product of several factors, including sediment supply in excess of transport capacity, inadequate sediment filtering by floodplains, and uniform in-channel deposition promoted by incised and entrenched channels.

In Kentucky, 3964 miles of streams assessed for WAH are listed as impaired; for 69 percent of these, sediment is cited as a cause of the impairment (KDOW 2008). These sediment-impaired streams include those watercourses with the following terms listed as the cause of impairment: sediment/ siltation, particle distribution/embeddedness, physical substrate alterations, solids suspended/bedload, bottom deposits, turbidity, and total suspended sediments. Curry's Fork watershed is listed as partial support for Warmwater Aquatic Habitat (WAH) and nonsupport for primary contact recreation (PCR) (KDOW 2008). Sedimentation/siltation was identified as one of the pollutant causes of this WAH impairment. Other pollutants identified for WAH impairment were nutrient/eutrophication biological indicators and dissolved oxygen. Fecal coliform is responsible for PCR impairment.

The goal of this sediment assessment project was to assess and quantify water pollutant loads being contributed from different sources within the watershed. This assessment, which supplements the investigation by Strand Associates, Inc., ("Strand") of the other pollutants cited for the Curry's Fork watershed, will support the development of watershed-scale management strategies to meet water pollution standards. Results of Strand's investigation are being reported separately.

The three objectives of the sediment assessment project were to estimate loads of fine sediment from each of four major subwatersheds, evaluate the relative contributions of different sediment sources, and interpret the possible links between the sediment loads and the WAH impairment. The project comprised three main activities: (1) sediment yield was measured as the mass of sediment leaving the subwatersheds over an annual period; (2) sediment production was measured as the mass of sediment eroded from stream banks, unmapped headwater channels, and upland surfaces; and (3) a geomorphic assessment was completed to identify other potential causes of WAH impairment.

2. Methods

The delivery of sediment from source to watershed mouth can be split into three components: sediment production, storage and transport, and yield (USEPA 1999) (Figure 2.1). These three components informed the Curry's Fork watershed sediment assessment, which was completed in two steps. First, sediment yield was monitored at the mouth of each subwatershed. Second, at representative sites in each subwatershed, sediment production was monitored. A geomorphic assessment of the sediment assessment reaches and adjacent upstream reaches was undertaken concurrently to identify some of the local morphological controls on sediment erosion and deposition and to investigate how these controls influence the physical habitat.

2.1 FINE SEDIMENT YIELDS

Fine sediment yield is the mass of sediment leaving a watershed over a specific period of time. Measurements of suspended sediment concentration and discharge were obtained from water samples and continuous monitoring of turbidity, water surface elevation, and average flow velocity. The sediment yield was calculated as the product of the suspended sediment concentration and discharge. Sediment yield was calculated over an annual period to incorporate the variations that occur within single flood events, between different flood events, and between different seasons.

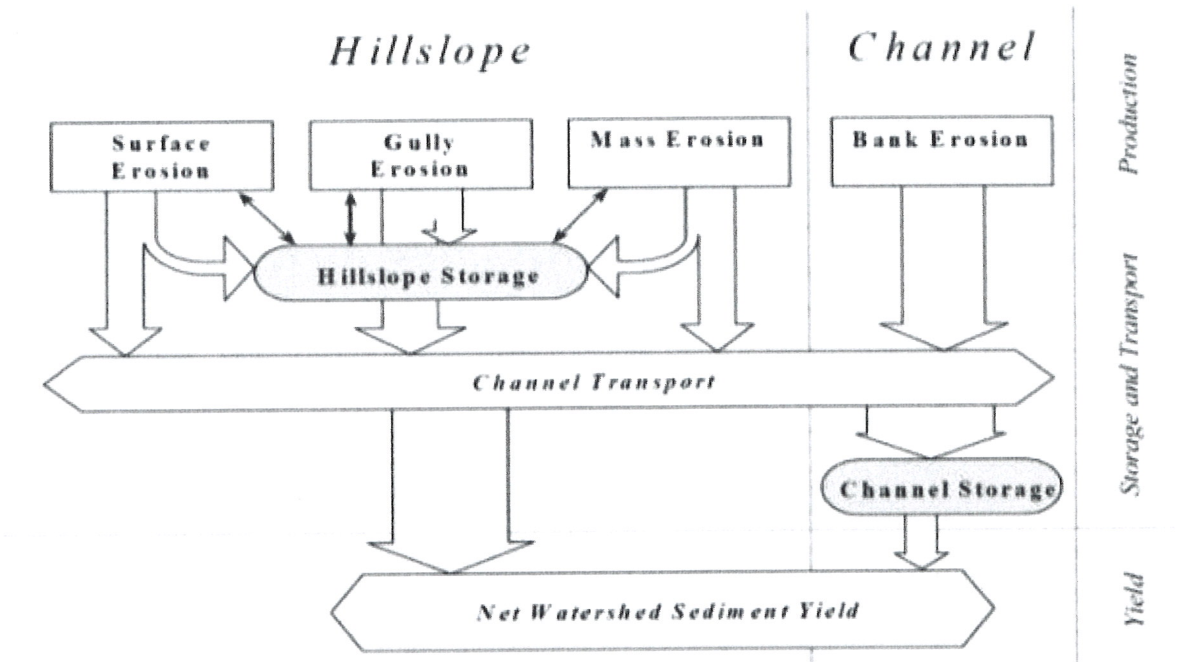


Figure 2.1 Different components of the sediment delivery system (USEPA 1999).

Site Selection

Data for calculating sediment yield were collected near the mouths of each of the four subwatersheds (Table 2.1). The main criteria for selecting measurement locations near each mouth were access and a stable grade control on which to install monitoring equipment. Bedrock was located to provide a solid base for installation and to ensure that stage-discharge relationships were not affected by scour of the bed. Data-logging equipment had to be located as high as possible to minimize the possibility of flood damage, so a high bank or bridge was used where available.

Table 2.1 Sediment Yield Sites

Site Name	Subwatershed	Latitude	Longitude	Drainage Area (mi^2)
CF2	Curry's Fork	38.31052	–85.45012	24.5
NC1	North Fork Curry's Fork	38.35948	–85.43795	10.0
SC1	South Fork Curry's Fork	38.35688	–85.43672	9.2
TB1	Asher's Run	38.30936	–85.44632	3.3

Data Collection

Although various methodologies for measuring annual suspended sediment loads may be appropriate for various watershed conditions (Gray and Gartner 2009), the same methods were applied to each subwatershed in this study so that the relative magnitude of sediment transport in each subwatershed could be viewed with more confidence than if separate sampling designs had been used. A monitoring station was established at each yield measurement site. The stations collected water samples and recorded measurements of turbidity, water surface elevation, and average flow velocity.

Each sediment monitoring station had three pieces of equipment: an ISCO automated pump sampler (Model 6712) with a 750 area-velocity module; a Campbell Scientific (previously D&A Instruments) OBS3+ turbidity sensor; and a Campbell Scientific CR200 datalogger. The ISCO was used to collect water samples during floods because manual sampling would have been impractical (at night, for instance) or dangerous (when velocities were very high). The inlet to the ISCO was mounted on a hinged rod attached to the bed. The rod had a float attached to the end that kept the sensor above the stream bed and away from bedload movement (Figure 2.2). A water sample was taken every 10 minutes after the stage had reached a trigger value. At CF2, the ISCO was triggered after a 1-ft rise on water stage; at SC1 and NC1 it was 0.5 ft; and at TB1 it was 0.5 ft. The ISCO collected 24 one-liter samples. The area-velocity module attached to the ISCO measured the water surface and the average velocity in the water column above the turbidity sensor.

The turbidity sensor was connected to the datalogger and attached to the rod at the same height as the ISCO inlet, at approximately half of the flow depth. During floods where the water stage was above the length of the 5-ft rod, the sensor was at less than the half the depth. The sensor did not have a wiper, so its face was cleaned every two weeks to limit biofouling. The sensor had a high nephelometric turbidity unit (NTU) range (0-4000 NTU) for recording data during very turbid flows. It recorded 60 individual NTU readings at 1Hz and stored the mean value and the standard deviation. Two alternating sets of data were recorded: the low range sensor (0-1000 NTU) first for 1 minute, then the higher range sensor (0-4000 NTU) for 1 minute.

Figure 2.2 Typical ISCO set-up with intake on hinged rod.

Monitoring began in late 2007 and continued through the beginning of 2010. During 2008, the sensors and/or loggers at all sites were offline due to mechanical problems or, in one instance, flood damage. The data for January through December 2009 were relatively complete at all sites and represented the seasonal variations throughout an entire year.

Analysis Methods

Stage and velocity data were used to calculate discharge. The 24 one-liter water samples collected by the ISCO were analyzed for suspended sediment concentration (SSC) using standard methods (Fishman and Friedman 1989). An SSC-turbidity relationship was developed by ordinary least squares regression between the SSC from water samples and the turbidity readings recorded during the same time intervals (Figure 2.3). This relation was then applied to all turbidity readings to estimate SSC for each reading. Where the turbidity reading was above 1000 NTU, the data from the upper range sensor was used; below 1000 NTU, the lower sensor data was used. Data correction routines in Aquarius Time Series analysis software were used to remove faulty readings (i.e., values below 0 NTU and/or above the sensor limit of 4000 NTU) and to interpolate between good readings.

The SSC estimated from the application of the relation to the turbidity readings was multiplied by discharge to give yield sediment masses for each 10-minute time interval. All sediment transport in each time interval was summed over the duration of 2009 to calculate total load (tons/yr). For large storm events, the turbidity at each site was plotted against discharge in two parts: (1) for the rising limb of the hydrograph and (2) for the falling limb of the hydrograph. The resultant plot was visually evaluated to infer information on sediment sources based primarily on direction of hysteresis (Williams 1989).

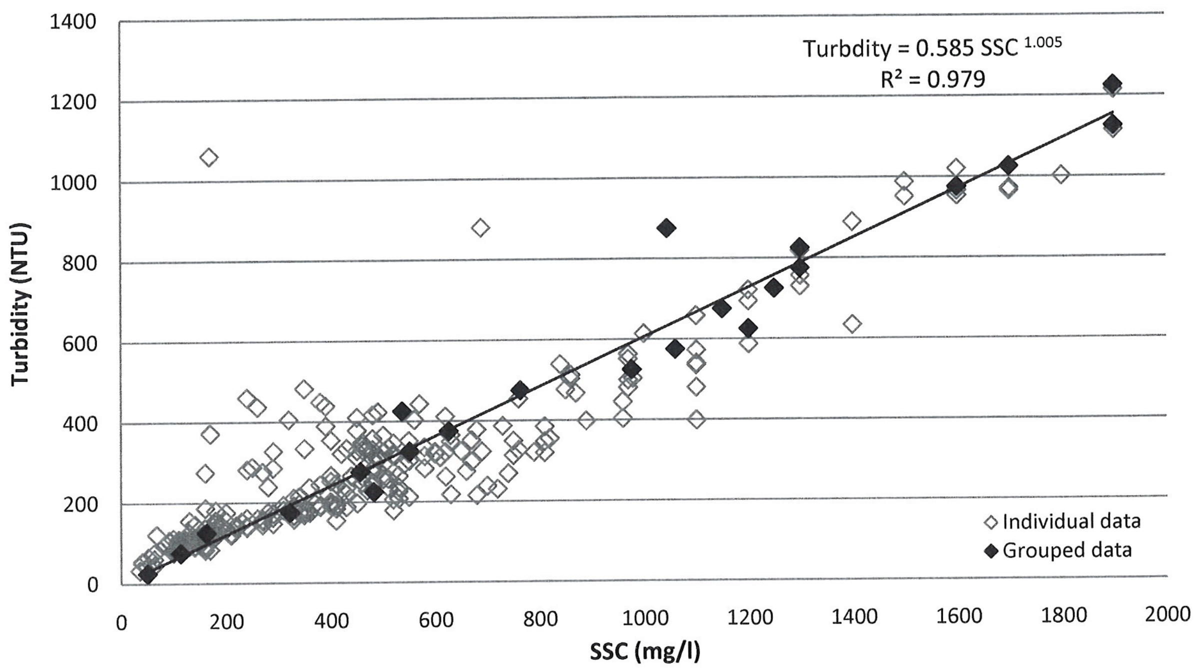


Figure 2.3 Turbidity-suspended sediment concentration used to calculate mass of sediment transported.

2.2 SEDIMENT PRODUCTION

The major sources of fine sediment that were selected for measurement in each subwatershed were the contributions from stream bank erosion, unmapped headwater channels, and upland surface erosion. Mass erosion processes such as landslides and debris flows (Cenderelli and Kite 1998; Eaton et al. 2003) were not considered to be significant sediment sources in the Curry's Fork watershed and were not assessed. Sediment from construction sites may be locally significant but was not assessed because guidelines for erosion prevention and sediment control already exist (e.g., Tonning 2007), and therefore these potential sources were not targeted in this study as opportunities for load reduction. One construction site was considered to be a potentially significant source of sediment but was located above Crystal Lake, and sediment from the site was assumed not to reach downstream waters.

2.2.1 Bank Erosion

Bank erosion hazard index (BEHI) readings, near-bank stress (NBS) readings, and erosion pin measurements were used to estimate bank erosion. BEHI is an assessment procedure that measures the potential for a streambank to erode when a stress is applied to it. Points are assigned to different categories that are significant in prediction of stream bank erosion: bank height ratio, bank angle, root depth, root density, and bank protection (Table 2.2 and Figure 2.4). Adjustments for bank materials (e.g., adding 10 points for sand) and for stratification (e.g., adding 5-10 points for an unstable layer) are permissible but were not typically necessary in the Curry's Fork watershed. The greater the total index value is, the higher the potential for erosion.

Use of erosion pin measurements and BEHI and NBS readings in a graphical prediction model (Figure 2.5) is a common method for estimating erosion rates for unsurveyed reaches

Table 2.2 BEHI Cross Section (Rosgen 2001)

Adjective Hazard or Risk Rating Categories		Bank Height/ Bankfull Height	Root Depth/ Bank Height	Root Density (%)	Bank Angle (Degrees)	Surface Protection (%)	Totals
VERY LOW	Value	1.0-1.1	1.0-0.9	100-80	0-20	100-80	
	Index	1.0-1.9	1.0-1.9	1.0-1.9	1.0-1.9	1.0-1.9	5-9.5
LOW	Value	1.11-1.19	0.89-0.5	79-55	21-60	79-55	
	Index	2.0-3.9	2.0-3.9	2.0-3.9	2.0-3.9	2.0-3.9	10-19.5
MODERATE	Value	1.2-1.5	0.49-0.3	54-30	61-80	54-30	
	Index	4.0-5.9	4.0-5.9	4.0-5.9	4.0-5.9	4.0-5.9	20-29.5
HIGH	Value	1.6-2.0	0.29-0.15	29-15	81-90	29-15	
	Index	6.0-7.9	6.0-7.9	6.0-7.9	6.0-7.9	6.0-7.9	30-39.5
VERY HIGH	Value	2.1-2.8	0.14-0.05	14-5.0	91-119	14-10	
	Index	8.0-9.0	8.0-9.0	8.0-9.0	8.0-9.0	8.0-9.0	40-45
EXTREME	Value	>2.8	<0.05	<5	>119	<10	
	Index	10	10	10	10	10	46-50

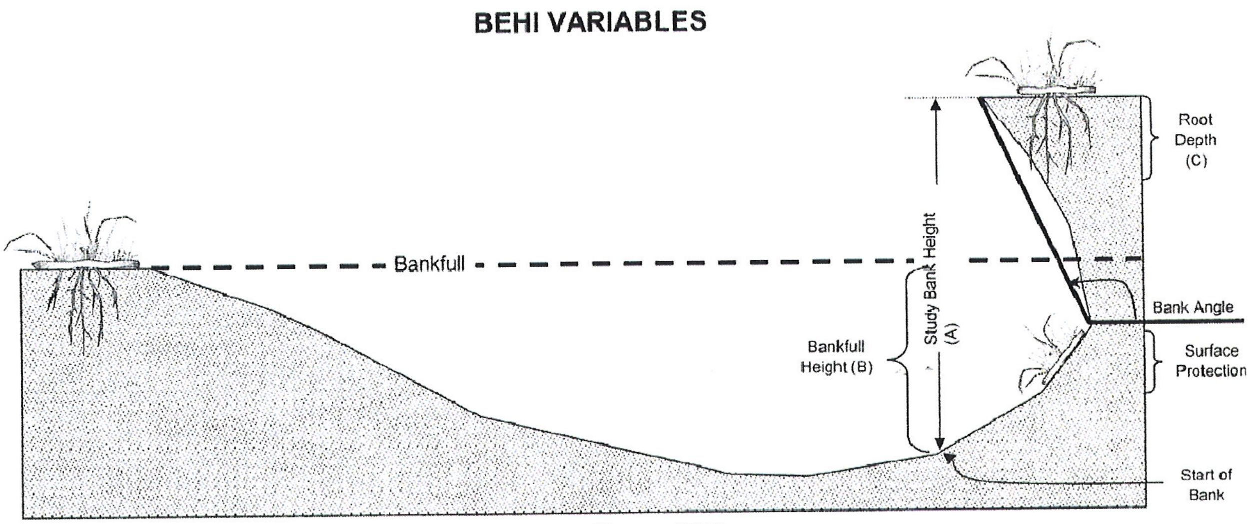


Figure 2.4 Definition sketch for obtaining BEHI parameters (Rosgen 2006).

(Rosgen 2001). Erosion rates measured using erosion pins are plotted against NBS for each category of BEHI. From this plot, the erosion rate can be predicted for any sites where NBS and BEHI are estimated.

Site Selection

Reaches for bank erosion measurements were delineated from NHD streamlines (Figure 2.6). These reaches (Figure 2.7) were adjacent to sediment yield measurement sites (Table 2.1) or Strand water quality sampling sites. Erosion pin sites in each reach were chosen according to the protocol in Rosgen (2001) such that measurements were made at banks with a range of BEHI and NBS combinations (e.g., very low BEHI/low NBS; high BEHI/moderate NBS; etc.). A total of 86 erosion pin measurements were made in all subwatersheds at a total of 29 sites. The BEHI/NBS assessment was conducted on all erosion pin measurement reaches and their adjacent reaches. A total of 27 reaches were selected for BEHI/NBS assessment (Table 2.3).

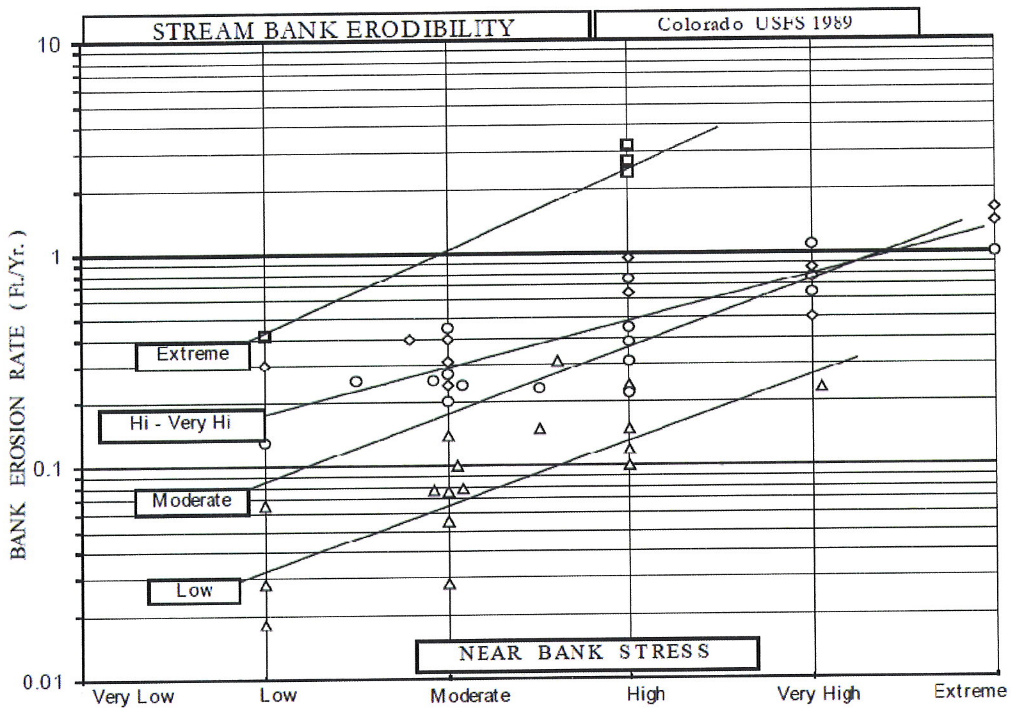


Figure 2.5 Bank erosion rate vs. NBS for each BEHI class (Rosgen 2001).

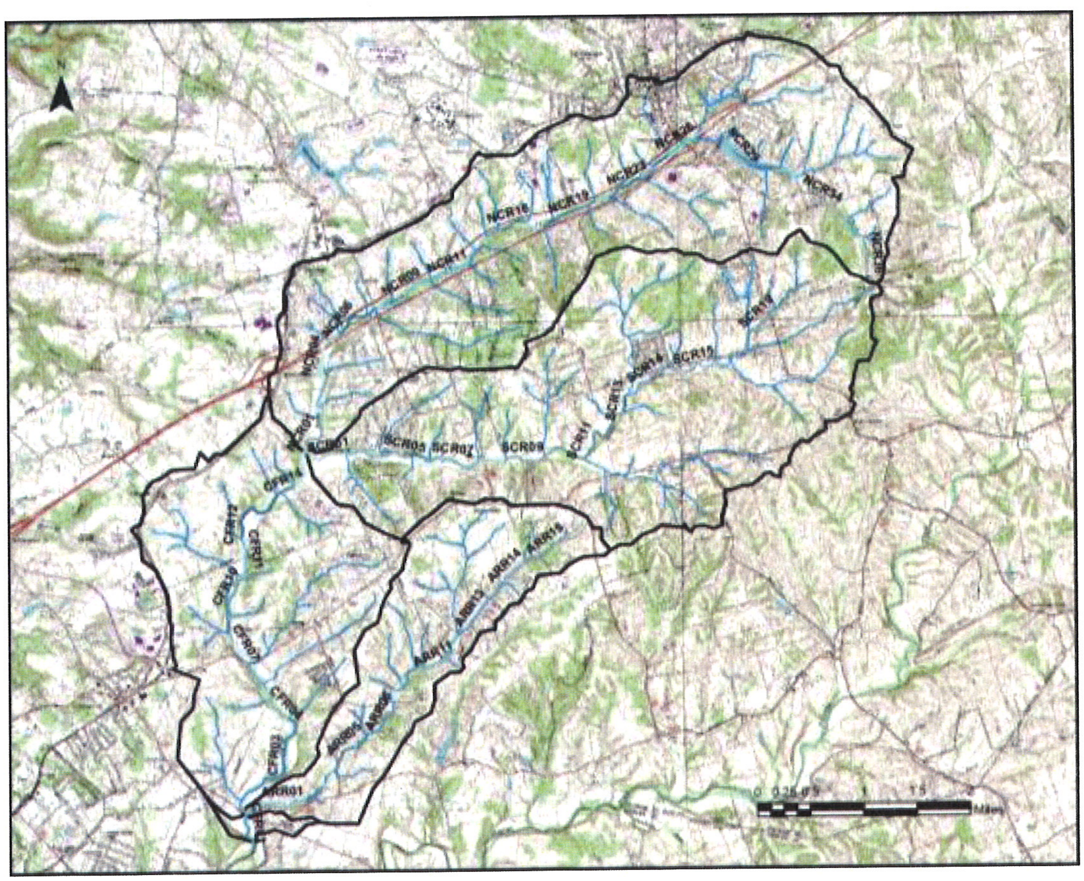


Figure 2.6 Reach IDs.

Table 2.3 Reach Identification for BEHI/NBS and Geomorphic Assessments

Subwatershed	Reach IDs	Total Length (ft)
Curry's Fork	CF01, CF02, CF03, CF12, CF13, CF14, CF15	10,943
North Fork	NC01, NC02, NC03, NC15, NC16, NC17, NC18, NC19	8,760
South Fork	SC01, SC02, SC03, SC04, SC07, SC13, SC14, SC15	9,872
Asher's Run	AR01, AR02, AR05, AR06	4,200

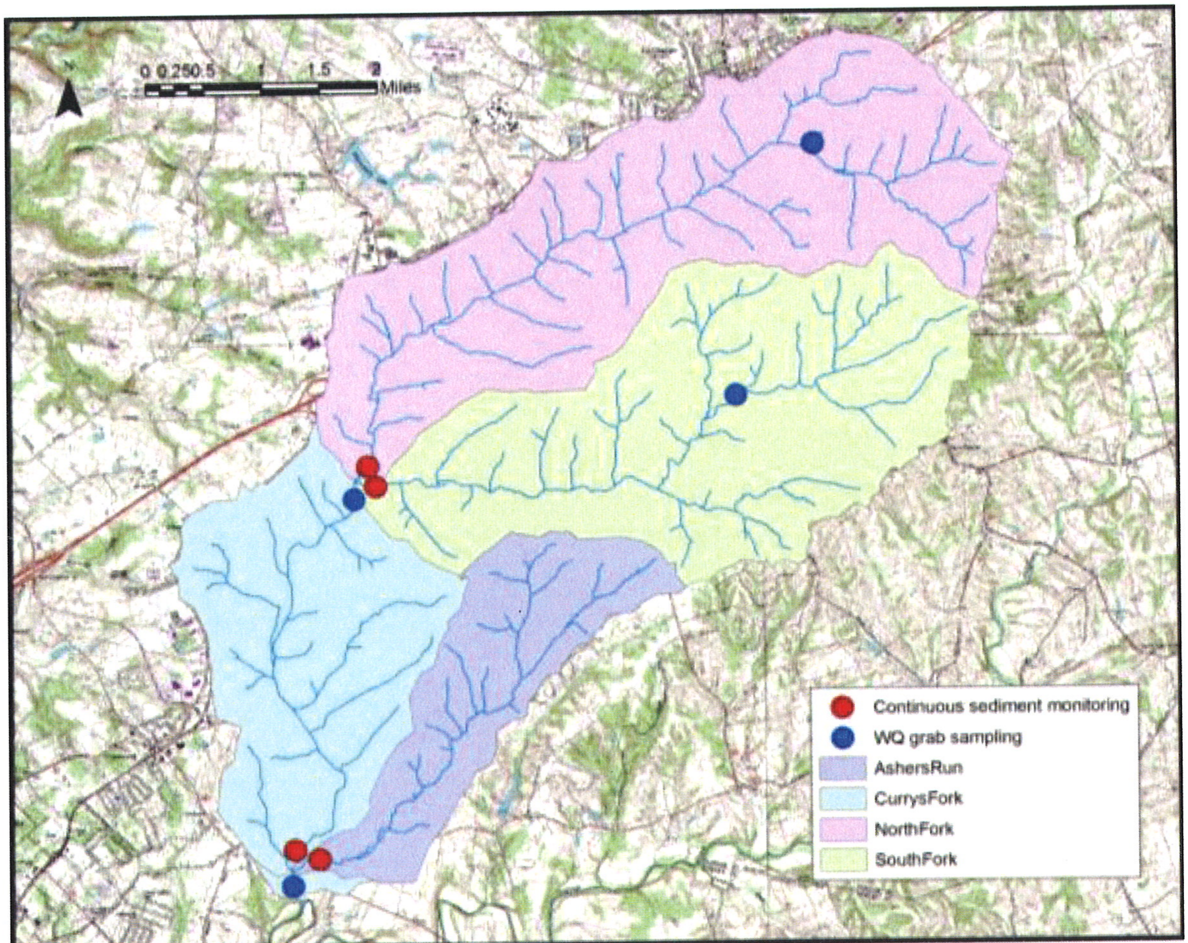


Figure 2.7 Locations of continuous sediment monitoring, water quality grab samples, and the major subwatersheds.

Data Collection

Eroding Bank Inventory

The locations and characteristics of eroding banks were inventoried for at least four reaches of each major subwatershed of the Curry's Fork watershed. At each eroding bank, the location of the upstream and downstream extent of the bank was measured using a hand-held GPS. GPS readings were averaged for at least 60 seconds to ensure a reliable position. The following parameters were measured and photographed in order to calculate the BEHI indices:

1. *Bank height* was measured with a ruler from the bank toe to the top of the eroding bank face. The bank toe was delineated as the transition from bed to bank sediments. This transition was often at the intersection of bedrock on the bed and fine-grained alluvial deposits that compose the banks. In some places, the transition was between bedrock and fine gravel. The top of the eroding bank face was determined by the presence or absence of perennial covering vegetation.
2. *Bankfull depth* was estimated from bankfull benches within each reach; often a bankfull bench was not present adjacent to the eroding bank, but the bankfull depth was assumed to be representative of the reach as a whole.
3. *Bank angle* was measured simply by measuring the height of the bank and the horizontal distance from the bank toe to the top of bank using a pocket rod. Where the shape of the bank was more complicated (such as an overhanging bank), the height and horizontal run of the steepest face was measured.
4. *Root depth* was measured from the top of the bank to depth at which significant amount of root material was found. In practice defining a line where most of the roots stopped was simple, as the bedrock or weathered bedrock fragments often marked the rooting depth. Occasionally, a few roots penetrated deeper than the majority; in these situations the rooting depth included the outlier if it was a large tree root. Small thin roots below the average rooting depth were not included.
5. *Root density* was estimated as the percentage of the soil that was composed of roots in the zone where roots were present.
6. *Bank protection* was measured by visually determining how much of the bank was not exposed to surface erosion processes. Sod mats, large woody debris, and rip-rap are common types of surface protection.
7. *Bank material type and stratigraphy* was visually assessed at each bank. The BEHI method distinguishes between bedrock, boulders, cobble, gravel, and sand, all of which were easily identified in the field without subsequent laboratory tests. No adjustments are recommended for silt/clay bank materials, which were by far the most common material in all of the assessed reaches. Bedrock was present only at the bank toe and the channel bed at nearly all assessed banks.

Because two identical stream banks may erode differently depending on the energy distribution against the stream bank, Rosgen (2006) uses the near bank stress (NBS) to index the energy distribution, which can be estimated in various ways. No guidance is given by Rosgen (2006) as to how estimates of NBS ratings from different methods are to be compared. The most meaningful method is to collect velocity measurements for different flows, draw velocity profiles in the near bank zone, and then calculate shear stresses from the velocity gradients. This approach, however, is extremely time consuming, and obtaining velocity measurements during floods would require access during infrequent flood flows and would involve considerable risk both for equipment and field personnel. The visual assessment method is the most rapid methods provided by Rosgen, requiring no quantitative measurements, but nevertheless can be an "accurate, appropriate method" (Rosgen 2006, p. 5-67). In this project the planform method (Rosgen 2006, p. 5-67) was used but was modified to include entrenchment and stream gradient, both of which influence NBS (Table 2.4).

Table 2.4 NBS Ranking

Points	Planform	Entrenchment	Gradient
Low or very low	Straight or inside of bend	No entrenchment	Below reach average (pool, backchannel)
Moderate or high	Outside of bend	Moderate entrenchment	Reach average (glide, run)
Very high or extreme	Converging, chute flow	Highly entrenched	Above reach average (riffle or rapid)

The modified visual assessment proved to be easy to apply and replicate assessments of the same site by trained personnel resulted in identical categorization. The scheme applied to the banks in each sub-watershed was developed after walking many miles of stream channels and so was calibrated to local conditions. To develop a similar scheme for a different watershed might require different weightings of each parameter. For example, in low-gradient sandbed streams, the slope may be very difficult to visually estimate, and woody debris jams may be a more significant control on NBS.

Bank Pin Measurements

Annual erosion rates were determined by installing erosion pins in eroding banks. The sampling strategy was based on obtaining a matrix of different BEHI rankings for each NBS rating so that a graphical model could be developed. Erosion pins were made from 2-to-3-ft steel rods, 0.25 inches in diameter. The erosion pins were installed at the low-flow water surface, at the bankfull level, and midway between the bankfull level and the top of the bank. In short banks (< 2 ft high) only two pins were installed: at the water surface and the bankfull level. The location of the bank pins was determined to give a range of representative conditions within a particular reach from slowly eroding banks to the banks experiencing severe erosion. The erosion pins were installed horizontally and carefully hammered into the bank until the end of the pin was flush with the bank surface.

The bank pins were installed from September to November 2007, and their GPS locations were recorded. The GPS points and a handheld metal detector were used to find the pins on subsequent survey visits. Each of the pins were resurveyed in August 2008, January 2009, and July 2010. The erosion pins were checked during those months to account for the influence of temperature on bank weathering processes.

The protrusion of the erosion pins was measured to the nearest 0.01 ft using a pocket rod, and then the pins were hammered into the bank until flush. The downside of installing the pins flush with the bank is that negative readings are difficult to detect. However, a metal detector was sensitive enough to detect most buried pins, and hence the depth of accumulated sediment could be estimated, albeit with less precision than exposed pins because of the disturbance to the bank profile caused by uncovering the pins.

Analysis Methods

Streambank Erosion

The average erosion rate for each bank was determined by weighting the rate measured at each erosion pin by the proportion of the bank represented by each of the pins. Typically, the top pin covered about 50 percent of the height of the bank, whereas the lower two pins covered 20-30 percent each. The weighted average of the three pins was used in calculations of sediment production. The annual rate of erosion, e_r (ft/yr), was determined by dividing the length of exposed erosion pin by the duration of field deployment in days and then multiplying by 365; final results presented represent the erosion between August 2008 and July 2010.

Erosion rates were plotted against NBS score for each BEHI category. The plot was visually evaluated to see if a clear relationship between erosion rate and NBS was apparent. The BEHI-NBS data were tested for statistical significance using Minitab 16; none of the BEHI or NBS parameters were significantly correlated with erosion rate at $p = 0.05$. Therefore, instead of using the BEHI-NBS method, the reach-averaged volumetric rate of sediment produced from bank erosion, V_B (ft^3/yr), was calculated from

$$V_B = (L_{LB} \times H_{LB} \times e_r) + (L_{RB} \times H_{RB} \times e_r) \tag{2.1}$$

where L (ft) is length of bank eroding, H (ft) is bank height, e_r (ft/yr) is erosion rate, and the subscripts $_{LB}$ and $_{RB}$ denote the left and right bank, respectively. The volumetric rate of sediment production estimated using this simplified method should be viewed with some caution, as the erosion rate data set was limited for each subwatershed (except SC2).

The mass of sediment produced from bank erosion per unit length per year, m_B (lb/ft/yr), was then calculated from

$$m_B = \frac{V_B \times \rho_b}{L_R} \tag{2.2}$$

where ρ_b (lb/ft^3) is the average bulk density of bank sediments and L_R (ft) is the length of the reach. The total mass for the blue line streams in each subwatershed was then estimated by multiplying m_B by the length of blue line streams.

Unmapped Channel Erosion

In the Curry's Fork watershed, many headwater channels not shown as blue line streams on USGS topographic maps are distinct watercourses with eroding banks. Estimating the sediment production contribution from bank erosion requires an estimate of the extent of these unmapped channels. The starting point for these channels, and hence the channel network, is the channel head. By determining the drainage area, or flow accumulation area, at which channel heads occur, a channel network can be generated using standard GIS routines. These generated networks can then be combined with field measurements of bank erosion to estimate sediment production rates for the networks.

Drainage areas of each channel head were measured from 30-ft resolution DEMs. The drainage areas of all channel heads were tabled, and summary statistics (mean, median, mode, standard deviation) were calculated.

Channel networks were generated in ArcGIS Spatial Analyst using the channel head measurements as the point at which the channel network begins. The channel network generation was performed on a 30-ft resolution DEM for the Curry's Fork watershed according to the following steps:

1. Calculate flow direction for each cell (Jenson and Domingue 1988).
2. Calculate flow accumulation for each cell (Jenson and Domingue 1988).
3. Identify the flow accumulation threshold value that represents the start of the channel network, and designate all cells below this value as channel.
4. Calculate stream order (Strahler 1957).
5. Convert raster dataset to vector.

6. Calculate length of channel network.

Sediment production from unmapped channels was estimated using Equation 2.1. The length of the eroding bank was estimated in GIS, bank heights were mapped in the field, and the erosion rate was estimated form erosion pin measurements.

A number of channel networks were generated to see which best represented the real channel network, and hence provided the most accurate measure of bank length. The flow accumulation area for the channel heads was changed in each network while all other parameters were kept constant. The channel heads ranged from less than 0.5 acres to more than 6 acres; some of the variation was due to the presence of a pipe, a pond, or another artificial structure at the channel head. These modified channel heads were not excluded because they represented common conditions in the watershed. The mean, median, and mode of all channel heads were used as initial flow accumulation areas. Also, the mean, median and mode ±1 standard deviation was used.

The field measurement locations were overlaid on the drainage network, and the Strahler stream order of each assessed reach was recorded. An average bank height and percentage of eroding bank were calculated for Strahler orders 1-3 separately. The averages were weighted by the lengths of the assessed reaches.

The average bank height and percentage of eroding bank were then used to calculate estimated sediment production rates for all Strahler 1-3 channels in each subwatershed. The erosion rate used was the weighted average of all erosion pin readings (n = 86) taken from sites with a drainage area less than 3 mi^2 (n = 29).

2.2.2 Upland Erosion

Soil erosion models are a widely used method of estimating upland erosion rates because instrumenting every hillslope and valley in a watershed is time- and cost-prohibitive. Use of soil erosion models without field measurements, however, is subject to great uncertainty and may produce results that are contrary to observed conditions (Trimble and Crosson 2000: Reid and Dunne 2006). In this study, field measurements at a number of ponds were made to obtain local sediment loads. These were coupled with a spatially-distributed model to cover as much of the watershed as possible. Additional measurements at pond sites were used to assess the accuracy of the modeling efforts to ensure that the results were sensible and realistic.

Site Selection

The four main criteria for pond selection were a known period of deposition (±10 percent), a clearly defined drainage area upslope of the pond, a minimum channel network upslope of the pond, and an outfall/spillway configuration that would lead to a high trapping efficiency (Verstraeten and Poesen 2001). Ponds on top of a ridge were therefore excluded, as were ponds with extensive bank erosion above the inlet and ponds with an outflow that was low enough to be frequently overtopped. The period of deposition was typically the time since construction or the time since the pond was dredged or cleaned out. The period of deposition had to be at least 10 years so that an easily measurable amount of sediment would have accumulated. In addition, ponds had to be accessible by vehicle. Ten ponds were selected for surveying (Figure 2.8).

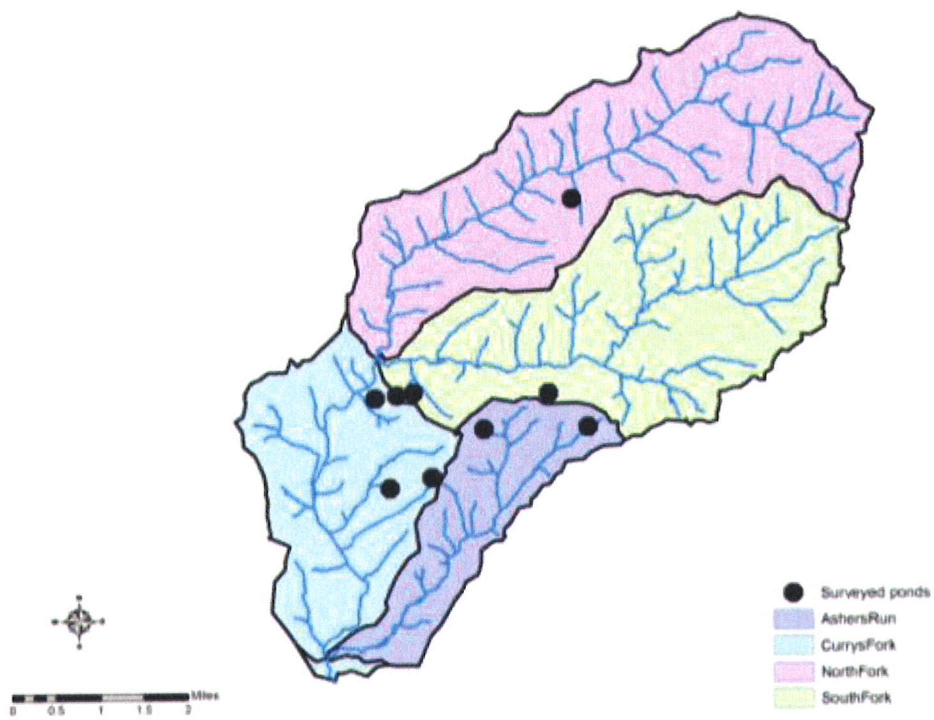


Figure 2.8 Surveyed ponds in the Curry's Fork watershed.

Data Collection

Area of deposition, volume of sediment deposition, and bulk density were measured at each pond. The pond perimeter and the volume of sediment deposited above the water surface were surveyed using standard total station equipment and methods. The pond perimeter was defined as the top of deposited sediment. Deposited sediment was visually distinct from the eroded soil in that it was generally layered, poorly consolidated, and minimally vegetated. Depth measurements could not be obtained using the total station due to the difficulty in keeping the boat and survey rod still enough to take a reading. Instead, a survey grid around the pond perimeter was established, and cross-section measurements collected from the boat were referenced to that survey grid. The number of cross-sections surveyed ranged from 4 to 11 and was determined by the size and shape of the pond size. Along each cross-section, two measurements were made: the depth to the top of deposited sediment and the bottom of deposited sediment (marked by increased resistance due to bedrock or clay liner).

To estimate bulk density, a series of sediment cores were collected in each pond using a modified Open Push Tube Sampler (ASCE 2000; McKean and Nordin 1986). At least five submerged cores were collected at each pond. All submersed sediment cores were extracted from the PVC on site using compressed air and were transferred to the laboratory for further analysis.

Sediment cores collected above the water surface could not be extracted without removing surrounding sediment, so a modified collection procedure was used. Only one surface core per pond was collected because this sediment covered a much smaller area than the submerged sediment. A thin-walled PVC tube was inserted until stiff resistance was met. The core was then loosened by removing the surrounding sediment using a spade and by hand. Once the core was detached from the surrounding sediment, the core was twisted and removed for further analysis.

Analysis Methods

Pond Survey Data

The in situ bulk density, ρ_C (lb/ft^3), of each sediment core was calculated from

$$\rho_C = \frac{M_C}{V_C} \tag{2.3}$$

where M_c (lb) is the oven dried mass of the core, and V_c (ft^3) is the in situ volume of the core. The mass was obtained after the samples were dried in the oven at 110°C for 24 hours. The in situ volume was used because (1) this volume was measured for many points, not just core locations, and (2) the in situ volume was easier to accurately measure than the volume after drying when the sediment core shape became very irregular. The bulk densities for submerged sediment cores in each pond were averaged to give ρ_{subm}; the bulk density for the sediment toe at the pond inlet is denoted ρ_{toe}.

The cross-section data collected in the field were entered into an Excel spreadsheet, and two lines were generated at each cross-section, one for the top of the deposited sediment layer and one for the bottom of the deposited sediment, representing the original land surface prior to pond construction.

The cross-sectional data were then exported to AutoCAD together with the perimeter survey and data surveyed above the water surface. A triangular grid network (TIN) was generated for both the top and bottom of deposited sediment using automated routines in the Autodesk Land Desktop Terrain Editor. The difference in volume between the two TINs was calculated in AutoCAD and represented the volume of deposited sediment. Separate TINS were generated for the sediment toe at the pond inlet, which was above the water surface. The volume of submerged sediment was then multiplied by ρ_{subm} for each pond to calculate the mass of submerged sediment in each pond. The above water sediment mass was calculated in the same way using ρ_{toe} values.

GeoWEPP Modeling

The GeoWEPP (Geo-spatial Interface for Water Erosion Prediction Project) was selected because it is relatively easy to use, uses commonly available geo-spatial datasets and uses the widely-used and physically based WEPP model. The WEPP model has the advantage over the Universal Soil Loss Equation in that it models soil loss and deposition, rather than soil loss alone. More documentation on the WEPP model is given in Flanagan and Nearing (1995); more documentation regarding the GeoWEPP interface is given in Minkowski and Renschler (2008).

The inputs for the GeoWEPP simulations were the National Land Cover Database (2001), soil types (USDA-NRCS SSURGO data), and topography (USGS 30-ft DEM). To run GeoWEPP, each soil type was converted into a GeoWEPP soil file, which has various soil properties such as interrill erodibility, critical shear, effective hydraulic conductivity, percent organics, percent clay, etc. Similarly, the land cover type was converted into a GeoWEPP management file. The GeoWEPP simulation runs for a user-specified interval. The Curry's Fork watershed GeoWEPP simulations were run using 50 years of climate data from the Louisville International Standiford Field airport climate station (USDA-ARS 2010).

2.3 GEOMORPHIC ASSESSMENT

Sediment production and deposition are complex processes that are based on local morphology and the recent history and water and sediment delivery to a particular reach. A geomorphic assessment of Curry's Fork was undertaken to identify some of the local morphological controls on sediment erosion and deposition and to investigate how these controls influence the physical habitat. The assessment included desk-based GIS analysis and a field investigation.

Site Selection

The focus was the main stem of each subwatershed as shown by the blue line streams on the USGS 7.5 minute topographic quadrangles. Data for the GIS assessment was collected from the same reaches assessed for BEHI/NBS ratings. A total of eight reaches of the main stem blue line streams in all four subwatersheds were selected for the field geomorphic assessment. The downstream limit of the reach coincided with a confluence with a receiving stream or a major tributary. A confluence or bridge was selected as a reference point that marked the downstream limit of each reach. The exception was in North Curry's Fork between the I-71 divided highway, where access was the primary consideration for reach length; access points to the stream were rare, so the downstream limit was chosen where field crews could get to the stream channel. The length of the assessment reach was typically between 1400 ft and 3000 ft in order to include representative variability in morphology and habitat function.

Data Collection

The main sources of data for the GIS data collection were USGS 7.5-minute topographic quadrangles, aerial photographs, and the National Hydrography Dataset (USGS 2009). The aerials used were primarily Jefferson County 2006 digital orthoimagery (LOJIC 2009) and 2006 NAIP 2-ft orthoimagery (KDGI 2009) in the headwaters that were not covered by the Jefferson County data. The main stem of each subwatershed was broken into a series of reaches that make up the NHD polylines, as was done for the eroding bank inventory.

The following parameters were measured for each reach in ArcGIS using standard functions:

- Sinuosity
- Valley width
- Stream width
- Riparian corridor width

The following parameters were observed directly from aerials or from topographic maps:

- Dams and weirs
- Bridges or culverts
- Floodplain development
- Bank armoring
- Berms and roads

- Channel pattern

The presence or absence of each of these 10 parameters was recorded in spreadsheet format for each reach.

At each blue line stream reach selected for field assessment, the channel and the floodplain were photo-documented using a high-resolution digital SLR camera and a handheld Geographical Positioning System (GPS) receiver pre-loaded with USGS 1:24,000 topographic maps. The geo-referenced photo-documentation was initiated at the downstream reference point and continued to the pre-identified upstream limit of the reach. At regular intervals (not more than 10 channel widths), a GPS reading and photograph were taken. The identifier numbers of each photograph and its corresponding GPS data point were synchronized so each photograph could be tied to a specific geographic location. To maximize the accuracy of GPS measurements, multiple readings (typically 30-60) were averaged to produce each GPS data point.

The geomorphic assessment differed from the Rosgen method (Rosgen 2006) that relies on a definition of a bankfull stage, which may not present or may not correspond to the active floodplain in incised channels (Simon and Darby 1999). Various functions that contribute to physical habitat were assessed in each reach. Structural habitat and indicators of processes directly driving physical morphology were documented regularly, as were hydrologic/hydraulic habitat and indicators of processes related to flow interaction with physical morphological boundary conditions (Table 2.5). The grade control in each reach was also recorded, as this determines the potential for each reach to degrade.

Analysis Methods

Numeric results (e.g., riparian corridor width) from the GIS data collection were plotted over topographic base maps to visualize the spatial distribution of each parameter. For non-numeric results, the percentage of total stream length with and without each feature was calculated. The data from the field assessment were collated in an Excel spreadsheet and plotted in GIS to visually identify patterns in physical habitat function parameters.

Table 2.5 Assessed Functions

Stream Function	Relevant Processes	Process Value	Target Condition	Suboptimal Condition	Poor Condition
Provides/Maintains In-channel Structural Habitat	Bank erosion	Maintains undercut bank habitat and supplies fine and coarse-grain sediment. Excessive fine-grain supply leads to substrate embeddedness, excessive coarse-grain supply may lead to bar formation and further bank erosion.	Proceeds at a rate that allows for riparian succession of native species. Sediment contribution remains less than system's transport capacity while avoiding riffle embeddedness or bed aggradation. Bank form provides habitat such as undercut areas. Mass failures are rare. Bank erosion does not jeopardize infrastructure such as culverts, crossings, etc.	Some actively eroding banks are outpacing reinforcing root growth, undercut banks are present but bank heights or erosion rates limit value as habitat feature, some mass failures may occur due to undercut banks and lack of root reinforcement. A potential for loss of developed land or damage to infrastructure may exist.	Annual bank retreat out paces reinforcing root growth. Mass failures are spatially and temporally frequent. Majority of stream bank length is eroding. Bank erosion jeopardizes structural integrity of infrastructure.
	Bedload transport	Controls short-term channel gradient, distribution and character of morphological habitat types, and substrate texture.	Proceeds at a rate that does not impact native benthic communities, localized scour and deposition maintains deepwater habitat and bed heterogeneity, well-graded riffle texture is maintained. Rate of deposition is similar to rate of erosion such that a systemic loss of grade control or increase in bank erosion is avoided. Lag material not mobilized.	Evidence of framework mobilization is apparent in some riffles while not in others. Bedload includes some lag material.	Highly mobile substrate provides inadequate refuge, spawning, or feeding habitat for benthic communities. Rate of deposition exceeds rate of erosion leading to widespread aggradation, riffle fining, bar formation, bank erosion, and morphological homogenization. Rate of erosion exceeds rate of deposition leading to widespread degradation, headcuts, channel incision, lowering of groundwater, morphological homogenization, etc.. Lag material is considerable percentage of bedload. Bedrock dominates reach length.
	LWD recruitment	Supplies components structural habitat typical of forested streams.	Proceeds at a rate that supports riparian succession of native species and maintains canopy cover.	Some sections of bank are without woody vegetation. Riparian management or logging has reduced potential for the input of LWD.	Woody vegetation is absent along stream banks. Bank erosion out paces establishment of woody vegetation. Riparian management or logging has eliminated potential of LWD input.
	Suspended load deposition	Supplies fertile soil to floodplain surface yet may create conditions of substrate embeddedness. Floodplain deposition of suspended sediment improves downstream water and structural habitat quality.	Deposition occurs on floodplain and as bank accretion, in-channel deposition is less than that which would embed riffle material or inundate habitat features within the assessed reach or in downstream reaches.	Fine-sediment embeds some riffles yet floodplain storage occurs where bank height allows. Fine-sediment deposition is localized to some habitat features and filling of pools is isolated to 1 or 2 pools between scouring flow events.	Deposition occurs mostly within active channel embedding riffles, filling pools, burying habitat associated with woody debris.
	LWD retention	Provides morphological habitat types typical of forested streams. Maintains cover/refugia habitat. Creates a source of carbon. Provides a form of flow resistance that limits reach-scale channel erosion.	Proceeds at a rate that matches long-term recruitment rate, collects in a form/location that decreases pool spacing, provides habitat, provides flow resistance required to prevent reach-scale bed degradation, and does not jeopardize infrastructure. Most LWD is accessible as low-flow habitat in the form of exposed live roots and downed timber.	LWD is frequent but often inaccessible as low flow habitat. Scour pools occur mostly at sharp bends with high banks instead of around LWD.	Debris mobilization or rot out paces recruitment rate leading to a long term decline in in-channel LWD. Collects in isolated locations only leaving reaches devoid of LWD habitat features. Collects in such a way as to jeopardize structural integrity of infrastructure or lead to flood damage.
Provides/Maintains In-channel Hydrologic/Hydraulic Habitat	Groundwater interaction	Controls residence time of in-channel surface water (unless naturally ephemeral). Controls duration and frequency of subsurface flow which supports burrowing benthic organisms. Controls floodplain soil moisture within the rooting depth of riparian vegetation.	Residence time of in-channel surface water is supported by groundwater exchange (unless naturally ephemeral). Frequency of subsurface flow can support burrowing benthic organisms typical of watershed. Groundwater saturates floodplain soils within the rooting depth of riparian vegetation for duration needed by desired vegetation.	Aquifer storage and groundwater residence time are reduced by incised channel, but existing connection supports surface flow along most of stream at least seasonally (unless naturally ephemeral). Some relocated channel has limited groundwater access.	Aquifer storage and groundwater residence time are reduced by an incised channel or exchange is absent due to channel aggradation, lateral relocation, or bedrock proximity. Subsurface flow would be inadequate to support life cycle of benthic organisms typical of watershed.
	Floodplain inundation	Reduces bed stress during floods and stores fine-grain sediment. These conditions allow for nutrient exchange to support native riparian and aquatic communities.	Occurs at a frequency that: allows for nutrient exchange to support native riparian and aquatic communities, alleviates bed stress, and removes fine-grain sediment from the channel.	Floodplain inundation most often occurs as localized overtopping of banks upstream of LWD jams or other features. Fine-grain sediment deposition is limited.	High flows are dissipated within active channel alone leading to mobilization of riffle frame work and loss of grade control. Occurs only rarely eliminating significant nutrient exchange and fine-sediment deposition.

3. Results

3.1 FINE SEDIMENT YIELDS

Because the same methods were used on each subwatershed, the relative magnitude of sediment transport in each subwatershed can be viewed with more confidence than if separate sampling designs had been used. The total sediment loads for all subwatersheds from January through December 2009 (Table 3.1) showed that the greatest total load was computed at South Fork Curry's Fork (SC1). The yields normalized by area, however, show that that Curry's Fork watershed contributed a similar amount of sediment as SC1.

The measured load at CF2 below the confluence of North and South Fork was 76,785 tons/yr, which supports the relative accuracy of the estimates from North and South Fork watersheds. From the sediment loads alone, Curry's Fork and South Fork Curry's Fork subwatersheds have the greatest potential for reducing sediment pollution. Asher's Run and North Fork Curry's Fork have much lower sediment load per unit area. Based on these estimates and on visual observations, portions of these subwatersheds should be considered for preservation.

Sediment transporting events were distributed throughout the annual measurement period (Figures 3.1–3.4), reflecting the somewhat unusual rainfall pattern in 2009, in which June and October were the wettest months (Table 3.2). The heaviest rainfall occurred in August and caused high rates of sediment transport in all subwatersheds. Total precipitation in 2009 was 53.9 inches, which is considerably higher than the 30-year normal rainfall of 44.5 inches (NOAA NCDC 2009). This annual variation increases the importance of long-term data sets with which to set target levels of turbidity and fine sediment production.

By plotting turbidity against discharge for individual flood events, turbidity from local sources can be differentiated from distal sources. The vast majority of storm events showed a clockwise loop (hysteresis) (Figure 3.5), which indicates a dominance of local sources (Williams 1989; Lefrançois et al. 2007), as sediment concentrations are higher before the flood peak than after. These turbidity-discharge loops may also indicate sediment "exhaustion" as the supply of sediment is reduced over time (Figure 3.6). In summer months (July to October), counter-clockwise turbidity-discharge loops were identified (Figure 3.7), which suggests that local sediment sources may be less significant when ice-related weathering processes, specifically freeze-thaw, are not active on streambanks.

Table 3.1 Mass Totals

Subwatershed	Drainage Area (mi^2)	Total Load (tons/yr)	Total Yield (tons/yr/mi^2)
Curry's Fork	5.27	21,275	4,037
North Fork Curry's Fork	10.04	17,100	1703
South Fork Curry's Fork	9.20	38,410	4175
Asher's Run	3.32	4,998	1,506

Table 3.2 Rainfall Monthly Totals for 2009 from Standiford Field Station (KSDF) in Louisville (NOAA-NCDC 2009)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total (inches)	3.63	2.20	1.36	4.43	4.59	9.22	6.02	5.88	5.70	7.00	1.05	2.85
Greatest 24 hr (inches)	1.73	0.89	0.31	1.27	1.53	2.72	2.85	4.53	3.97	2.09	0.88	1.32

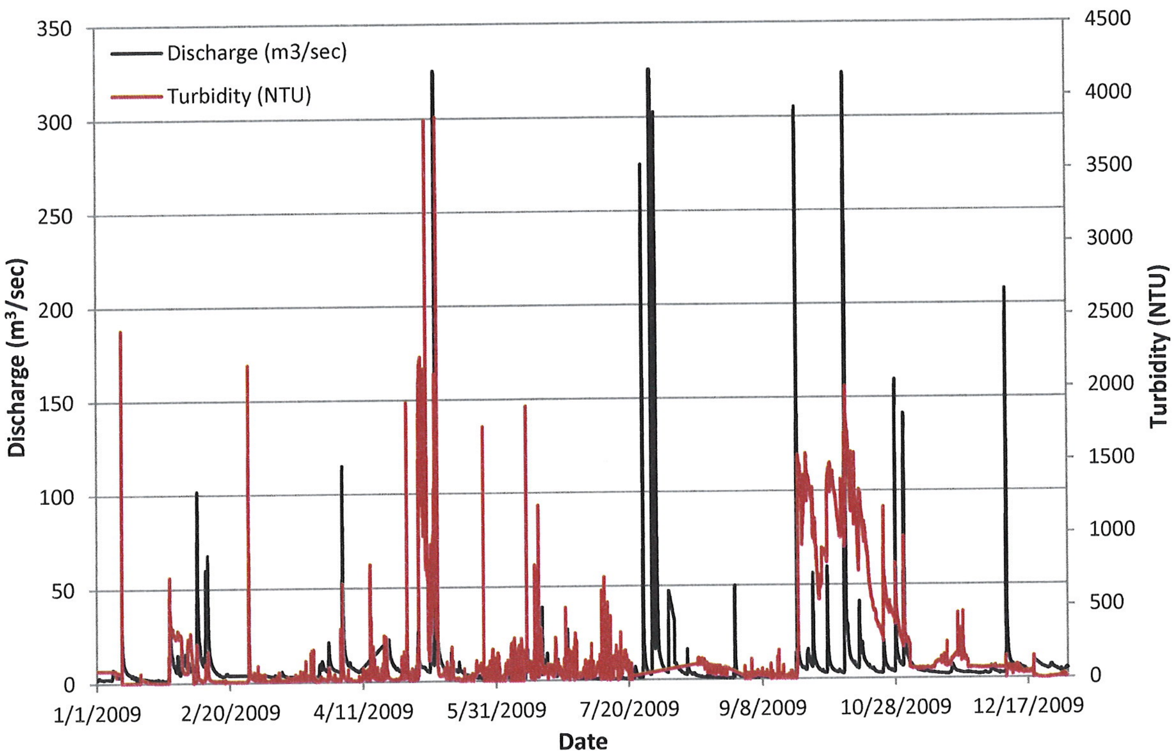


Figure 3.1 Stage and turbidity data for CF2.

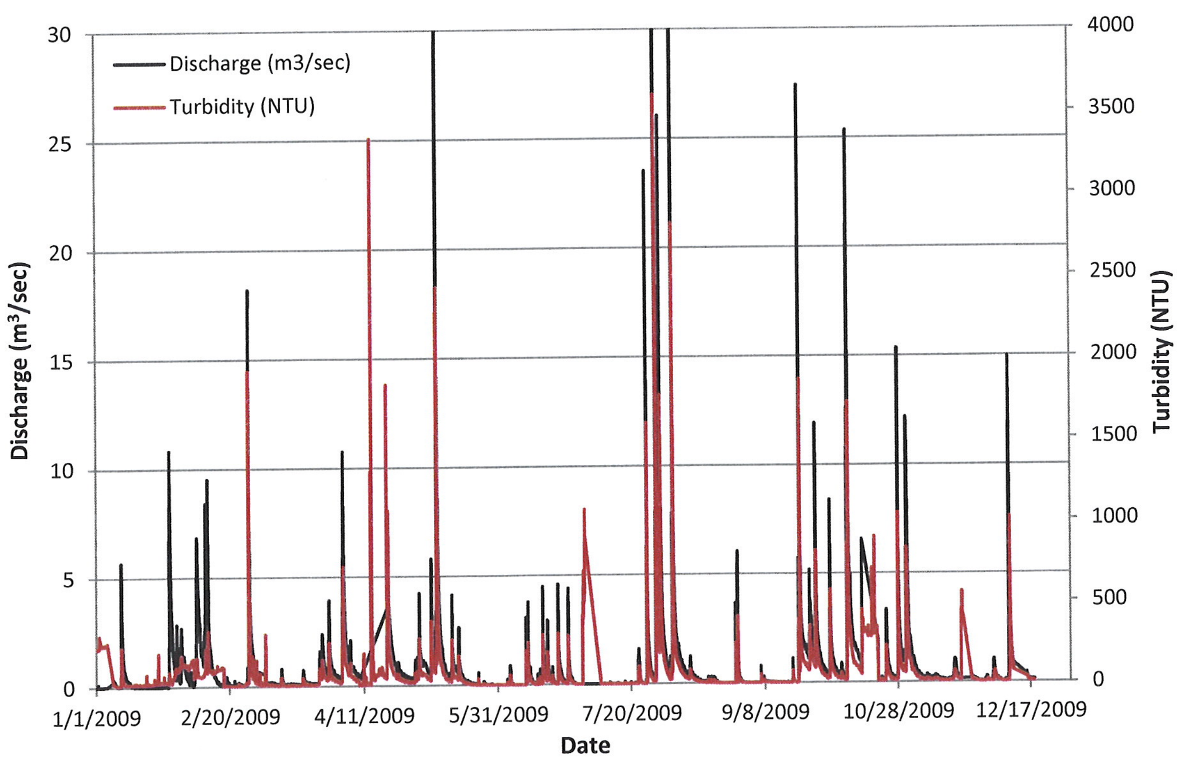


Figure 3.2 Stage and turbidity data for NC1.

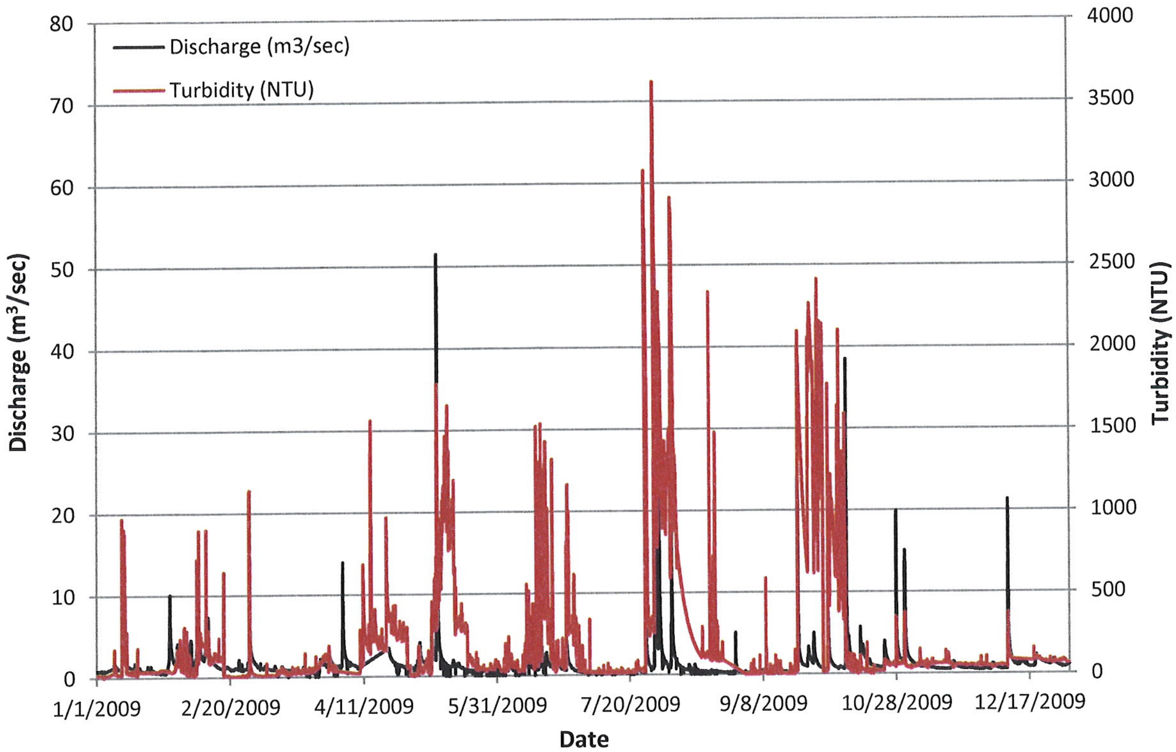


Figure 3.3 Stage and turbidity data for SC1.

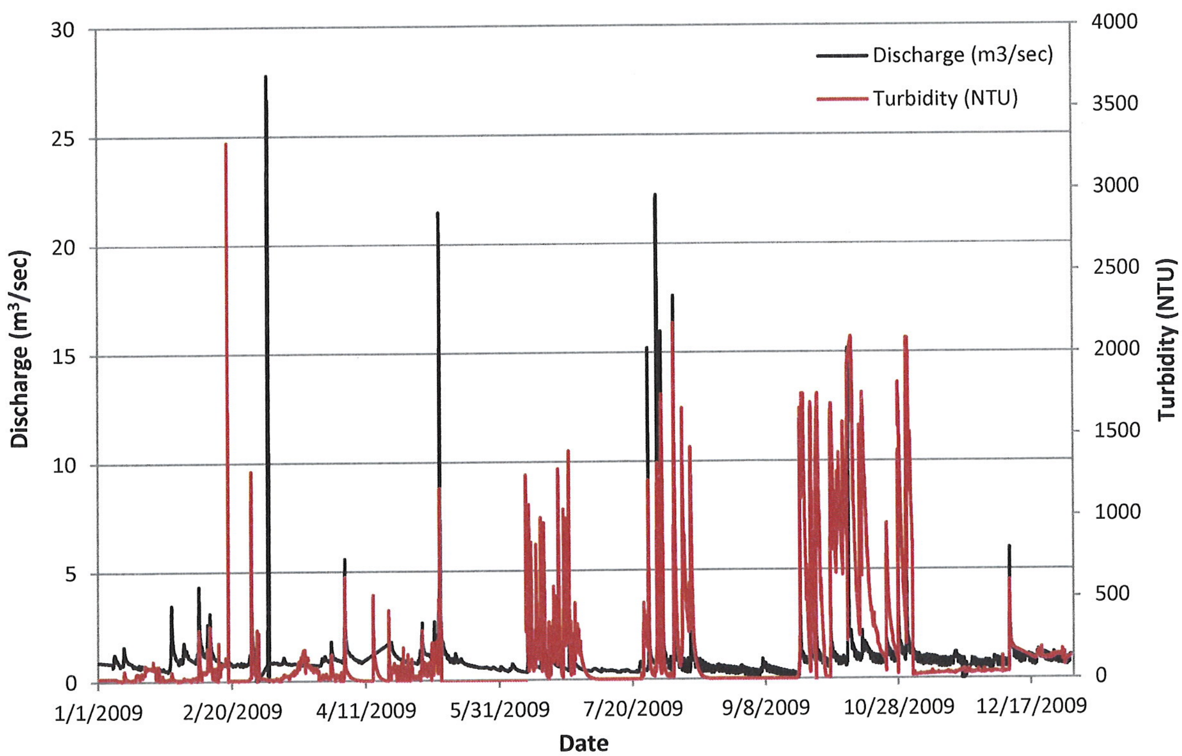


Figure 3.4 Stage and turbidity data for TB1.

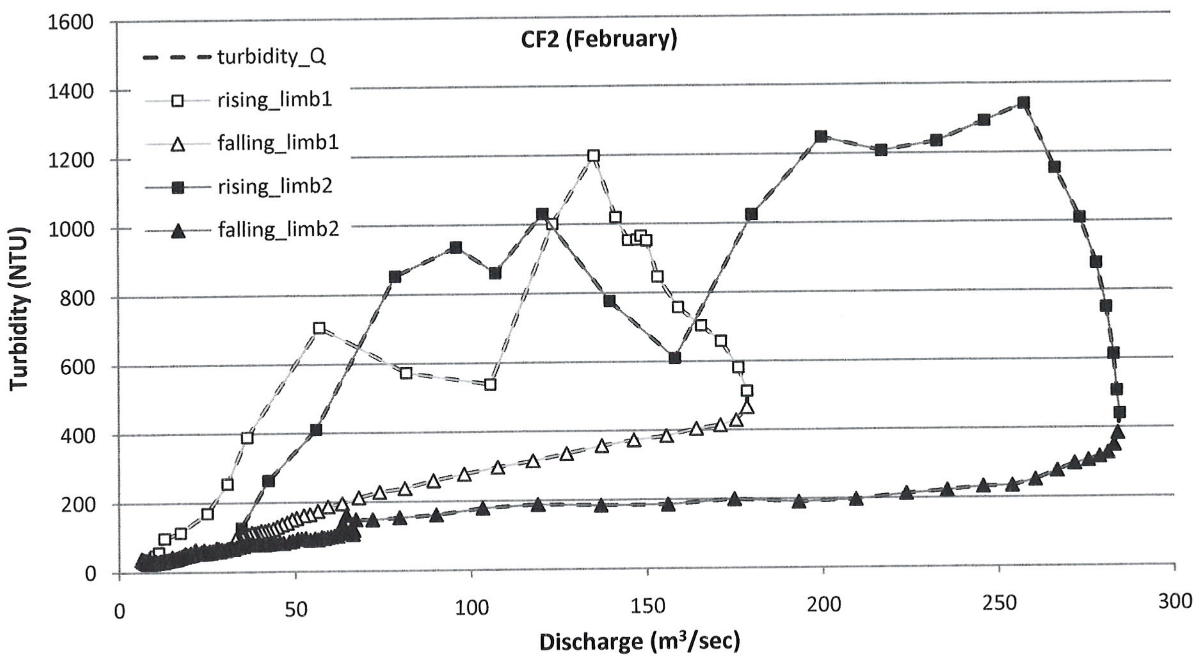


Figure 3.5 Clockwise hysteresis loop, which is indicative of a local sediment supply.

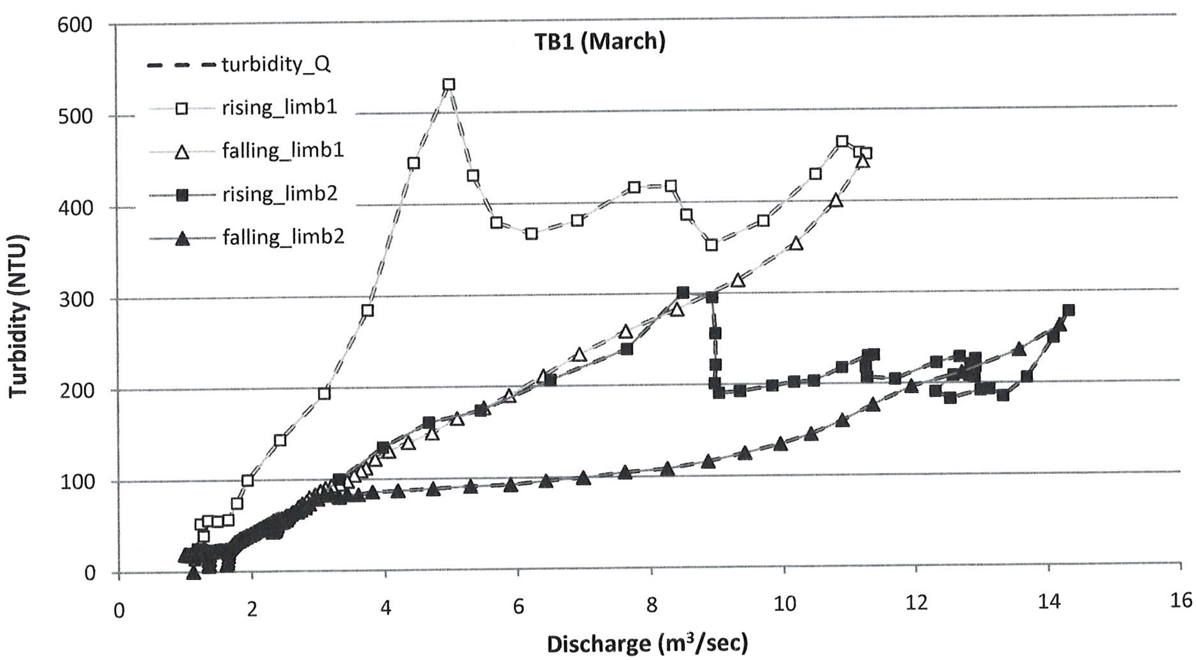


Figure 3.6 Two hysteresis loops for TB1 from consecutive floods showing diminishing sediment supply. 18 Mar 2008.

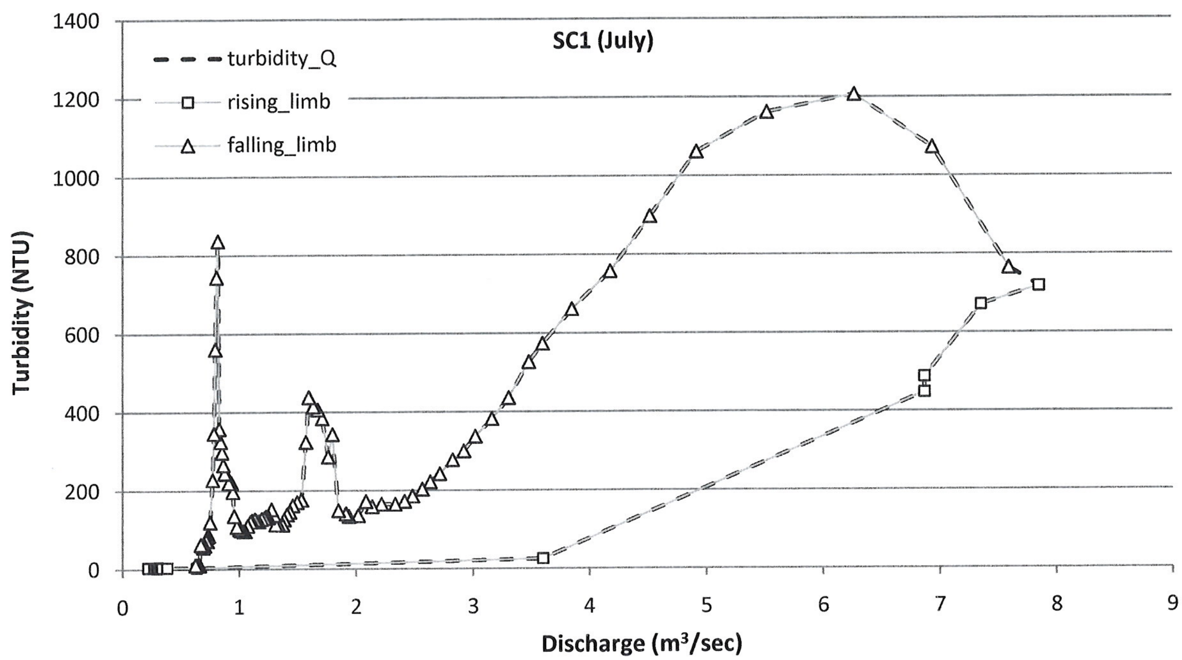


Figure 3.7 Counter-clockwise hysteresis for SC1, which was only observed during summer floods, indicating dominance of distal sediment sources. 31 Jul 2008.

3.2 SEDIMENT PRODUCTION

3.2.1 Bank Erosion

Bank Erosion Rates

Measured bank erosion rates ranged from 0.0 ft/yr to 0.73 ft/yr (Table 3.3). Spatial variability was high: some banks in the same reach with similar BEHI/NBS ratings had very different erosion rates. The BEHI/NBS method failed to identify the statistically significant controls on bank erosion rates in Curry's Fork watershed and did not produce a usable predictor of bank erosion rates in the surveyed reaches in Curry's Fork watershed (Figure 3.8). The lack of a usable BEHI-NBS relationship can be attributed primarily to the lack of variability in the key parameters within the watershed: bank materials were relatively similar, mass wasting was absent, and weathering, which is independent of NBS, appeared to be a strong control on erosion rate at all sites.

Given the high variability of erosion rates, general trends were difficult to discern, but one clear temporal pattern was evident from field observations: weathering of the banks during winter months loosened large amounts of sediment that could be entrained by subsequent flows (Figure 3.9). The process of needle ice growth is well documented in other locations and was observed in all subwatersheds in Curry's Fork. The bank material composition in Curry's Fork watershed (primarily silt and clay) is particularly susceptible to freeze-thaw weathering (Lawler 1986; Couper 2003), suggesting this is a long-term contributing factor to bank erosion.

Table 3.3 Erosion Rates

Measurement Location			NBS	Bank	No. Pins	BH/BF	RD/BH	WRD	Angle	Total BEHI	BEHI Rank	E.Rate* (ft/yr)
Site	Latitude	Longitude										
SC2	38.36801	–85.37528	High	L	3	10	1	8	2	31	High	0.70
SC2	38.36804	–85.37534	Moderate	L	3	10	1	8	2	31	High	0.60
SC2	38.36807	–85.37632	Moderate	L	3	10	2	4	2	28	Moderate	0.14
SC2	38.36809	–85.37636	High	L	3	10	2	6	4	32	High	0.18
SC2	38.3681	–85.37636	Very high	L	3	10	1	10	2	33	High	0.00
SC2	38.36828	–85.37652	Very high	R	3	10	1	8	4	33	High	0.16
SC2	38.36845	–85.37731	Moderate	R	3	10	1	8	2	31	High	0.06
SC2	38.36836	–85.37761	Low	L	3	10	1	8	2	31	High	0.13
SC2	38.36812	–85.37805	Very low	L	3	6	2	10	2	30	High	0.71
SC2	38.36793	–85.37836	Low	L	3	6	1	8	2	27	Moderate	0.69
SC2	38.3678	–85.37882	High	L	3	10	1	8	8	37	High	0.32
SC2	38.3678	–85.37882	Very high	L	3	10	2	6	2	30	High	0.61
SC2	38.36788	–85.37891	Moderate	R	3	10	1	6	8	35	High	0.00
SC2	38.36737	–85.37968	Very low	R	2	1	1	2	2	16	Low	0.71
SC2	38.36715	–85.38012	Very low	L	3	6	1	6	2	25	Moderate	0.71
SC2	38.36667	–85.38054	Very low	R	3	10	1	4	4	29	Moderate	0.12
SC2	38.36662	–85.38118	Moderate	R	3	10	2	10	2	34	High	0.26
SC2	38.36658	–85.3817	High	R	3	10	1	8	4	33	High	0.20
SC2	38.36652	–85.38171	Very low	L	3	8	1	8	2	29	Moderate	0.00
SC2	38.36643	–85.38229	Very high	R	3	10	1	4	2	27	Moderate	0.19
SC2	38.36588	–85.38241	Moderate	R	3	10	1	6	6	33	High	0.16
SC2	38.36526	–85.38272	Moderate	L	3	10	1	8	6	35	High	0.09
SC2	38.3649	–85.3843	High	R	3	10	1	4	2	27	Moderate	0.21
SC2	38.36421	–85.38463	Moderate	L	3	8	1	4	2	25	Moderate	0.47
SC2	38.36382	–85.38466	Very high	R	3	6	1	6	4	27	Moderate	0.34
SC2	38.36382	–85.38458	High	L	3	10	2	10	2	34	High	0.15
SC2	38.36529	–85.38413	High	R	3	10	1	4	8	33	High	0.20
SC2	38.36545	–85.38387	Moderate	L	3	10	1	8	2	31	High	0.00
SC2	38.36571	–85.38379	Extreme	R	3	10	2	8	4	34	High	0.20
SC2	38.36656	–85.38325	Low	L	3	8	1	8	10	37	High	N/A†
SC2	38.3665	–85.38333	Low	R	3	10	1	6	10	37	High	0.14
SC1	38.35635	–85.43785	High	L	3	6	2	6	4	28	Moderate	0.29
SC1	38.35682	–85.43836	Low	R	3	8	1	8	4	31	High	0.73
SC1	38.35668	–85.43839	Low	L	3	8	6	6	4	34	High	0.17
SC2	38.35601	–85.40966	Low	L	3	10	2	6	4	32	High	0.01
NC1	38.35749	–85.4399	Very high	R	3	10	6	6	2	34	High	0.38
NC1	38.35789	–85.44011	High	R	3	10	2	4	4	30	High	0.31
NC1	38.35785	–85.43975	Moderate	L	3	10	2	4	2	28	Moderate	0.63
NC1	38.35867	–85.43969	Very high	R	3	10	6	6	4	36	High	0.42
CF1	38.30557	–85.45005	High	L	3	10	6	8	2	36	High	0.31
CF1	38.30568	–85.45011	Moderate	L	3	10	2	6	2	30	High	0.17
CF1	38.30607	–85.45063	moderate	R	3	10	8	8	2	38	High	0.09
TB1	38.30923	–85.44581	Moderate	R	3	8	8	10	4	40	Very high	0.46
TB1	38.30909	–85.44602	Very low	L	2	1	2	10	2	25	Moderate	0.40
TB1	38.30917	–85.44693	High	R	3	10	6	10	2	38	High	0.37
CF2	38.31076	–85.45024	Low	R	3	10	1	6	4	31	High	0.13
CF2	38.31013	–85.45106	Moderate	R	3	10	2	6	4	32	High	0.21
CF2	38.30982	–85.45114	Moderate	L	3	10	6	8	2	36	High	0.24
CF2	38.3095	–85.4513	Low	L	3	10	2	6	2	30	High	0.09
CF3	38.35645	–85.44062	Moderate	R	3	10	1	6	4	31	High	0.11
CF3	38.35651	–85.44065	High	R	3	10	2	8	4	34	High	0.09
CF3	38.35668	–85.44055	Moderate	R	3	10	2	4	2	28	Moderate	0.10
CF3	38.35666	–85.44029	Moderate	L	3	10	2	4	2	28	Moderate	0.19
TB1a	38.3188	–85.42899	High	R	3	8	1	4	4	27	Moderate	0.00
TB1a	38.31875	–85.42831	Low	L	3	10	2	4	4	30	High	0.12
TB1a	38.31884	–85.42824	Moderate	R	3	10	2	4	4	30	High	0.08

* Weighted erosion rate, 21Aug08-28Jul10. † Taken out with debris removal.

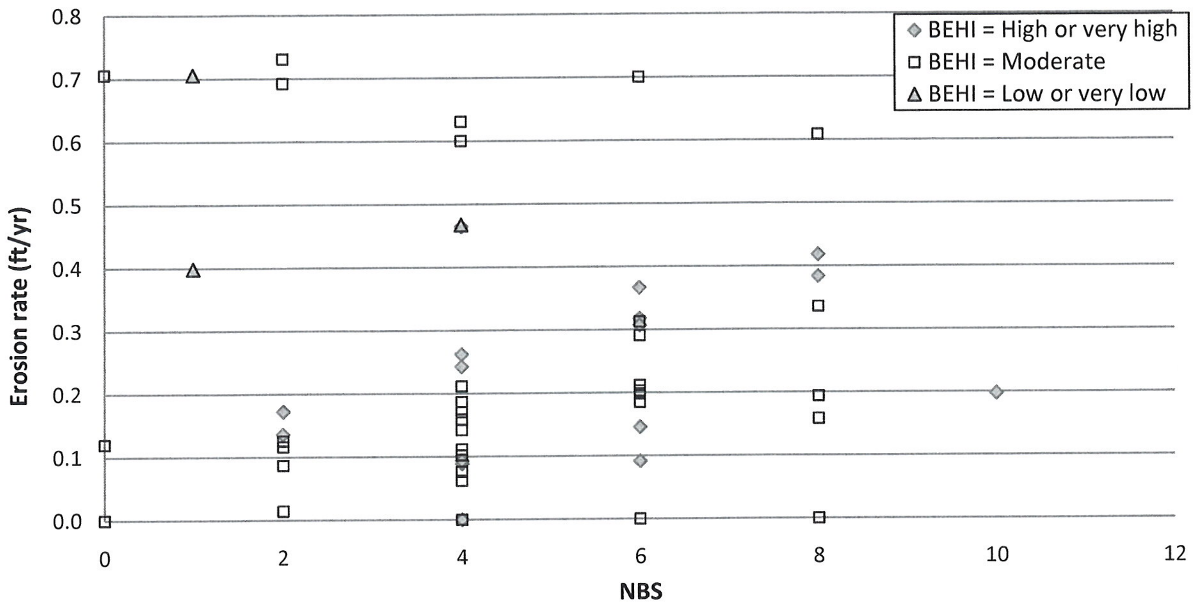


Figure 3.8 Erosion rate vs. BEHI rating for all erosion pin sites.

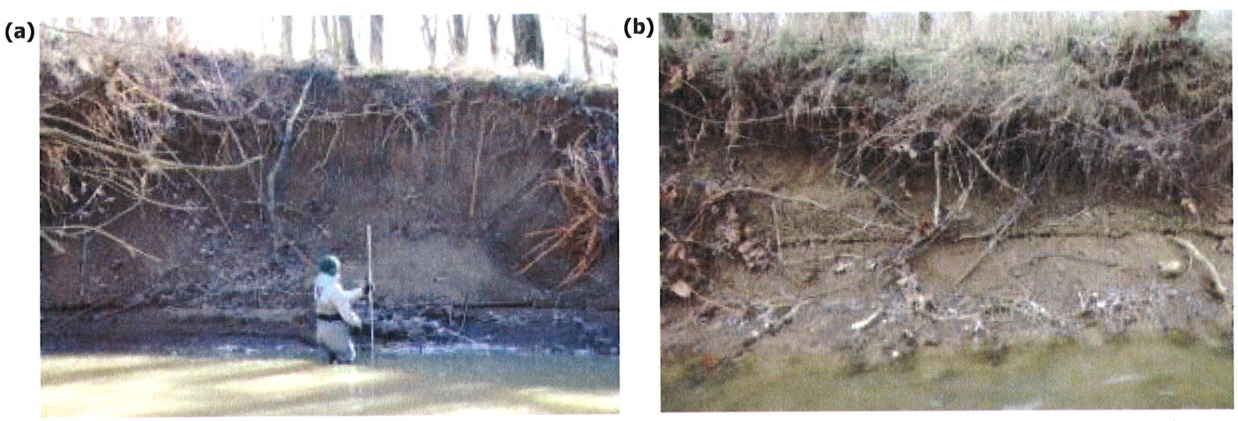


Figure 3.9 Freeze-thaw was a cause of accelerated bank erosion at many locations in all subwatersheds on both (a) large and (b) small channels. The horizontal line ~1 ft above the water surface shows the loose sediment removed by a recent flood event.

Some of the difficulty in obtaining estimates of bank erosion rates is not specific to the BEHI/NBS method: bank erosion results from the interaction between the existing bank materials (grain size and stratification), channel configuration, weather, vegetation, and the sequence of flows; these interactions are not necessarily amenable to quantification. Hence, more field measurement methods are needed to extend the capabilities of existing models, which often focus on one major mechanism of erosion (e.g., mass wasting) and seldom include important weathering processes (e.g., freeze-thaw).

Unmapped Channels

Use of the mean channel head flow accumulation area (Table 3.4) as the starting point produced the most accurate channel network, as it produced the smallest number of Type I (false positive) and Type II (false negative) errors (Figure 3.10). Average values of bank height and percentage eroding banks (Table 3.5) were used to estimate the amount of sediment produced by these unmapped channels.

Table 3.4 Flow Accumulation Areas for Channel Heads

Parameter	Area (ft^2)	Area (acres)
Mean	101,431	2.33
Median	73,305	1.68
Mode	30,000	0.75
St. deviation	81,983	1.88

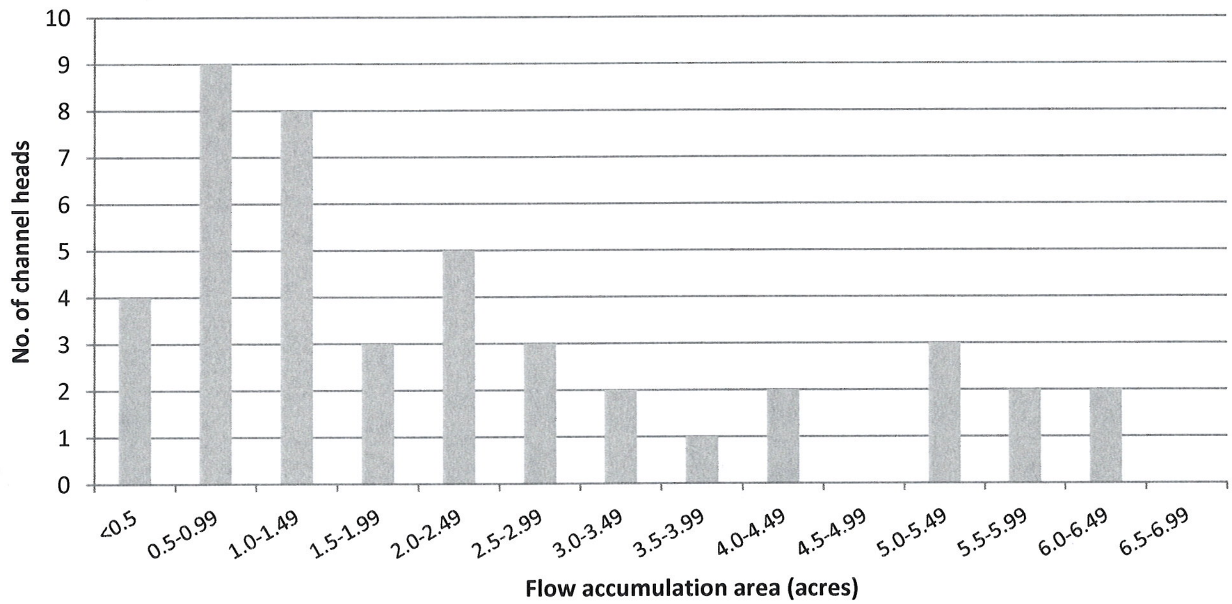


Figure 3.10 Flow accumulation areas for channel heads.

Table 3.5 Properties of Unmapped Channels

Stream Order	No. of Measurements	Length Assessed (ft)	Average Bank Height (ft)	Average Area Eroding (%)
1	38	2420	0.847	24.5
2	33	2130	1.728	22.3
3	21	1241	1.586	22.6

For sediment production estimates, a conservative estimate of the channel network with minimal Type I errors was produced by using the mean channel head plus one standard deviation as the flow initiation threshold. Stream channels not represented in this network are close to the ridgetop and are often very small. Therefore, errors from omitting these channels should have a minimal effect on estimates of sediment production.

Sediment Production from Bank Erosion

The highest rates of sediment production due to bank erosion occurred in the lower reach of the Curry's Fork main stem (Table 3.6). The primary reason for the sediment production in the lower reaches is the very high banks, which average over 9 ft; bank heights of 12 ft were not uncommon (Figure 3.11). Removal of the high banks through stream restoration would remove a significant source of sediment but would be expensive due to the large

Table 3.6 Mass of Sediment Produced by Bank Erosion

Subwatershed	Mass (tons/yr)	Unit rate (tons/mile/yr)	Channel length (miles)
Asher's Run	**923.6**	**35.7**	**25.8**
Main stem	720.6	147.9	4.9
Blue line tribs	83.1	11.2	7.4
Unmapped tribs	119.9	8.9	13.5
Curry's Fork	**1612.8**	**35.6**	**45.4**
Main stem (downstream)	730.2	322.5	2.3
Main stem (upstream)	470.0	185.6	2.5
Blue line tribs	163.3	12.9	12.6
Unmapped tribs	249.3	8.9	27.9
North Fork	**1491.8**	**18.7**	**79.9**
Main stem (downstream)	361.6	257.4	1.4
Main stem (upstream)	381.4	94.7	4.0
Blue line tribs	331.6	12.8	26.0
Unmapped tribs	417.2	8.6	48.5
South Fork	**1770.3**	**23.0**	**76.9**
Main stem (downstream)	576.3	195.6	2.95
Main stem (upstream)	521.0	152.9	3.41
Blue line tribs	239.4	10.9	21.9
Unmapped tribs	433.6	8.9	48.6

Figure 3.11 The banks in Curry's Fork subwatershed near the confluence with Floyds Fork (reach CF01) are typically over 10 ft high.

amount of earthmoving. If a demand for the soil could be identified, the cost would be reduced considerably. A similar situation of high banks and high sediment production was found in the lower reaches of North Fork Curry's Fork; stream restoration projects could significantly reduce sediment production in this area.

The lowest rates of sediment production from a main stem were measured at NC1b, which runs between the south- and northbound lanes of I-71. The banks at NC1b are relatively low, are not eroding for a high percentage of their length, and are well vegetated (Figure 3.12); this is an area suitable for protection rather than restoration. North Fork Curry's Fork was the only subwatershed where the main stem contributed less than half of the sediment production from bank erosion. Many tributaries flow though a culvert under the north or south bound lanes of I-71, which would make a sensible site for a sediment trapping BMP due to the backwater from the culvert and the presence of a stable grade control.

The main stem of Asher's Run has lower banks and a smaller drainage area than the main stem in the other subwatersheds, but the sediment production rate was still relatively high, especially near the confluence with Curry's Fork. The downstream reaches of Asher's Run have higher banks than upstream reaches, so from a sediment production standpoint they would be the best places to focus stream restoration efforts.

This pattern of higher banks near the confluence with a larger stream reach was found in all subwatersheds and is more dramatic when the drainage areas of confluencing streams are very different (e.g., where Asher's Run confluences with Curry's Fork). This suggests that determinations of impairment based on biological sampling near confluences—even 1000 ft from them—may be biased by sediment production rates that are higher in that location compared to upstream reaches.

Figure 3.12 Reach NC16 between the north- and southbound lanes of I-71.

3.2.2 Upland Surface Erosion

Pond surveys showed a wide range of upland surface erosion rates, with the highest rate measured for the only site that had experienced consistent row crops since construction (Table 3.7). The results also matched field observations: sites with bare soil and rills (Figure 3.13) had higher erosion rates than sites with stable, completely vegetated hillslopes (Figure 3.14). The Ennes pond had higher rates than expected from the observable landcover, but landowner interviews indicated severe erosion in the past decade due to construction activities upslope of the pond. Soil erosion models are not well-suited to capturing these local variations in land use intensity because of a lack of sufficiently detailed input data.

Overall, the GeoWEPP model performed well (Figure 3.15), with predicted sediment mass being the same order of magnitude as that measured in the pond surveys. An ordinary least squares regression of the pond survey data versus GeoWEPP output almost exactly matches the line demonstrating perfect agreement, indicating that the model did not consistently over- or under-predict. Although erosion rates calculated in the model may have errors, no evidence was found of systematic bias that might indicate whether sediment mass calculations were too high or low.

From the GeoWEPP modeling, the highest rates of erosion per unit area were estimated in the Curry's Fork subwatershed (Table 3.8), and the lowest rates were estimated in Asher's Run. No clear pattern of upland soil erosion rates was identified in any of the subwatersheds (Figures 3.16–3.19), which is indicative of the lack of variation in topography, geology, and land use. Agricultural land was pasture and hay and not row-cropped.

The mass of upland sediment deposited on hillslopes and floodplains was relatively insignificant in each subwatershed, varying from 2.6 percent to 6.1 percent of the total mass of sediment eroded. Curry's Fork subwatershed had the highest proportion of sediment deposition because of the main stem's wide floodplain and long hillslopes with deposition zones at the base of the slope. Based on a comparison of bank erosion and upland erosion (Tables 3.6 and 3.8), the upland areas appear to offer the greatest opportunity to reduce overall loads. The output of the GeoWEPP model estimated that more sediment was produced from hillslope erosion than from bank erosion in all four subwatersheds. Sediment production from upland surface erosion, however, occurs over a large area, making implementation of sediment reducing BMPs difficult. Also, if streambank erosion is converted into a per unit area rate using floodplain width, then both upland surface erosion and bank erosion are of similar magnitude.

Table 3.7 Erosion Rates Estimated from Ponds

Pond ID	Latitude	Longitude	Drainage Area (acres)	Date Built/ Cleaned	Sediment Volume (ft^3)	Hillside Erosion Rate (tons/acre/yr)
Cooper	38.3514	−85.4356	4.0	1981*	29277.45	0.33
Deibel	38.3376	−85.4282	5.6	1959-1961	49714.29	0.67
Ennes	38.3775	−85.4076	3.1	1981*	36771.84	0.74
Forrest	38.3840	−85.3982	4.6	1981*	34943.13	0.62
Ghad2	38.3456	−85.4172	13.1	1981	69390.00	0.36
Lanham	38.3456	−85.4172	7.0	1993	21852.45	0.38
Northwood	38.3459	−85.3952	5.5	1983	47162.79	1.09
Seymour	38.3359	−85.4372	2.5	1995	15133.23	0.66
Yates	38.3518	−85.4321	8.2	1979	29679.48	0.19
Young	38.3516	−85.4035	6.4	1981	22062.51	0.15

* Date estimated from USGS topographic quadrangles and KTC aerial photographs

Figure 3.13 The land around the pond on the Diebel property had more intense grazing than at other sites, which was reflected by the bare soil and signs of rilling.

Figure 3.14 The land around the pond on the Cooper property was typical of low intensity land use with little or no bare soil.

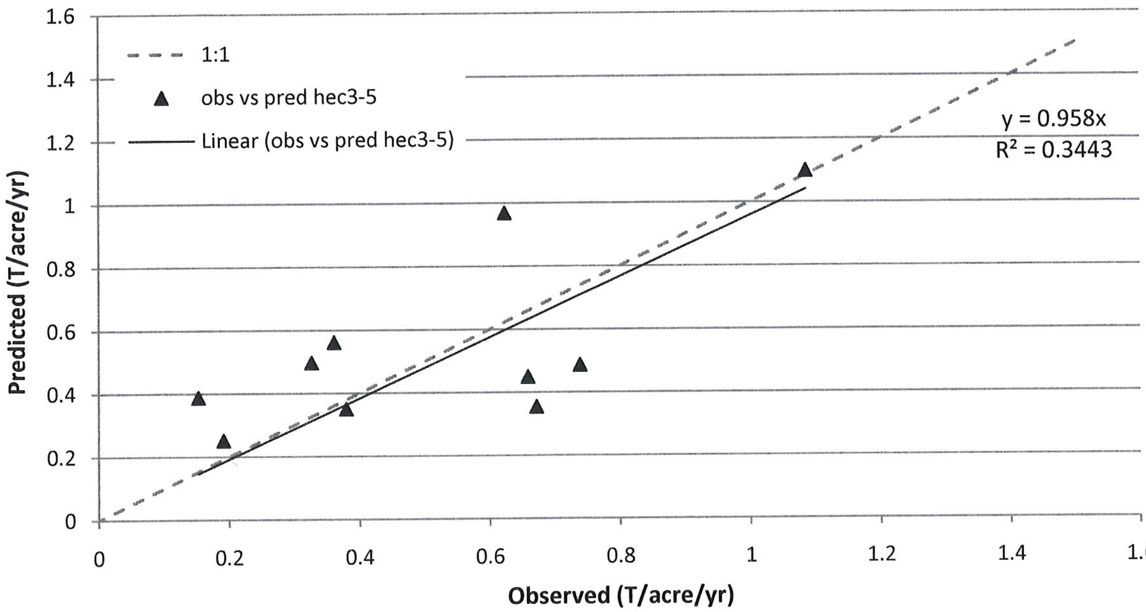


Figure 3.15 Predicted (GeoWEPP) versus observed (pond) upland surface erosion.

Table 3.8 GeoWEPP Output

Subwatershed	Soil Loss (T/yr)	Sediment Deposition (T/yr)	Sediment Yield (T/ac/yr)
Asher's Run	3,601	192	2.19
Curry's Fork	15,449	954	5.65
North Fork	15,894	418	3.26
South Fork	12,129	512	2.56

A different approach to reducing sediment would be to focus on the delivery of sediment from upland surface erosion to downstream waters rather than reduce the soil loss directly. Legacy impacts to the streams of the Eastern United States are well documented and have resulted in widespread incision of stream channels and their tributaries (Wohl and Merritts 2007). In the headwaters, this incision propagates upslope, extending the drainage network (Schumm et al. 1984; 1987). One consequence of this drainage expansion is that natural sediment storage zones are bypassed, with sediment being delivered to downstream waters that prior to disturbance would have been deposited and stored. Identifying opportunities to re-create these sediment storage zones could be effective in reducing the delivery of NPS to downstream waters.

3.2.3 Sediment Summary and Potential Sources of Error

For all subwatersheds, the mass of sediment from upland surface erosion was greater than from bank erosion. This difference was due to the much smaller area occupied by stream channels. When normalized by floodplain width, sediment production from bank erosion is greater than or similar to that from upland surface erosion. Importantly, sediment produced by bank erosion goes straight into the channel, whereas sediment produced by upland erosion may deposit at the base of the hillslope, deposit on the floodplain of receiving stream, or may be washed through the watershed without interacting with the channel bed.

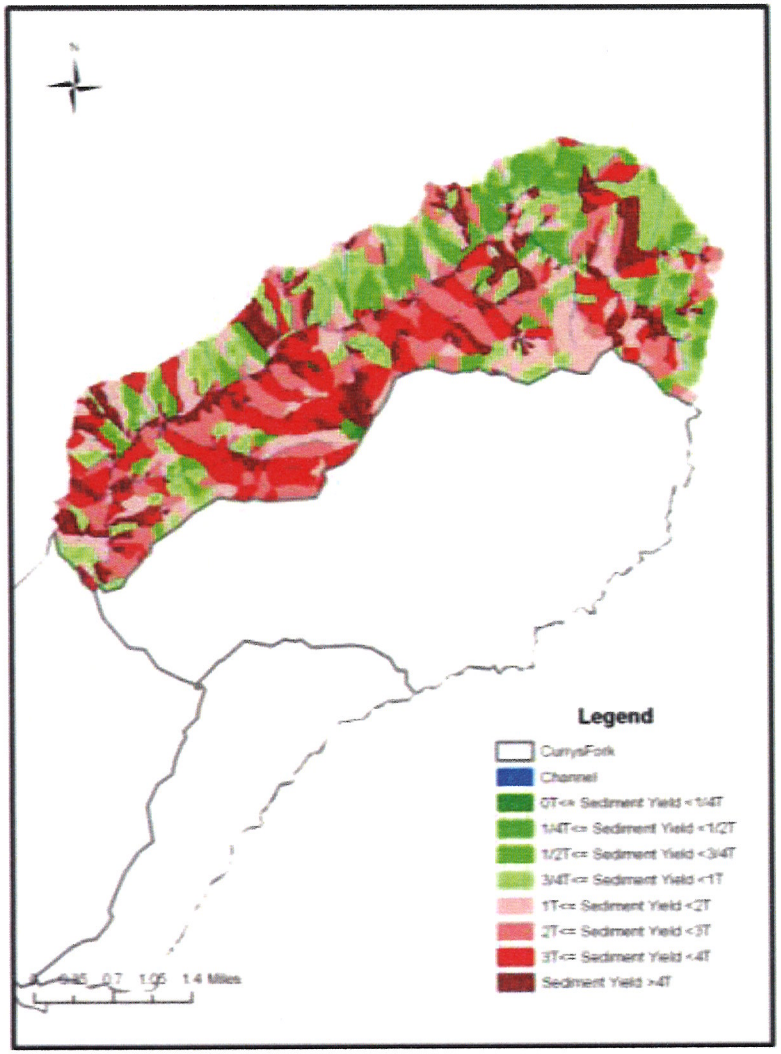


Figure 3.16 Predicted upland surface erosion rates for North Fork Curry's Fork subwatershed.

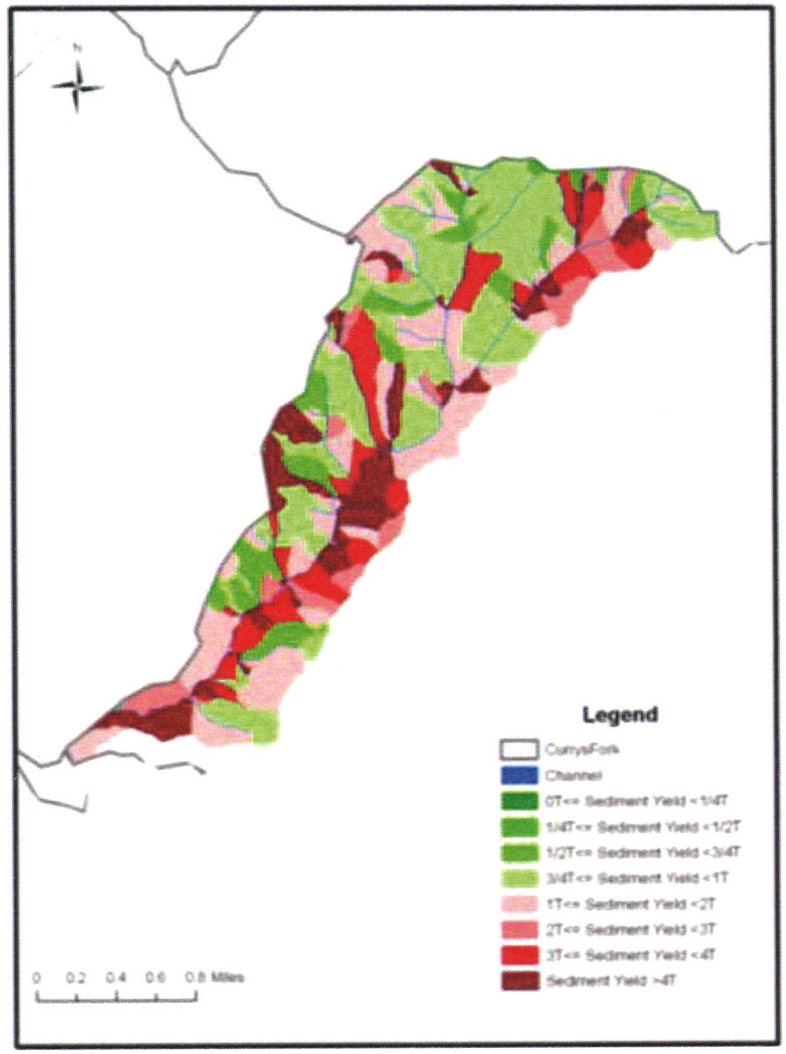


Figure 3.17 Predicted upland surface erosion rates for Asher's Run subwatershed.

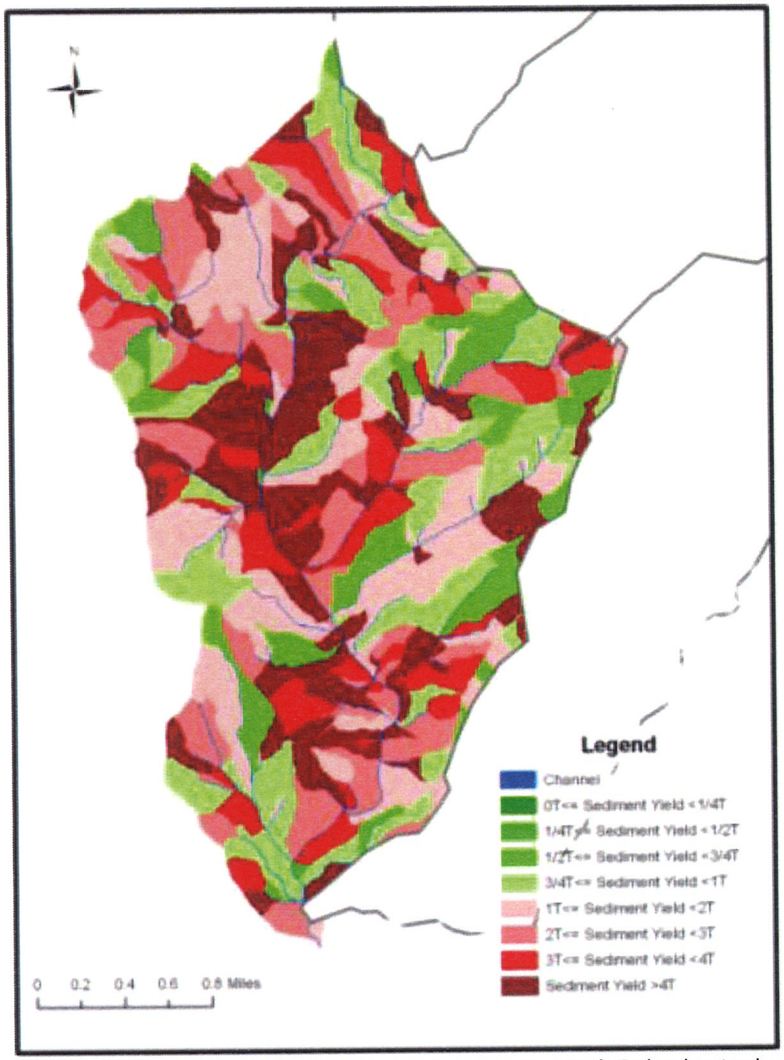


Figure 3.18 Predicted upland surface erosion rates for Curry's Fork subwatershed.

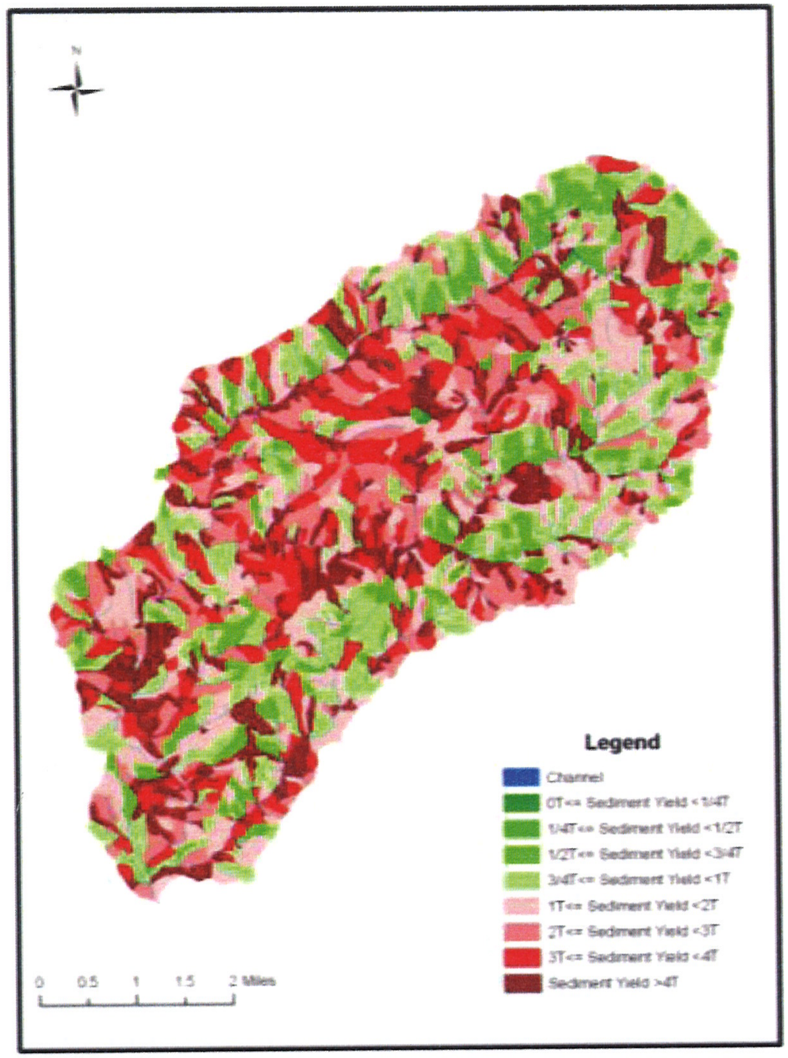


Figure 3.19 Predicted upland surface erosion rates for South Fork Curry's Fork subwatershed.

One problem of reducing siltation through reduction in sediment load is that only small amounts of sediment may be required to cause siltation. The timing of sediment delivery may be more important than the amount of sediment, but the link between sediment delivery and siltation development is poorly understood. The results of the sediment yield and sediment production assessment show that agreement between sediment yield and sediment production was good for Asher's Run, Curry's Fork, and North Fork Curry's Fork subwatersheds (Table 3.9). For South Fork Curry's Fork, the sediment yield was significantly higher than the sediment production.

Table 3.9 Mass Totals

Subwatershed	Drainage Area(mi^2)	Total Measured Load (tons/yr)	Bank and Upland Erosion (tons/yr)
Asher's Run	3.32	4,998	4524
Curry's Fork	5.27	21,275	17061
North Fork	10.04	17,100	17385
South Fork	9.20	38,410	13899

Possible reasons for the discrepancy between yield and production include

- Over-estimation of sediment yield estimates
- Under-estimation of sediment production estimates
- Omission of sediment sources

To reduce sediment yield errors, more high-quality calibration data are needed, such as depth-integrated suspended sediment sampling during flood flows. This kind of sampling, however, is expensive and generally carried out by organizations with resources for making measurements during large floods (e.g., USGS). Increased collection of turbidity datasets will help to increase confidence in sediment yield predictions as well as help to identify outliers. Other sources of calibration data are ponds, lakes, and reservoirs that have relatively high trapping efficiencies. The ponds used in this project were for upland surface erosion only, but larger reservoirs could be used to check the accuracy of sediment yield estimates from bank erosion and upland surface erosion.

Underestimation of sediment production estimates could be improved by using more tools to estimate the spatially-distributed sediment production caused by bank erosion. The BEHI/NBS method that was initially used in this study is not applicable to Curry's Fork watershed and presumably to other similar watersheds. Because of the importance of this subaerial weathering in small streams, bank erosion models must include this process to generate accurate estimates of sediment production. In addition, more methods for looking at gully erosion and erosion in unmapped channels are required, as these may be significant sources of sediment, such as in North Fork Curry's Fork.

Also needed are erosion rate measurement techniques that moderate the effect of short-term fluctuations due to extreme floods or droughts. Dendrogeomorphic methods are increasingly used in the environmental sciences to provide estimates of erosion rates over periods of 5 to 100 years (Gärtner 2006) and do not require a period of high flows between measurements. These dendrogeomorphic methods could be applied to monitor bank erosion rates for nonpoint source pollution projects.

Omission of sediment sources is always possible. In this project, many miles of stream and floodplain were assessed to identify the important sources of sediment. Inspection of aerial photography greatly improves the spatial coverage, but current aerial photography is dominated by leaf-on orthoimagery (e.g., National Agriculture Imagery Program (NAIP)). These images have limited utility in identifying sediment production, especially stream bank or gully erosion, which generally occur under a riparian cover. Greater availability of leaf-off aerial orthoimagery would help identify sediment sources not identified in the field.

3.3 GEOMORPHIC ASSESSMENT

3.3.1 GIS Analysis

The vast majority of stream reaches within the Curry's Fork watershed were found to have been straightened or to be contiguous with straightened reaches and so would have been indirectly affected (Figure 3.20). Some reaches were not clearly visible on the aerials so may have been straightened also but not designated as such. The influence of such widespread straightening, together with the deforestation of the hillsides that has been documented throughout the Bluegrass (Parola et al. 2007; Mastin 2009) and United States (Wohl and Merritts 2007), has had a substantial impact on the contemporary channel configuration. The primary influence is the incision to bedrock and the entrenchment due to the deposition of post-settlement alluvium (Parola et al. 2007). The ecological impact of channel incision is

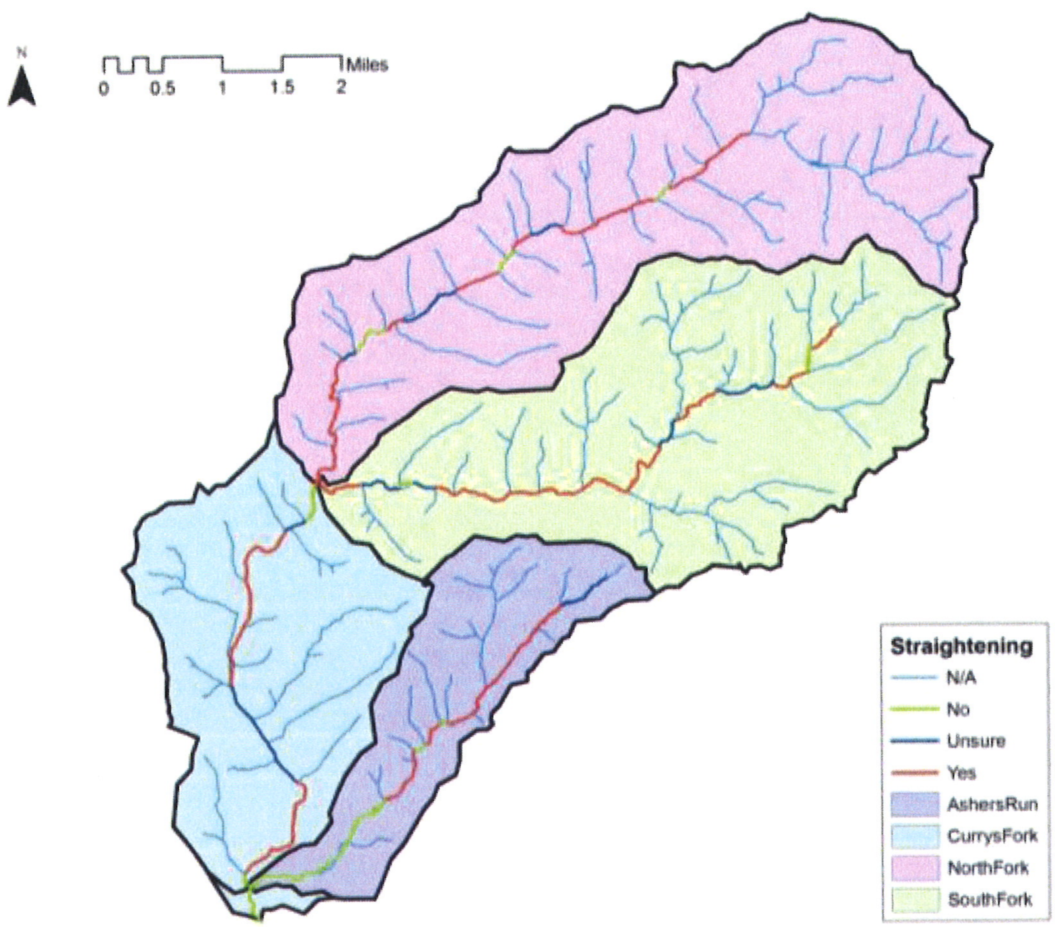


Figure 3.20 Stream reaches affected by channel straightening.

well documented (Bravard et al. 1999) and may be particularly acute during summer months as the intact bedrock substrate of many Bluegrass channels provides little or no refuge for macroinvertebrates. Typically, the primary mechanism by which incised streams increase their sinuosity and develop a wider floodplain is through lateral bank erosion on one bank and point bar deposition on the other (Thorne 1999). In the cohesive soils in the Bluegrass, this process of channel lateral widening mainly occurs when debris jams are present to deflect flood flows towards the banks and initiate erosion. Despite the typically wide riparian corridor (Figure 3.21), however, the geomorphic assessment identified relatively little accumulation of woody debris within the stream channel and only localized avulsion. Although 26 of 74 assessed stream reaches contained multi-thread channels (Table 3.10), these typically occupied only a short distance (<500 ft).

Oldham County is one of the fastest growing counties in Kentucky (US Census Bureau 2009), and development could potentially impact Curry's Fork. To identify reaches that are already impacted and those that could be in the future, each reach was classified according to the degree of development in the river corridor to identify the current conditions (as of 2006 aerials). The main stem of Curry's Fork and the lower two-thirds of North Fork have remarkably little development on the valley flat (Figure 3.22). Some of this pattern is due to the topography: the ridges and hills are better for development, whereas the valley flat is prone to flooding. Development in Asher's Run is primarily in the upper reaches, whereas

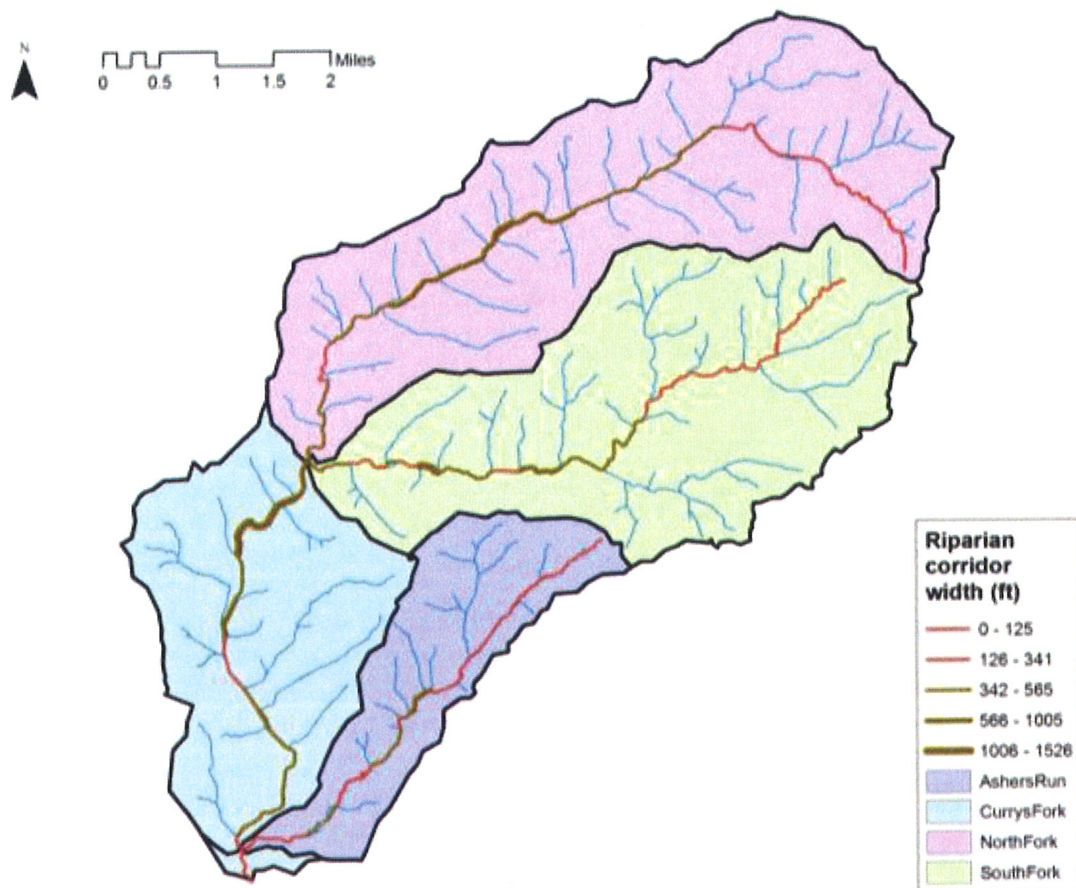


Figure 3.21 Although width is not directly correlated with quality of riparian corridor, the width does show where direct impact to the stream from agriculture or development is possible or where indirect impacts may reach the stream channel.

Table 3.10 GIS Summary

Reaches in bold boxes were analyzed together.

Reach ID	Sinuosity	Valley Width (ft)	Stream Width (ft)	Valley: Stream Width Ratio	Riparian Buffer Width (ft)	Buffer: Stream Width Ratio	Channel Modifications	Berms and Roads	River Corridor Development	Meander Migration Avulsion
ARR01	1.278	279.0	27.3	10.2	341	12	No	No	No	Multiple channels
ARR02	1.094	399.7	17.3	23.1	519	30	No	No	No	Multiple channels
ARR03	1.055	434.3	24.0	18.1	430	18	No	No	No	Multiple channels
ARR04	1.055	434.3	24.0	18.1	430	18	No	No	No	Multiple channels
ARR05	1.277	282.0	19.0	14.8	316	17	No	No	Powerline crossing	No
ARR06	1.047	397.3	15.4	25.9	460	30	Yes	No	Low density residential; one floodplain pond	No
ARR07	1.056	183.0	13.7	13.4	65	5	Yes	No	Low density residential	No
ARR08	1.320	353.0	18.0	19.6	417	23	No (downstream trib straightened)	No	One large floodplain pond	No
ARR09	1.122	270.7	18.0	15.0	710	39	Yes	No	No	No
ARR10	1.238	259.0	18.0	14.4	820	46	No	No	Powerline crossing	No
ARR11	1.050	399.0	18.3	21.8	177	10	Yes	No	No	No
ARR12	1.120	320.3	23.7	13.5	111	5	Yes (highly modified)	No	No	No
ARR13	1.044	239.7	16.8	14.2	218	13	Yes	No	Some low density residential	No
ARR14	1.161	190.7	43.0	4.4	330	8	Yes	No	Some low density residential	No
ARR15	1.089	211.3	12.7	16.7	313	25	Possibly	No	Some low density residential	No
ARR16	ponds	ponds	ponds	ponds	N/A	N/A				
CFR01	1.110	1008.0	69.7	14.5	170	2	No	Road and embankment	Residential Development right bank	Minimal
CFR02	1.203	1096.3	60.0	18.3	209	3	No	No	Commercial right bank	Small side channel avulsion
CFR03	1.078	707.3	57.7	12.3	440	8	Yes	No	No	Multiple channels
CFR04	1.000	783.7	58.0	13.5	396	7	Probably	No	No	Multiple channels
CFR05	1.000	869.7	56.0	15.5	634	11	Probably	No	Powerline crossing	Multiple channels
CFR06	1.000	731.3	55.0	13.3	441	8	Probably	Small road embankment	No	Multiple channels
CFR07	1.000	664.7	53.0	12.5	262	5	Probably	Small road embankment	No	No
CFR08	1.000	681.0	58.7	11.6	171	3	Yes	No	No	No
CFR09	1.000	551.0	46.7	11.8	307	7	Yes	No	No	No
CFR10	1.058	732.3	51.7	14.2	661	13	Yes	No	No	1 side channel
CFR11	1.045	517.7	57.0	9.1	429	8	Yes	No	No	No
CFR12	1.203	648.7	66.7	9.7	1526	23	Yes	No	No	1 splay area
CFR13	1.042	544.7	59.7	9.1	1378	23	Probably	No	Left bank residential	1 splay area
CFR14	1.042	544.7	59.7	9.1	1378	23	Probably	No	Left bank residential	1 splay area
CFR15	1.141	798.3	54.7	14.6	804	15	No	No	Left bank residential, downstream section only	No
NCR01	1.359	716.3	30.0	23.9	478	16	Yes	No	Low density residential	No
NCR02	1.138	621.3	40.8	15.2	503	12	Yes	No	Low density residential	Multiple channels
NCR03	1.138	621.3	40.8	15.2	503	12	Yes	No	Low density residential	Multiple channels
NCR04	1.247	538.0	40.0	13.5	295	7	Yes	I-71	I-71, Low density residential	No
NCR05	1.078	386.0	38.7	10.0	418	11	Maybe	I-71	I-71	No
NCR06	1.150	400.3	34.3	11.7	506	15	No	I-71	I-71	1 large splay

(Continued)

Reach ID	Sinuosity	Valley Width (ft)	Stream Width (ft)	Valley: Stream Width Ratio	Riparian Buffer Width (ft)	Buffer: Stream Width Ratio	Channel Modifications	Berms and Roads	River Corridor Development	Meander Migration Avulsion
NCR07	1.071	442.3	34.0	13.0	427	13	Yes, upstream of bridge	I-71	I-71	No
NCR08	1.071	442.3	34.0	13.0	427	13	Yes, upstream of bridge	I-71	I-71	No
NCR09	1.088	526.7	35.0	15.0	625	18	Maybe	I-71	I-71	1 side channel
NCR10	1.000	517.3	24.7	21.0	716	29	Yes	I-71	I-71, Powerline crossings (3)	1 Anabranched section
NCR11	1.000	517.3	24.7	21.0	716	29	Yes	I-71	I-71, Powerline crossings (3)	1 Anabranched section
NCR12	1.101	533.7	31.3	17.0	840	27	No	I-71	I-71	No
NCR13	1.101	533.7	31.3	17.0	840	27	No	I-71	I-71	No
NCR14	1.059	300.3	27.7	10.9	1088	39	Yes	I-71	I-71	No
NCR15	1.059	300.3	27.7	10.9	1088	39	Yes	I-71	I-71	No
NCR16	1.058	298.0	25.3	11.8	1005	40	Maybe	I-71	I-71	Not visible
NCR17	1.137	475.0	27.3	17.4	834	31	Yes	I-71	I-71	Not visible
NCR18	1.137	475.0	27.3	17.4	834	31	Yes	I-71	I-71	Not visible
NCR19	1.084	386.7	32.0	12.1	509	16	Yes	I-71	I-71	Multiple channels
NCR20	1.050	378.7	21.7	17.5	446	21	Yes	I-71	I-71	Not visible
NCR21	1.050	378.7	21.7	17.5	446	21	Yes	I-71	I-71	Not visible
NCR22	1.111	378.3	17.0	22.3	453	27	No	I-71	I-71, powerline crossing	No
NCR23	1.063	346.3	16.5	21.0	451	27	Yes	I-71	I-71	No
NCR24	1.000	384.3	17.7	21.8	419	24	Yes	I-71	I-71	Multiple flood channels
NCR25	1.000	217.0	17.2	12.6	415	24	Yes	I-71	I-71	No
NCR26	1.000	219.3	21.0	10.4	356	17	Yes	I-71 and KY-53	I-71	No
SCR01	1.112	1006.7	38.3	26.3	401	10	Yes	No	Low density residential	1 split channel
SCR02	1.154	582.0	47.3	12.3	317	7	Maybe	No	Low density residential	No
SCR03	1.154	520.0	51.5	10.1	389	8	No	No	Low density residential	1 split channel
SCR04	1.154	520.0	51.5	10.1	389	8	No	No	Low density residential	1 split channel
SCR05	1.046	652.0	41.5	15.7	193	5	Maybe	No	Low density residential	1 split channel
SCR06	1.042	618.0	30.3	20.4	1400	46	Yes	No	No	1 split channel
SCR07	1.139	710.0	37.7	18.8	559	15	Yes	No	School on right bank, powerline crossing, pond on right bank	No
SCR08	1.000	610.0	49.7	12.3	287	6	Yes	No	Low density residential	No
SCR09	1.091	332.7	50.0	6.7	633	13	Yes	No	Low density residential	No
SCR10	1.157	569.0	36.0	15.8	566	16	Yes	No	Low density residential	1 small side channel
SCR11	1.301	528.0	39.0	13.5	467	12	Yes	No	Low density residential	No
SCR12	1.158	505.5	30.7	16.5	375	12	Maybe	No	Low density residential	No
SCR13	1.078	478.5	27.0	17.7	188	7	Maybe	No	Low density residential	No
SCR14	1.115	321.7	32.3	9.9	185	6	Yes	Road	Road in upstream section floodplain; low density residential	No
SCR15	1.128	404.3	24.3	16.6	32	1	Maybe	Road	Road in floodplain; low density residential	No
SCR16	1.283	367.3	20.7	17.8	67	3	Yes	Road	Road in floodplain; low density residential	No
SCR17	1.047	251.3	Not visible	N/A	125	N/A	Yes	Road	Road in floodplain; low density residential	Not visible
SCR18	1.144	320.0	<10	32.0	0	0	No	No	Agricultural	No
SCR19	1.117	235.3	<10	23.5	29	3	Yes	No	Agricultural	No

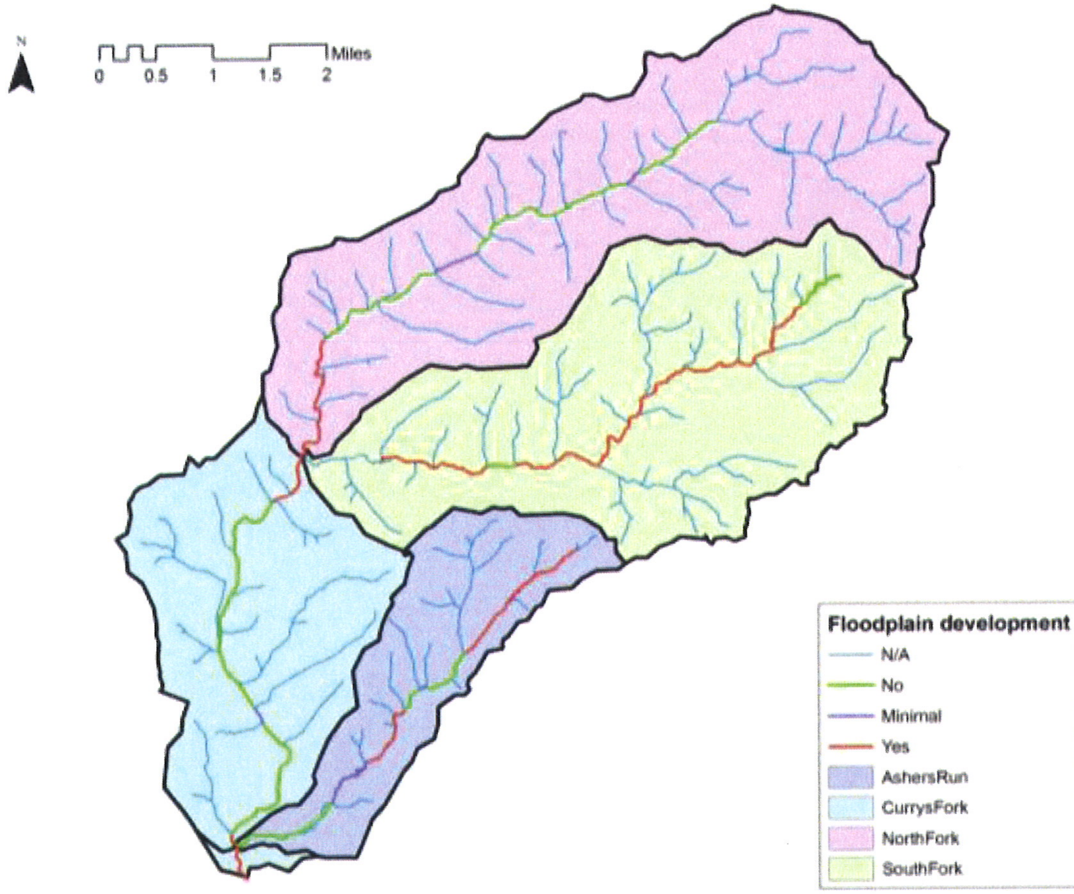


Figure 3.22 River corridor development as an indicator of the human influence on contemporary stream channel.

the majority of the main stem of South Fork has some encroaching development. In general, the development along Curry's Fork is low intensity. The possible exceptions are the tributaries of North Fork, particularly along Commerce Parkway, where future development is planned. The industrial nature of this development may have implications for nonpoint source pollution, especially for the relatively undisturbed reaches between the north and south bound lanes of I-71.

3.3.2 Field Investigation

Variations in stream and floodplain function were assessed in all subwatersheds (Table 3.11). A generalized description of each subwatershed is provided below, and example images are provided in the appendix. Channel morphology can vary over very short distances even within a single reach, so these are general descriptions; local exceptions will always exist.

Table 3.11 Functional Results*

Reach ID	Stream Order	Bank Erosion	Bedload Transport	LWD Recruitment	Suspended Sediment Deposition	LWD Retention	Groundwater Interaction	Floodplain Inundation	Grade Controls†
ARR01a	3	S	S	S	P	P	T	P	Bedrock
ARR01b‡	3	T	S	T	S	S	T	S	Bedrock
ARR02	1	T	S	T	S	S	T	S	Bedrock
ARR05	3	S	S	P	S	P	S	S	Culvert
ARR06	3	T	T	T	P	P	S	S	Culvert
ARR12	3	S	S	P	S	P	S	S	Bedrock
ARR13	2	T	T	T	S	S	S	T	Culvert
ARR15	2	P	P	P	S	P	S	T	Culvert and bedrock
CFR01	4	P	S	S/P	S	P	S	P	Floyd's Fork
CFR02	4	P	S	S	S	P	S	P	Bedrock
CFR03	4	S	S	S	S	S	S	S	Bedrock
CFR05	4	S	T	S	S	S	S	T	Bedrock
CFR11	4	T	S	S	P	S	S	S	Bedrock
CFR12	4	T	S	S	S	S	S	S	Bedrock
CFR13	4	T	T	T	S	S	T	T	Bedrock
CFR14	4	T	T	T	S	S	T	T	Bedrock
CFR15	4	S	S	S	S	S	S	S	Bedrock
NCR01	3	S	P	S	S	S	P	P	Bedrock
NCR02	3	S	S	S	S	S	S	S	Bedrock
NCR03	3	S	S	S	S	S	S	S	Bedrock
NCR08	3	T	T	S	S	S	S	S	Bedrock
NCR15	3	T	T	S	S	S	T	T	Bedrock
NCR16	3	T	T	S	S	S	T	T	Bedrock
NCR17	3	T	T	T	S	T	T	T	Bedrock
NCR18	3	S	T	S	S	S	T	S	Bedrock
NCR19	3	S	S	S	S	S	S	S	Bedrock
SCR01	4	P	S	S	S	P	P	P	Bedrock
SCR02	4	S	T	T	S	T	S	S	Bedrock
SCR03	4	S	T	T	S	T	S	S	Bedrock
SCR07	4	S	S	S	P	T	S	S	Bedrock
SCR13	4	S	S	S	P	T	S	P	Bridge and bedrock
SCR14	3	P	S	S	P	S	S	P	Bedrock
SCR15	3	P	S	S	P	P	S	S	Bridge and bedrock

* Based on Table 2.5 Assessed Functions: Target (T); Suboptimal (S); Poor (P).

† In every assessed reach, bedrock was identified and provided a minimum grade control, limiting future rapid incision to the height of riffles (typically between 1 ft and 3 ft).

‡ Reach was split because the lower part of the reach was influenced by backwater from the main stem of Curry's Fork and had a considerably different morphology than the upper part of the reach.

North Fork

The North Fork can be organized into three distinct groups of reaches: those downstream of I-71, those between I-71, and those upstream of I-71. Downstream of I-71, the main stem and its tributaries are entrenched, incised to bedrock, and lacking in habitat variability. Reaches of the main stem downstream of I-71 could potentially be very good for stream restoration projects because the valley is wide relative to the stream width, and residential encroachment is limited. A significant reduction in sediment loading to the stream could be expected if the long stretches of eroding banks were restored. The tributaries to the main stem downstream of I-71 were reasonably constrained by development and would provide logistical challenges to stream restoration. Most of the tributaries, however, do have good riparian buffers that should be preserved.

The reaches in between the north- and southbound lanes of I-71 offer insight into the potential of Curry's Fork with no floodplain development, no removal of large woody material, and no bridge crossings/culverts to locally limit lateral migration. The channel is gradually increasing sinuosity after it was straightened in several reaches and has a wide riparian corridor. Eroding banks are common and provide good habitat, but because the banks are low, the mass of sediment supplied the channel is low. The habitat in these reaches is the most varied in the subwatershed, if not all of the Curry's Fork drainage network, with well-developed riffles and pools, and a well-connected floodplain. This reach also did not appear to dry out during the summer months, although this may be related to the effluent from wastewater treatment plants. Future changes in WWTP effluent discharge quantities and locations may affect the availability of low flow.

South Fork

The South Fork can be organized into two groups of reaches: those reaches downstream of SC2 have residential development or are immediately adjacent to a subdivision, whereas those reaches upstream of SC2 have less residential impact but have agricultural land occupying most of the valley flat, with only isolated houses. The riparian corridor downstream of SC2 is generally wide, although it is not continuous; upstream of SC2, the riparian corridor is very narrow and limited in extent.

Lower reaches of the main stem have good habitat, especially in anabranched reaches, except near the confluence with North Fork Curry's Fork, where very high banks and a flat bedrock bed were evidence of incision and lack of habitat. The anabranched reaches coincided with reaches with LWD both from fallen trees and small jams in the channel. In the anabranched reaches, a lower floodplain or bar deposits were acting to trap sediment and, presumably, nutrients and contaminants associated with fine sediment. These sections had diverse physical habitat with riffles, pools, runs, and backwater areas. In contrast, the single-thread sections had limited riffle and pool development, less available cover, and little evidence of interaction between channel and floodplain. Anabranched reaches also have more eroding banks, so the net storage and sources of sediment are difficult to determine; scientific research on anabranched channels in incised systems is particularly lacking (Makaske 2001) and would provide useful information for their role in affecting NPS pollution loads.

Stream restoration projects in the single thread main stem reaches would have the main benefit of reducing sediment supply by reducing the bank height and increasing the connectivity between floodplain and main channel. One main stem reach adjacent to Centerfield Elementary could provide a suitable site for improving stream function and provide a demonstration of the improvements that could made in physical habitat in these stream reaches. Most of the tributaries to these reaches of South Fork Curry's Fork are extensively developed to the extent that stream restoration potential is limited, although channel improvements may be possible close to the confluence with the main stem.

The habitat in the upper reaches of South Fork showed the most consistent siltation of all the reaches assessed in the Curry's Fork watershed. None of these reaches met the target condition for any of the assessed functions. These reaches also had the least extensive riparian corridor of all assessed reaches. Moreover, the quality of the riparian corridor is generally poor, with a significant percentage of invasive species such as osage orange (*Maclura pomifera*) (Vesely et al. 2009). One cause of suspended sediment deposition in the upper reaches of South Fork was sediment delivery from the tributaries during low flow periods (Figure 4SF). Siltation may be caused not by high loads of sediment but by relatively small amounts that are delivered when the flow in the channel is insufficient to influx. Restoration of these tributaries on the Oldham County Board of Education East Moody Lane property will locally reduce the input of fine sediment from these side channels when the flow in the main channel is low. The other potential source for fine sediment is the agricultural land use upstream, but results from GeoWEPP and field observations suggest that sediment production from these fields is relatively low.

Curry's Fork

The main stem of Curry's Fork can be classified in to two main groups of reaches: those that are influenced by Floyd's Fork and those upstream of the backwater influence. The main stem near the confluence with Floyd's Fork has very high banks, and as a result of this entrenchment, little coarse sediment is deposited, limiting potential for bar or riffle formation (Figure 1CF). Some pea gravel is typically present, but this sediment is frequently mobilized and hence poor habitat for many benthic organisms that require a stable substrate. Improving habitat function in this downstream reach would involve a considerable amount of earthmoving to reduce entrenchment and improve floodplain-channel interaction. The floodplain of the downstream-most reach was inundated during the study period but only when Floyd's Fork was also in flood and causing backwater. Away from the backwater influence of Floyd's Fork, the stream reaches have lower banks, more stable substrate, and more connectivity with the floodplain (Figure 2CF). The channel configuration is relatively consistent up to the confluence of the North and South Fork with alternating single-thread and anabranched reaches. The single-thread channels have higher banks and are generally eroding on one bank. The anabranched reaches have a mixture of eroding and depositing regions. The anabranched reaches are the result of local erosion of the floodplain due to fallen woody debris and are typically three channels or less. The impact of these multiple channels on the storage of nonpoint source pollutants has received limited scientific study but would be valuable information, especially for stream restoration design. Field observations suggest that these anabranched reaches could be very useful for providing diverse habitat and storing sediment and associated pollutants.

Asher's Run

Asher's Run can be classified into three groups of reaches: those reaches in the immediate vicinity of Curry's Fork main stem, those reaches upstream of this confluence but downstream of Camden Lane, and those reaches upstream of Camden Lane. Reaches downstream of Camden Lane generally have a good riparian buffer and limited development, whereas reaches upstream have a less extensive riparian buffer and more direct channel impacts from development

In the stream reaches immediately upstream of the confluence with the main stem of Curry's Fork, the influence of the larger stream is clear: banks are high (Figure 1AR) and signs of frequent overbank flooding due to backwater effects are evident. Both banks in these reaches are eroding, so the local sediment production is relatively high, albeit for a short distance. Above the influence of the main stem, the bank height decreases, the amount of coarse sediment deposition increases, and the variability in physical habitat improves. There are alternating single-thread and anabranched reaches up to the Camden Lane bridge. The anabranched reaches have a lot of available cover, varied substrate, and varied flow conditions (fast, slow, deep, shallow, and combinations thereof)(Figure 2AR).

Asher's Run upstream of Camden Lane is straighter, less forested, and has fewer anabranching reaches than downstream. Some reaches show signs of floodplain modification (Figure 3AR), whereas in others the stream itself has been modified (Figure 4AR). Although a stream restoration project in this group of reaches may be beneficial in terms of improving the physical habitat, a number of constraints from adjacent roads and residential development would limit the ability to enact major changes in floodplain configuration. An alternative strategy would be to focus restoration efforts on the lower reaches of Asher's Run, where fewer landowners and more valley width would facilitate restoration work, and treatment of upstream water quality during low flow could be incorporated into the project design.

3.3.3 General Habitat Findings

Although each subwatershed had particular reaches that both met and did not meet target functions, higher-quality reaches shared similar characteristics throughout the Curry's Fork watershed: the reaches that met the target functions had lower banks, more floodplain accessibility, greater groundwater connection, and more diverse morphology, and they were typically located away from the valley walls. The field investigations and multiple trips to the watershed throughout different times of the year also suggest that the presence or absence of low-flow habitat is significantly variable in the watershed. Many reaches in Asher's Run, South Fork, and North Fork were observed to dry out, whereas others maintained at least some standing water throughout the year. The main stem typically did not dry out except in isolated circumstances. Currently, wastewater treatment plant (WWTP) effluent is likely contributing water that maintains low-flow habitat downstream of discharge points on tributaries of the North Fork. Because several changes in WWTP effluent management are envisaged as part of this plan and as separate initiatives (John Bennett, La Grange Utility Commission, pers. comm.), their impact on low-flow hydrology should be considered in future watershed management activities. Low or absent base flow also has indirect impacts on aquatic communities through secondary effects such as elevated temperatures, decreased DO, elevated BOD, and increased concentrations of contaminants and nutrients due to lack of mixing and dilution. Hence, impacts on the quantity of water during summer months may also impact water quality.

4. Conclusions

To help develop an effective watershed-scale management strategy for reducing NPS pollution in Curry's Fork watershed, a study was conducted focusing on fine sediment loads and geomorphology, specifically relating to physical habitat functions. Annual loads of fine sediment in each of Curry's Fork's four major subwatersheds were measured, the contribution from bank erosion and upland surface erosion was measured, and the physical habitat functions were assessed in representative reaches of each subwatershed.

The highest subwatershed sediment loads were measured in South Fork Curry's Fork; the lowest were measured in Asher's Run. The highest rates of sediment production from bank erosion were in the lower reaches of Curry's Fork subwatershed close to the confluence with Floyd's Fork where bank heights are over 10 ft. All blue line stream reaches had banks that were much higher than average in the vicinity of the confluence with larger receiving watercourse. The representativeness of reaches near confluences should be accounted for in biological/habitat sampling design.

Sediment production from upland surface erosion did not have clear spatial trends, reflecting the relative uniformity of geology, topography, soil types, and land use. Because of the lack of discrete areas with high upland surface erosion, consideration should be given to identifying potential locations for construction of storage areas or depositional zones to trap sediment eroded from the uplands. These storage areas could be constructed as wetlands at the base of hillsides or as small retention basins.

The vast majority of stream reaches in all subwatersheds were incised to bedrock, at least in pools, had a dearth of in-stream cover/submerged structures, and showed signs of channel straightening. Stream restoration projects to improve surface-groundwater connectivity, increase habitat diversity, reduce shear stress, reduce bank erosion, and create floodplain wetlands could be implemented in most stream reaches, with some reaches of North Fork Curry's Fork between the divided interstate being the main exception.

The availability of low-flow habitat is spatially variable and ecologically important in the Curry's Fork watershed. Water quantity can dramatically and directly impact water quality, especially when base flow discharge is low, temperatures rise, and mixing is reduced. Currently, wastewater treatment plant (WWTP) effluent is likely contributing water that maintains low-flow habitat downstream of discharge points. Future changes in WWTP effluent discharge quantities and locations may affect the availability of low flow.

In the Curry's Fork watershed, siltation generally did not occur as a result of large floods. Siltation tended to occur under much lower flow conditions, and fine sediment was in fact cleaned from the bed during large flood events that transported the highest total loads. A better understanding of the link between sediment production and the development of siltation as well as greater integration between sediment assessments and biological monitoring would improve the development of management strategies to reduce impairment associated with this nonpoint source pollutant.

References

American Society of Civil Engineering (ASCE). 2000. Soil sampling. ASCE Technical Engineering and Design Guides adapted from the US Army Corps of Engineers, No 30. 214 pp.

Asselman NEM. 1999. Suspended sediment dynamics in a large drainage basin: the River Rhine. Hydrological Processes 13: 1437-1450.

Bravard JP, Kondolf GM, and Piégay H. 1999. Environmental and societal effects of channel incision and remedial strategies. In SE Darby and A Simon (eds.), Incised River Channels, Wiley, Chichester, UK, pp. 304-341.

Cenderelli DA and Kite JS. 1998. Geomorphic effects of large debris flows on channel morphology at North Fork Mountain, eastern West Virginia, USA. Earth Surface Processes and Landforms 23:1-19.

Eaton LS, Morgan BA, Kochel RC, and Howard AD. 2003. Role of debris flows in long-term landscape denudation in the central Appalachians of Virginia. Geology 31(4):339-342.

Fishman MJ and Friedman LC (eds.). 1989. Methods for determination of inorganic substances in water and fluvial sediments. Techniques of Water-Resources Investigations of the United States Geological Survey Book 5, chapter A1. United States Government Printing Office, Washington DC. 24p. Available at http://pubs.usgs.gov/twri/twri5-a1/pdf/twri_5-A1_n.pdf, accessed Jan2011.

Flanagan DC and Nearing MA (eds.). 1995. USDA Water Erosion Prediction Project hillslope and watershed model documentation. NSERL Report No. 10. USDA-ARS National Soil Erosion Research Laboratory, West Lafayette, IN.

Gray JR and Gartner JW. 2009. Technological advances in suspended-sediment surrogate monitoring. Water Resources Research 45 W00D29: 1-20.

Kentucky Division of Water (KDOW). 2008. Draft Integrated Report to Congress on the Condition of Water Resources in Kentucky. Volume II. 303(d) List of Surface Waters. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky.

Kentucky Division of Geographic Information (KDGI). 2009. Kentucky 2006 2FT Imagery (KY1Z). Available at http://kygisserver.ky.gov/ArcGIS/rest/services/KY1Z_Services/KyImage2006/MapServer, accessed Jul2009.

Lefrançois J, Grimaldi C, Gascuel-Odoux C, and Gilliet N. 2007. Suspended sediment and discharge relationships to identify bank degradation as a main sediment source on small agricultural catchments. Hydrological Processes 21:2923-2933.

Louisville/Jefferson County Information Consortium (LOJIC). 2009. Jefferson 2006 Digital Ortho Imagery. Available at: ftp://ftp.kymartian.ky.gov/hs/jefferson_2006/, accessed Jul2009.

Makaske B. 2001. Anastomosing rivers: a review of their classification, origin and sedimentary products. Earth-Science Reviews 53: 149-196.

Mastin C. 2009. A quantitative assessment of channelization in the Appalachian Highland region, MEng Thesis, University of Louisville. Available at http://digital.library.louisville.edu/u?/etd,842, accessed Mar2011.

McKean CJP and Nordin RN. 1986. A simple semi-continuous piston corer for organic sediments. Hydrobiologia 137: 251-256.

Minkowski MA and Renschler C. 2008. GeoWEPP for ArcGIS 9.x Full Version Manual. University at Buffalo - The State University of New York (SUNY), Buffalo, NY, 121p.

National Oceanic and Atmospheric Administration National Climatic Data Center (NOAA NCDC). 2009. Local climatological data for Louisville Intl-Standiford Field (KSDF). Available at http://www7.ncdc.noaa.gov/IPS/hpd/hpd.html, accessed Apr2009.

Parola AC, Vesely WS, Croasdaile MA, Hansen C, and Jones MS. 2007. Geomorphic characteristics of streams in the Bluegrass physiographic region of Kentucky. Project final report for Kentucky Division of Water NPS 00-10, University of Louisville Stream Institute, Louisville, KY, 60 pp.

Reid LM and Dunne T. 1996. Rapid evaluation of sediment budgets. Catena Verlag GMBH, Reiskirchen, Germany, 164 pp.

Rosgen DL. 2001. A practical method of computing streambank erosion rates. Seventh Federal Interagency Sediment Conference, March 24-29, Reno, NV.

Rosgen DL. 2006. Watershed assessment of river stability and sediment supply (WARSSS). Wildland Hydrology, Pagosa Springs, CO.

Simon A and Darby S. 1999. The nature and significance of incised river channels. In A Simon and S Darby (eds.), Incised River Channels: Processes, Forms, Engineering, and Management. John Wiley and Sons, New York, NY.

Thorne CR. 1999. Bank processes and channel evolution in the incised rivers of North-Central Mississippi. In Simon A and Darby S (eds.) Incised River Channels: Processes, Forms, Engineering, and Management. John Wiley and Sons, New York, NY.

Tonning B. 2007. Kentucky erosion prevention and sediment control field guide. Available at http://stormwater.ky.gov/constructiondevelopment-community-resources, accessed Mar2011.

Trimble SW and Crosson P. 2000. US soil erosion rates: myth and reality. Science 289(5477): 248-250.

US Census Bureau. 2009. American fact finder. Available at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml, accessed Apr2009.

US Environmental Protection Agency. 1999. Protocol for developing sediment TMDLs. EPA 841-B-99-004. Office of Water (4503F), US Environmental Protection Agency, Washington, DC, 132 pp.

US Geological Survey (USGS). 2009. National Hydrography Dataset (NHD) - Line Features. Available at ftp://data.gis.eppc.ky.gov/shapefiles/nhd_line_features.zip, accessed Feb2008.

Verstraeten G and Poesen J. 2001. Modeling the long-term sediment trap efficiency of small ponds. Hydrological Processes 15: 2797-2819.

Vesely WS, Parola AC, and Hansen C. 2009. Mitigation plan for South Fork Curry's Fork and tributaries, Oldham County. University of Louisville Stream Institute, Louisville, KY, 86 pp. Nov 5.

Williams GP. 1989. Sediment concentration versus water discharge during single hydrologic events in rivers. Journal of Hydrology 111:89-106.

Appendix:
Field Investigation Photos

Figure 1NF The reach of North Fork upstream of the confluence with South Fork has high eroding banks and limited coarse sediment deposition.

Figure 2NF Exposed tree roots and eroding banks are typical in the lower reaches of North Fork, but in-channel woody debris is relatively scarce.

Figure 3NF Upstream of the confluence with South Fork, the bank height in North Fork is lower and riffles and pool are more abundant.

Figure 4NF Between the divided highway of I-71, the streambanks of North Fork are low, and the floodplain is well developed.

Figure 1SF The South Fork channel near the confluence with North Fork is incised and entrenched, and exposed tree roots are found on both banks.

Figure 2SF Upstream of the confluence with North Fork, the banks in South Fork are lower, and coarse sediment deposition has formed riffles, bars, and pools.

Figure 3SF The site of the stream restoration project funded by the in-lieu fee program administered by the Kentucky Department of Fish and Wildlife Resources. The site is owned by the Oldham County Board of Education.

Figure 4SF Turbid water entering the main stem of South Fork at the upstream end of the restoration site. The water stage in tributaries often rises in response to rain before the main stem does, delivering fine sediment.

Figure 1CF Close to the confluence with Floyd's Fork, the banks of Curry's Fork are high (over 10 ft) and may get higher as erosion reaches the base of the hillside.

Figure 2CF Upstream of the confluence with Floyd's Fork, the main stem bank height drops, and coarse sediment deposition has formed riffles, bars, and pools.

Figure 3CF Curry's Fork downstream of the confluence of North Fork and South Fork is straight with eroding banks on both sides of the channel and only small bars formed by coarse sediment deposition.

Figure 4CF Where woody debris accumulates in the channel, coarse sediment deposition results, forming much more varied habitat than in adjacent straight reaches.

Figure 1AR The highest banks in Asher's Run are located close to the confluence with Curry's Fork.

Figure 2AR Upstream of the confluence with Curry's Fork, the bank height on Asher's Run drops, and coarse sediment and wood deposition has formed varied habitat comprising riffles, bars, and pools.

Figure 3AR Section of Asher's Run upstream of Camden Lane showing banks comprising mortared stone walls.

Figure 4AR Upstream of Camden Lane, Asher's Run has almost no riparian corridor, and the floodplain is impacted by low-density residential land use.

APPENDIX D
QUALITATIVE MUSSEL SURVEY OF THE FLOYDS FORK WATERSHED

Qualitative Mussel Survey of the Floyds Fork Watershed

Steve McMurray
Rodney Pierce
John Brumley

319 Monitoring Funds

Kentucky Division of Water
200 Fair Oaks Lane
Frankfort, KY 40601

Executive Summary

During the summer and fall of 2003, the Nonpoint Source Section of the Kentucky Division of Water conducted a qualitative mussel survey in the Floyds Fork watershed. A total of 23 stations were sampled along the mainstem of Floyds Fork and its major tributaries. Nineteen native mussel species and one invasive were found during the study. Live individuals of 10 native taxa were also discovered during the study. An earlier study of Floyds Fork was conducted by Taylor in 1978. Although the species lists from both surveys were very similar, Taylor collected only live or fresh dead specimens, while KDOW also enumerated weathered and relict valves. Because of the lack of live individuals in the KDOW survey, it was apparent that the quality of the mussel population in Floyds Fork has declined since 1978. Possible causes for the decline could be increased nutrients, sedimentation and other pollutants released from increased suburbanization of the watershed. Loss of riparian habitat also could be influencing the physicochemical properties of Floyds Fork and therefore impacting the mussel populations.

Introduction

Aquatic biologists in the Nonpoint Section began a qualitative mussel survey of the Floyds Fork watershed in August 2003 for the purpose of identifying mussel beds within the watershed. Historical records indicated that Floyds Fork had a robust mussel fauna at one time (Taylor 1980). Data collected from this survey would be compared to historic data and then used as a benchmark to look at changes in the watershed as a result of increasing urban and suburban development.

Description of Study Location and Sampling Stations

Floyds Fork is located in the north central Kentucky near the city of Louisville. It flows from the town of Ballardsville in Oldham County to its confluence with the Salt River near the city of Shepherdsville in Bullitt County. It has a catchment area of 285 mi^2. Floyds Fork is located in the Outer Bluegrass sub-ecoregion (Woods et al. 2002). Generally, the watershed is characterized by rolling hills with mixed woodland and pasture. Land use in the drainage includes horse farming, cattle farming, urban and suburban development and rural residential areas.

In 2003, 23 stations in the Floyds Fork watershed were qualitatively surveyed. Fifteen of these stations were located on the mainstem, while eight stations were located on the major tributaries of Floyds Fork (Table 1 and Figure 1).

Table 1. Sampling location information

Stat.#	Stream Name	Location	RM	County	Lat./Long.
1	Floyds Fork	KY 1526 Br.	7.4	Bullitt	38.0339/85.6593
2	Floyds Fork	Below Echo Trail	34.4	Jefferson	38.1987/85.4731
3	Floyds Fork	Above Echo Trail	34.6	Jefferson	38.2003/85.4753
4	Floyds Fork	Off Gilliland Rd.	36.55	Jefferson	38.2173/85.4725
5	Floyds Fork	0.9 km above I-65 Br.	37.4	Jefferson	38.2258/85.4775
6	Floyds Fork	US 60 Br.	38.7	Jefferson	38.2348/85.4723
7	Floyds Fork	Piercy Mill Rd. Ford	41.2	Jefferson	38.2489/85.4674
8	Floyds Fork	Aiken Rd. Br.	43.4	Jefferson	38.2656/85.4641
9	Floyds Fork	KY 362 Br.	44.9	Jefferson	38.2790/85.4650
10	Floyds Fork	Below Currys Fork	47.9	Oldham	38.3024/85.4494
11	Floyds Fork	Above Currys Fork	48.3	Oldham	38.3009/85.4477
12	Floyds Fork	0.8 km below KY 1408 Br.	50.4	Oldham	38.2986/85.4267
13	Floyds Fork	0.7 km below KY 1408 Br.	50.5	Oldham	38.2939/85.4256
14	Floyds Fork	KY 1315 Br.	58.05	Oldham	38.3227/85.3460
15	Floyds Fork	KY 53 Br.	60.8	Oldham	38.3476/85.3291
16	Cedar Creek	Above mouth	0.1	Bullitt	38.0358/85.6593
17	Chenoweth Run	KY 1819 Br.	0.2	Jefferson	38.1825/85.5250
18	Pope Lick	S. Pope Lick Rd. Br.	0.15	Jefferson	38.1891/85.4899
19	Brush Run	KY 1531 Br.	0.2	Jefferson	38.1897/85.4541
20	Long Run	Off Echo Trail	0.3	Jefferson	38.2017/85.4677
21	Currys Fork	KY 1408 Br.	0.4	Oldham	38.3075/85.4508
22	NF Currys Fork	KY 393 Br.	6.7	Oldham	38.3772/85.4275
23	Lick Fork	Hunt Lane Br.	0.5	Oldham	38.3162/85.3434

Methods

Mussel data was collected utilizing timed, visual-based, qualitative searches at each sampling location. One to three aquatic biologists were used to conduct the search at each station. Searches lasted between 0.5 to 2.0 hours depending upon the size of the stream segment. Catch per unit effort was calculated for each search. Voucher shells were collected at each station. These voucher specimens are housed in the Eastern Kentucky University museum.

Results

A total of 19 native unionid and one invasive (*Corbicula fluminea* – Asiatic clam) species were observed during the survey. At least one live individual from 10 of the native species was discovered, while fresh dead specimens from two other species were also present. All observed species were considered common. The Asiatic clam was collected from most of the stations sampled during the survey. *Lampsilis siliquoidea* was present at 74% of the sampling stations and *Pyganodon grandis* at 68% of the stations. *Quadrula pustulosa, Quadrula quadrula* and *Tritogonia verrucosa* were observed at only one station. Table 2 lists the species collected at each site.

Station #1 – Floyds Fork

This station on Floyds Fork was the most downstream location in the survey. On August 20th, seven native species (*Amblema plicata*, *Elliptio dilatata, Fusconaia flava, Megalonaias nervosa, Quadrula pustulosa, Quadrula quadrula* and *Tritogonia verrucosa*) were observed. No live specimens were discovered. *Quadrula pustulosa, Quadrula quadrula* and *Tritogonia verrucosa* were found only at this station. *Quadrula quadrula* was the most abundant native species at this site with four and a half weathered dry valves collected.

Station #2 – Floyds Fork

On October 10th, four native species (*Alasmidonta viridis, Amblema plicata, Fusconaia flava* and *Lampsilis siliquoidea*) were observed at this station. All shells were weathered dry. The only live individuals collected at this site were of the Asiatic clam. *Lampsilis siliquoidea* was the most abundant native species at this location with 15 weathered dry valves collected.

Station #3 – Floyds Fork

On October 13th, eight native species (*Alasmidonta viridis, Amblema plicata, Fusconaia flava, Lampsilis cardium, Lampsilis siliquoidea, Lasmigona costata, Potamilus alatus* and *Pyganodon grandis*) were observed at this station. Six live specimens of *Lampsilis siliquoidea* and one live specimen of *Lasmigona costata* were discovered. *Lampsilis siliquoidea* was the most abundant native species with the six live specimens and 15 weathered dry valves observed.

Station #4 – Floyds Fork

On October 13th, eleven native species (*Actinonaias ligamentina, Alasmidonta viridis, Fusconaia flava, Lampsilis cardium, Lampsilis siliquoidea, Lasmigona complanata, Leptodea fragilis, Megalonaias nervosa, Potamilus alatus, Pyganodon grandis* and *Strophitus undulatus*) were present at this station indicating a fairly diverse mussel fauna. Live specimens of *Lampsilis cardium* and *Pyganodon grandis*, as well as a fresh dead valve of *Megalonaias nervosa* was observed at this station. *Lampsilis siliquoidea* was the most abundant native species with 15 valves recorded.

Station #5 – Floyds Fork

On October 13th, eight native species (*Alasmidonta viridis, Amblema plicata, Lampsilis cardium, Lampsilis siliquoidea, Lasmigona complanata, Leptodea fragilis, Ptychobranchus fasciolaris,* and *Pyganodon grandis*) were recorded from this sampling location. A few live individuals *of Lampsilis siliquoidea* and *Pyganodon grandis* were observed. *Lampsilis siliquoidea* was the most abundant native species with two live specimens and ten weathered valves collected at this station.

Station #6 – Floyds Fork

The mussel bed at this sampling location was the most productive in the survey with at total of 12 native species present (*Actinonaias ligamentina, Alasmidonta viridis, Amblema plicata, Elliptio dilatata, Fusconaia flava, Lampsilis cardium, Lampsilis siliquoidea, Lasmigona complanata, Lasmigona costata, Potamilus alatus, Ptychobranchus fasciolaris,* and *Pyganodon grandis*) on October 9th. Of these taxa, live specimens of *Actinonaias ligamentina, Alasmidonta viridis, Lampsilis cardium, Lampsilis siliquoidea, Lasmigona complanata, Lasmigona costata,* and *Potamilus alatus*) were observed. Like at most stations in the survey, *Lampsilis siliquoidea* was the most abundant native species with five live specimens and 20 weathered valves recorded.

Station #7 – Floyds Fork

On October 8th, only seven native taxa were represented (*Actinonaias ligamentina, Fusconaia flava, Lampsilis cardium, Lampsilis siliquoidea, Lasmigona complanata, Potamilus alatus,* and *Pyganodon grandis*). Even though diversity was low at this station, live individuals from three taxa (*Actinonaias ligamentina, Lampsilis cardium* and *Lampsilis siliquoidea*) were observed. *Lampsilis siliquoidea* was again the most abundant species at this location with three live specimens and seven and a half weathered shells.

Station #8 – Floyds Fork

On August 15th, ten native species (*Actinonaias ligamentina, Alasmidonta viridis, Amblema plicata, Elliptio dilatata, Fusconaia flava, Lampsilis cardium, Lampsilis siliquoidea, Lasmigona complanata, Ptychobranchus fasciolaris,* and *Pyganodon grandis*) were recorded from this sampling location. No live specimens were observed. Twenty-two and a half weathered valves of *Lampsilis siliquoidea* were collected representing the most abundant taxa at this station.

Station #9 – Floyds Fork

On October 7th, eight native species (*Actinonaias ligamentina, Alasmidontat viridis, Amblema plicata, Fusconaia flava, Lampsilis cardium, Lampsilis siliquoidea, Lasmigona complanata* and *Pyganodon grandis*) were observed at this station. A few live individuals of *Actinonaias ligamentina* and *Lampsilis siliquoidea* were recorded. *Lampsilis siliquoidea* was the most dominant taxa at this station with four live specimens and ten weathered valves discovered.

Station #10 – Floyds Fork

On October 8th, only six native species (*Actinoaias ligamentina, Lampsilis cardium, Lampsilis siliquoidea, Lasmigona complanata, Pyganodon grandis* and *Strophitus undulatus*) were collected a this station. Despite the low diversity of this mussel bed, live individuals of all native species were observed except for *Pyganodon grandis*. *Lampsilis siliquoidea* was the most abundant taxa with 14 live specimens and 10 weathered shells present during the survey.

Station #11 – Floyds Fork

On October 8th, two native species were observed at this station, *Alasmidonta viridis* and *Strophitus undulatus*. One live individual of each taxa was recorded. No weathered valves were found.

Station #12 – Floyds Fork

On October 7th, six native unionids were observed at this location (*Actinonaias ligamentina, Amblema plicata, Lampsilis cardium, Lampsilis siliquoidea, Pyganodon grandis* and *Strophitus undulatus*). Even though low diversity occurred at this mussel bed, live individuals of each native taxa were recorded, except for *Lampsilis cardium*. Again, *Lampsilis siliquoidea* was the most abundant species with seven live specimens and six and a half weathered shells found.

Station #13 – Floyds Fork

At this survey location on October 7th, six native species were observed (*Actinonaias ligamentina, Fusconaia flava, Lampsilis cardium, Lampsilis siliquoidea, Potamilus alatus* and *Pyganodon grandis*). Live individuals of *Lampsilis siliquoidea* and *Pyganodon grandis* were found. The Asiatic clam was not observed at this station. *Lampsilis siliquoidea* was the most abundant species with four live specimens and 20 weathered shells recorded.

Station #14 – Floyds Fork

On August 18th, two native species, *Lampsilis siliquoidea* and *Pyganodon grandis*, were discovered at this sampling location. Live specimens of both taxa were observed with *Lampsilis siliquoidea* the most abundant taxa with three live individuals and eight and a half weathered valves present.

Station #15 – Floyds Fork

Live individuals of *Actinonaias ligamentina, Lampsilis siliquoidea* and *Pyganodon grandis* were recorded at this Floyds Fork station on August 18th. *Lampsilis siliquoidea* was the most abundant species at this location with 14 live specimens and five and a half weathered valves observed.

Station #16 – Cedar Creek

There were no live mussel specimens found at Cedar Creek on August 20th. However, the weathered valves of five native taxa were encountered (*Alasmidonta viridis, Amblema plicata, Lampsilis cardium, Lampsilis siliquoidea* and *Ptychobranchus factionaries*). *Alasmidonta viridis* was the most abundant species with 12 and a half weathered valves counted.

Station #17 – Chenoweth Run

No mussel species were found at the Chenoweth Run sampling station on August 19th.

Station #18 – Pope Lick

No mussel species were observed at the Pope Lick sampling location on August 19th.

Station #19 – Brush Run

No mussels were discovered at the Brush Run station on August 19th.

Station #20 – Long Run

Four native taxa were collected from Long Run (*Actinonaias ligamentina, Lampsilis siliquoidea, Lasmigona complanata* and *Toxolasma parvus*) on August 15th. *Actinonaias ligamentina, Lampsilis siliquoidea* and *Toxoplasma parvus* were the most abundant taxa at the station with two and a half weathered valves of each species collected.

Station #21 – Currys Fork

In Currys Fork on August 18th, five native species were identified (*Actinonaias ligamentina, Alasmidonta viridis, Lampsilis siliquoidea, Pyganodon grandis* and *Toxolasma parvus*). Three live specimens of *Lampsilis siliquoidea* were observed during the survey and this species was the most abundant taxa with an additional eight and a half weathered valves recorded.

Station #22 – North Fork Currys Fork

On August 14th, only three native mussel species were found at this North Fork Currys Fork station (*Lampsilis siliquoidea, Pyganodon grandis* and *Toxolasma parvus*). Live specimens of *Lampsilis siliquoidea* and *Pyganodon grandis* were recorded. As with other stations in this survey, *Lampsilis siliquoidea* was the most abundant species at this location with one live specimen and eight and a half weathered valves observed.

Station #23 – Lick Fork

No mussels were discovered at the Lick Fork station on August 18th.

Discussion

Taylor (1980) conducted a mussel survey at six stations on Floyds Fork in 1978. During that survey, only one live or fresh dead specimen of each species was collected. This makes some comparisons between the 1978 and 2003 surveys difficult. Both Taylor (1980) and

DOW found a total of 19 native mussel species. Of those 19 species, in the 2003 survey, 12 were represented with live or fresh dead individuals. Sixteen taxa were collected in both surveys (*Alasmidonta viridis, Amblema plicata, Elliptio dilatata, Fusconaia flava, Lampsilis cardiium, Lampsilis siliquoidea, Lasmigona complanata, Lasmigona costata, Leptodea fragilis, Potamilus alatus, Ptychobranchus fasciolaris, Pyganodon grandis, Quadrula pustulosa, Strophitus undulatus, Toxoplasma parvus* and *Tritogonia verrucosa*). Three species (*Pleuroblema clava, Truncilla truncata* and *Utterbackia imbecillis*) were collected during the 1978 survey, but not in 2003 and three species (*Actinonaias ligamentina, Megalonais nervosa* and *Quadrula quadrula*) were found in 2003 that were not discovered in 1978. Taylor (1980) found one federally listed species, *Pleuroblema clava*, and KDOW did not find any..

The two surveys share two common sampling locations: Station #8 Floyds Fork at Aiken Road and Station #6 Floyds Fork at US 60. Taylor (1980) found seven taxa at Station #8 in 1978. KDOW discovered 10 species at the site. Six species were common to both surveys: *Alasmidonta viridis, Fusconaia flava, Lampsilis cardium, Lampsilis siliquoidea, Lasmigona complenata* and *Pyganodon grandis*. Taylor (1980) encountered only one species, *Strophitus undulata*, in 1978 that was not collected in 2003, while KDOW identified four taxa in 2003 that were not found in 1978 (*Actinonaias ligamentina, Amblema plicata, Elliptio dilitata* and *Ptychobranchus fasciolaris*) at Station #8.

At Station #6, Taylor (1980) found only five species in 1978, while KDOW identified 12 taxa. Four species were found during both surveys (*Alasmidonta viridis, Lampsilis cardium, Lampsilis siliquoidea* and *Pyganodon grandis*). KDOW tallied eight species (*Actinonaias ligamentina, Amblema plicata, Elliptio dilatata, Fusconaia flava, Lasmigona complenata, Lasmigona costata, Potamilus alatus* and *Ptychobranchus fasciolaris*) that were not found in 1978 and Taylor (1980) encountered one taxa, *Leptodea fragilis*, not found in the 2003 survey.

During the 2003 KDOW survey, *Corbicula fluminea*, the Asiatic clam, was common throughout the Floyds Fork watershed. This invasive species was only found at two sampling locations in 1978. Taylor (1980) indicated that the presence of *Corbicula* in Floyds Fork was the first documented occurrence of the taxa in the Salt River basin. The rapid spread has undoubtedly influenced native populations not only in the Floyds Fork watershed, but all of Kentucky's river basins.

Although data collection in each survey was conducted differently, a couple of general comparisons can be drawn from the taxa lists. First, about the same numbers of taxa were identified in 1978 and 2003. Second, most of the same mussel species were represented in both surveys. Superficially, the mussel fauna of the Floyds Fork basin does not appear to be drastically different from when Taylor conducted his survey in 1978. However, weathered, dead shells represented most the individuals collected by KDOW in the 2003 survey. It is not known how many live specimens were present when Taylor conducted his survey, but it is inferred that live specimens were very abundant. By 2003, live specimens were fairly rare and only a half of the species collected by KDOW were represented by live specimens. This data shows that the mussel fauna in Floyds Fork has declined since 1978.

There are several possible explanations for the decline of live mussels in Floyds Fork. Suburbanization of the watershed has increased tremendously from 1978 to the present. With suburbanization comes increased impervious surfaces that can change the hydrology of the watershed, increased nutrient inputs from golf courses, wastewater treatment systems and manicured yards that can change the food sources for the mussels, increased sedimentation from construction of new homes and neighborhoods that can bury mussels and fill in preferred substrate types and increased loads of pollutants associated with increased human pressure (i.e. road salt, lawn and garden pesticides) that can be toxic to the mussels. In addition to suburbanization, the loss of riparian corridors along tributaries and the loss of floodplains/wetlands adjacent to streams within the basin have greatly influenced physicochemical factors such as summer temperatures and dissolved oxygen concentrations   Competition for food and substrate with the invasive species, *Corbicula fluminea*, also has taken its toll on the native mussels in Floyds Fork.   Individually, these sources may not dramatically influence mussel populations.   As a group, however, these sources have and continue to impact what was once very healthy mussel population.

Literature Cited

Taylor, R., 1980. Mussels of Floyds Fork, a small northcentral Kentucky stream: Unionidae. The Nautilus 94: 13-15.

Woods, A.J., Omernick, J.M., Martin, W.H., Pond, G.J., Andrews, W.M., Call, S.M., Comstock, J.A., and Taylor, D.D. 2002. Ecoregions of Kentucky (color map). USGS, Reston, VA.

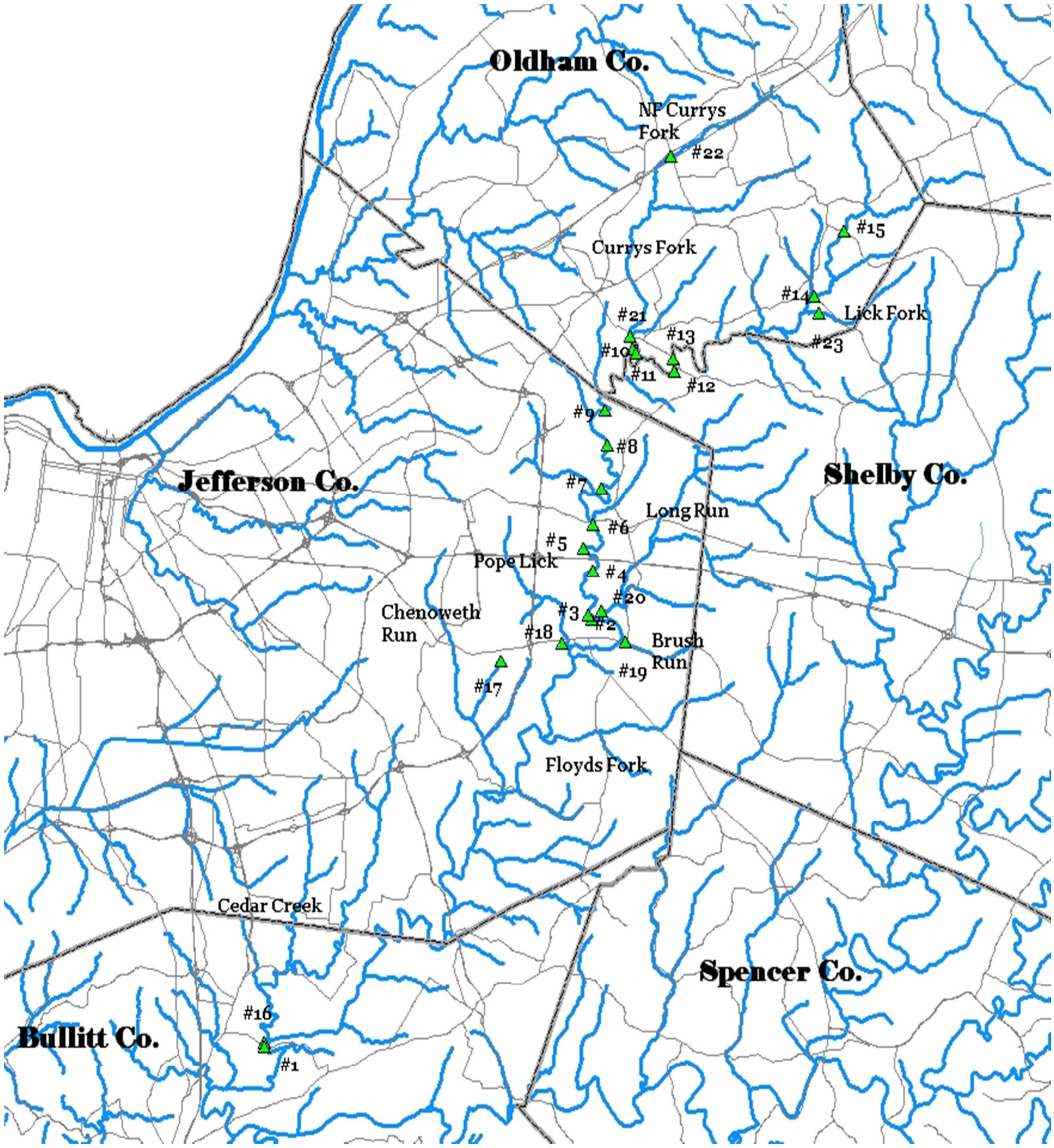


Figure 1. Map of Floyds Fork Watershed and Sampling Station Locatons

Table 2. Mussel species observed in the Floyds Fork survey

Species	Stations 1	2	3	4	5	6	7
Actinonaias ligamentina Mucket – A				1wd		1lv	1lv2wd
Alasmidonta viridis Slippershell – C		5wd	1wd	5wd	3wd	1lv	
Amblema plicata Threeridge – C	2.5wd	2wd	0.5wd		2wd	2.5wd	
Elliptio dilatata Spike – O	2.5wd					1.5wd	
Fusconaia flava Wabash Pigtoe – C	2.5wd	3wd	2wd	15wd		2.5wd	0.5wd
Lampsilis cardium Plain Pocketbook – C			2wd	4lv5wd	4wd	5lv3wd	1lv3.5wd
Lampsilis siliquoidea Fatmucket – A		15wd	6lv15wd	15wd	2lv10wd	5lv20wd	3lv7.5wd
Lasmigona complanata White Heelsplitter – C				2wd	1wd	1lv0.5wd	2.5wd
Lasmigona costata Flutedshell – O			1lv			1lv	
Leptodea fragilis Fragile Papershell – O				3wd	4fd		
Megalonaias nervosa Washboard – O	1.5wd			1fd			
Potamilus alatus Pink Heelsplitter – O			0.5wd	1sf		2lv1wd	0.5wd
Ptychobranchus fasciolaris Kidneyshell – O					0.5sf	2.5wd	
Pyganodon grandis Giant Floater – A			5wd	1lv5wd	1lv3.5wd	10 wd	5wd
Quadrula pustulosa Pimpleback – R	2wd						
Quadrula quadrula Mapleleaf – R	4.5wd						
Strophitus undulatus Creeper – O				1wd			
Toxoplasma parvus Lilliput – O							
Tritogonia verrucosa Pistolgrip – R	1.5wd						
Total Taxa	7	4	8	11	8	12	7

Table 2. Mussel species observed in the Floyds Fork survey (Cont'd)

Species	Stations						
	8	9	10	11	12	13	14
Actinonaias ligamentina Mucket – A	0.5wd	2lv	6lv		3lv1.5wd	5wd	
Alasmidonta viridis Slippershell – C	1.5wd	3.5wd		1lv			
Amblema plicata Threeridge – C	7.5wd	0.5wd			1lv		
Elliptio dilatata Spike – O	2.5wd						
Fusconaia flava Wabash Pigtoe – C	2.5wd	0.5wd				1wd	
Lampsilis cardium Plain Pocketbook – C	3.5wd	1.5wd	2lv		0.5wd	2wd	
Lampsilis siliquoidea Fatmucket – A	22.5wd	4lv10wd	14lv20wd		7lv6.5wd	4lv20wd	3lv8.5wd
Lasmigona complanata White Heelsplitter – C	3.5wd	2wd	1lv				
Lasmigona costata Flutedshell – O							
Leptodea fragilis Fragile Papershell – O							
Megalonaias nervosa Washboard – O							
Potamilus alatus Pink Heelsplitter – O						1wd	
Ptychobranchus fasciolaris Kidneyshell – O	2.5wd						
Pyganodon grandis Giant Floater – A	6.5wd	5.5wd	10wd		5lv4wd	1lv10wd	1lv2.5wd
Quadrula pustulosa Pimpleback – R							
Quadrula quadrula Mapleleaf – R							
Strophitus undulatus Creeper – O			1lv	1lv	1lv		
Toxoplasma parvus Lilliput – O							
Tritogonia verrucosa Pistolgrip – R							
Total Taxa	10	8	6	2	6	6	2

Table 2. Mussel species observed in the Floyds Fork survey (Cont'd)

Species	Stations 15	16	17	18	19	20	21	22	23
Actinonaias ligamentina Mucket – A	11lv3wd					2.5wd	0.5wd		
Alasmidonta viridis Slippershell – C		12.5wd					0.5wd		
Amblema plicata Threeridge – C		1wd							
Elliptio dilatata Spike – O									
Fusconaia flava Wabash Pigtoe – C									
Lampsilis cardium Plain Pocketbook – C		2wd							
Lampsilis siliquoidea Fatmucket – A	14lv5.5wd	4.5 wd				2.5wd	3lv8.5wd	1lv8.5wd	
Lasmigona complanata White Heelsplitter – C						1wd			
Lasmigona costata Flutedshell – O									
Leptodea fragilis Fragile Papershell – O									
Megalonaias nervosa Washboard – O									
Potamilus alatus Pink Heelsplitter – O									
Ptychobranchus fasciolaris Kidneyshell – O		2wd							
Pyganodon grandis Giant Floater – A	13lv2.5wd						3.5wd	1lv3wd	
Quadrula pustulosa Pimpleback – R									
Quadrula quadrula Mapleleaf – R									
Strophitus undulatus Creeper – O									
Toxoplasma parvus Lilliput – O						2.5wd	0.5wd	3.5wd	
Tritogonia verrucosa Pistolgrip – R									
Total Taxa	3	5	0	0	0	4	5	3	0

Note: A=Abundant (found in>10 stations); C= Common (found in 6-10 stations); O=Occasional (found in 2-5 stations); R=Rare (found in only one sample); lv=live specimen; wd=weathered, dry valve; fd=fresh, dead valve; sf=sub-fossil valve

APPENDIX E
QA PROJECT PLAN FOR DATA COLLECTION PROGRAM OF THE CURRY'S FORK WATERSHED BASED PLAN

QAPP - approved 06-06
file copy

ENVIRONMENTAL AND PUBLIC PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION

Ernie Fletcher
Governor

Division of Water
14 Reilly Road
Frankfort, Kentucky 40601-1190
www.kentucky.gov

LaJuana S. Wilcher
Secretary

June 19, 2006

Mary Ellen Kinser, Judge-Executive
Oldham County Fiscal Court
100 West Jefferson Street
LaGrange KY 40031

RE: 06-06; "QA Project Plan for the Data Collection Program of the Curry's Fork Watershed Based Plan" – Quality Assurance Project Plan

Dear Ms. Kinser:

The Division of Water has received and reviewed your Quality Assurance Project Plan for the above referenced project. Your plan has been approved pending conditions on the attached approval form. If you have any questions concerning this correspondence, contact Rodney Pierce (QAPP NPS Coordinator) at (502) 564-3410.

Sincerely,

John Eisiminger

John Eisiminger, Supervisor
Nonpoint Source Section
Kentucky Division of Water

JE:dcb

Attachment

c: Valerie Lucas
Tony Tolliver
Tim Miller

RECEIVED
JUN 18 2007
STRAND ASSOCIATES, INC.
LOUISVILLE, KY

Nonpoint Source QAPP Approval Form

GRANT YEAR: NPS #:	2006 06-06
PROJECT:	QA Project Plan for the Data Collection Program of the Curry's Fork Watershed Based Plan

Rodney N. Pierce — Date: 6/16/06 — X Approve / θ Disapprove
NPS

Larry Dusak — Date: 6/21/06 — X Approve / θ Disapprove
DOW QAO

Conditions for Approval:

1. Any changes to the QAPP must be submitted to the DOW in writing.
2. The QAPP must be distributed to all parties involved. This includes all personnel that will be involved in fieldwork. A list should be developed and submitted to the DOW.
3. Drainage areas should be determined for biological monitoring sites. Biological collections should be made during the appropriate index period. Consult KDOW 2006 as referenced in QAPP.
4. Resubmit Table A-1 (p A-5). Latitude and longitude formatting has been compromised.
5. Submit a literature-cited page that contains full citations for references used in the QAPP.

Report for

Oldham County, Kentucky

QA Project Plan for the Data Collection Program of the Curry's Fork Watershed Based Plan

Prepared by:

STRAND ASSOCIATES, INC.®
325 West Main Street, Suite 710
Louisville, KY 40202
strand.com

On Behalf of:

Oldham County Fiscal Court

May 2005

Submitted for Approval to:

The Kentucky Natural Resources and Environmental Protection Cabinet Department for Environmental Protection Division of Water, Nonpoint Source Section

Signature of Approving Official:

____

STRAND ASSOCIATES, INC.® ENGINEERS

TABLE OF CONTENTS

Page No.

APPENDICES

LIST OF TABLES

LIST OF FIGURES

DISTRIBUTION LIST/PROJECT TEAM

1. Mary Ellen Kinser
   Oldham County Fiscal Court, Judge Executive
   100 West Jefferson Street
   LaGrange, KY 40031

2. Valerie Lucas, P.E.
   Project Manager – Strand Associates
   325 West Main Street, Suite 710
   Louisville, KY 40202

3. Paul Maron, P.E.
   Quality Assurance Manager – Strand Associates
   325 West Main Street, Suite 710
   Louisville, KY 40202

4. Bob Hawley
   Environmental Data Collection Manager – Strand Associates
   325 West Main Street, Suite 710
   Louisville, KY 40202

5. Lisa Sexton
   Laboratory Analysis Project Manager – EnviroData Group
   2520 Regency Road
   Lexington, KY 40503

6. Dr. Art Parola
   Geomorphic Data Quality Assurance Manager – UofL Stream Institute
   Department of Civil & Environmental Engineering
   J.B. Speed School of Engineering, University of Louisville
   Louisville, KY 40292

7. Dr. Michael Croasdaile
   Geomorphic Data Collection Manager – UofL Stream Institute
   Department of Civil & Environmental Engineering
   J.B. Speed School of Engineering, University of Louisville
   Louisville, KY 40292

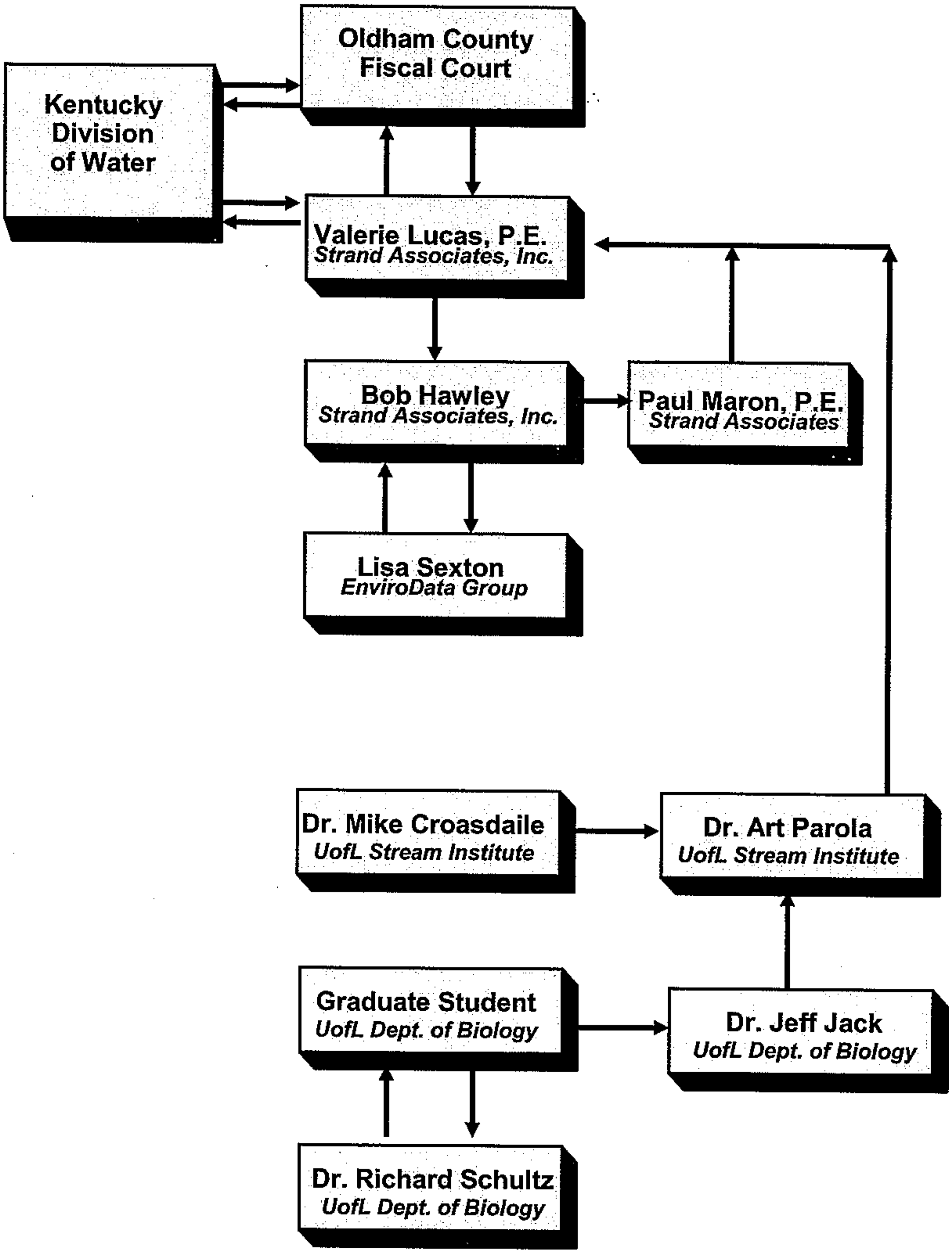
8. Dr. Jeffrey Jack
   Biological Data Quality Assurance Manager – UofL Stream Institute/ Dept. of Bio.
   Department of Biology, University of Louisville
   Louisville, KY 40292

9. Biology Graduate Student
   Biological Data Collection Manager – UofL Stream Institute/ Dept. of Bio.
   Department of Biology, University of Louisville
   Louisville, KY 40292

10. Dr. Richard Schultz
    Biological Laboratory Project Manager – UofL Stream Institute/ Dept. of Bio.
    Department of Biology, University of Louisville
    Louisville, KY 40292

Other Data Users: Kentucky Division of Water

The following organizational chart shows the relationships and lines of communication among all project participants. After collecting and analyzing the respective data types (chemical, geomorphic, and biologic), the data will be reviewed by the respective QA manager. The QA managers will then funnel the data and corresponding reports to the Project Manager, Valerie Lucas, who will compile the data on behalf of Oldham County Fiscal Court. The compiled annual reports will then be sent to the Kentucky Division of Water.



A. PROJECT MANAGEMENT

A1. Distribution List

1. Mary Ellen Kinser
   Oldham County Fiscal Court, Judge Executive
   100 West Jefferson Street
   LaGrange, KY 40031

2. Valerie Lucas, P.E.
   Project Manager – Strand Associates
   325 West Main Street, Suite 710
   Louisville, KY 40202

3. Paul Maron, P.E.
   Quality Assurance Manager – Strand Associates
   325 West Main Street, Suite 710
   Louisville, KY 40202

4. Bob Hawley
   Environmental Data Collection Manager – Strand Associates
   325 West Main Street, Suite 710
   Louisville, KY 40202

5. Lisa Sexton
   Laboratory Analysis Project Manager – EnviroData Group
   2520 Regency Road
   Lexington, KY 40503

6. Dr. Art Parola
   Geomorphic Data Quality Assurance Manager – UofL Stream Institute
   Department of Civil & Environmental Engineering
   J.B. Speed School of Engineering, University of Louisville
   Louisville, KY 40292

7. Dr. Michael Croasdaile
   Geomorphic Data Collection Manager – UofL Stream Institute
   Department of Civil & Environmental Engineering
   J.B. Speed School of Engineering, University of Louisville
   Louisville, KY 40292

8. Dr. Jeffrey Jack
   Biological Data Quality Assurance Manager – UofL Stream Institute/ Dept. of Bio.
   Department of Biology, University of Louisville
   Louisville, KY 40292

9. Biology Graduate Student
   Biological Data Collection Manager – UofL Stream Institute/ Dept. of Bio.
   Department of Biology, University of Louisville
   Louisville, KY 40292

10. Dr. Richard Schultz
    Biological Laboratory Project Manager – UofL Stream Institute/ Dept. of Bio.
    Department of Biology, University of Louisville
    Louisville, KY 40292

Other Data Users: Kentucky Division of Water

A2. Project Organization

The organizational chart provided in Appendix A shows the relationships and lines of communication among all project participants. After collecting and analyzing the respective data types (chemical, geomorphic, and biologic), the data will be reviewed by the respective QA manager. The QA managers will then funnel the data and corresponding reports to the Project Manager, Valerie Lucas, who will compile the data on behalf of Oldham County Fiscal Court. The compiled annual report will then be sent to the Kentucky Division of Water.

A3. Problem Background

Oldham County continues to be one of the fastest growing areas in the State of Kentucky with residential, commercial, and light industrial developments planned for the near future. Curry's Fork of Floyds Fork runs through the heart of Oldham County and is listed as a 1st priority 303(d) stream by the Kentucky Division of Water (KDOW). Much of the Curry's Fork watershed has already seen the impacts of development; however, recent efforts suggest a possible recovery.

Oldham County Sanitation District has begun this recovery process through the planning of two centralized wastewater treatment facilities. The construction of these centralized treatment facilities will result in the decommissioning of over a dozen package treatment plants. Thus, it may be suggested that pathogen pollutants should be reduced following these projects. Additionally, the current Phase II stormwater efforts should also make basic improvement in nonpoint source pollution.

However, regardless of current efforts, there is still one pollutant unaddressed by current plans on Curry's Fork. Nothing is being done to address the listed pollutant of "Habitat Alteration (Other than Flow)". Curry's Fork suffers from poor habitat suspected to be from modification other than hydromodification. This suggests that the stream will not be able to fully support aquatic life until actions are taken to improve the habitat of the stream itself.

The goal of this project is to improve the water quality of Curry's Fork. This will be accomplished through the development and implementation of a Watershed Based Plan (WBP). The primary objectives will fulfill the nine elements of a WBP as summarized by KDOW. Additional objectives will target implementation of selected aspects of the plan. Project activities will focus on effectively meeting the objectives of the project through scientific analysis, community involvement, KDOW review, and selected implementation.

A4. Project Description

Based on available information, it may be anticipated that a significant amount of environmental data collection will be needed within the Curry's Fork watershed. The project incorporates water quality monitoring, geomorphic assessment, flow and Total Suspended Solids (TSS) data collection, and biological monitoring.

A4.1 Water Chemistry Data

Water Quality Monitoring will occur in Year 1 of the project to establish baseline conditions of the watershed. Monitoring will take place twice per month during the recreational contact period of May through October during Year One of the project. Eight water quality sampling sites are proposed for Year 1. Every effort will be made to sample on the same day of the month. Sampling will occur regardless of dry or wet weather. Initial monitoring will include analyses for fecal coliform, TSS, BOD-5, Nutrients, and a Metals scan along with pH, temperature, DO, and conductivity measurements. Sample suites may be modified after the initial months of data collection to better target identified pollutants.

A4.2 Geomorphic Data

A Geomorphic Assessment of the watershed will be performed during the first two years of the project as well. The assessment will focus on identifying the extent of sedimentation and habitat modification other than flow. In coordination with this assessment, flow and TSS data will be collected for duration of one year during wet weather events at locations upstream of the confluence of significant tributaries in the watershed (4 total locations). Geomorphic Assessment will occur in three phase:

Phase 1 Geomorphic Assessment: Using remote sensed data and limited field examination of stream reaches, a geomorphic assessment will be conducted for the entire watershed or sub-watershed selected. An attempt will be made to maximize the use of GIS database information. A search for historic information on the watershed and stream channels will be conducted during this phase.

Phase 2 Rapid Geomorphic Reach Assessment: The main stem channel of the impaired stream and select major tributaries will be examined to identify sediment sources. In addition, tributaries that appear to be producing high loads will be examined. Bed level controls and lateral controls, regions of high apparent bed or bank erosion, and sources of woody debris will be identified. Preliminary channel classification and conceptual channel evolution models will be developed based on this evaluation. Verification of information determined from the Phase 1 Geomorphic Assessment will be conducted. Reaches identified as producing high sediment loads or sediment deposition will be selected for Phase 3 assessment. Potential reference reaches, bank stabilization, or restoration reaches will also be identified. Rapid geomorphic measurement may be obtained in these reaches.

Phase 3 Detailed Stream Surveys: Reaches identified as "representative" of reaches producing high sediment loads, severe deposition or reference reaches will be surveyed to determine detailed geomorphic characteristics and to develop estimates of bank and bed erosion and sediment supply under a range of channel disturbance regimes. The detailed measurements will provide a basis for estimation of loads and reference conditions. If applicable, the Bank Erosion Assessment using BEHI Method (Rosgen 2003) will be employed to evaluate the sediment source contribution from stream banks.

An annual report will be submitted for the geomorphic assessment. The University of Louisville Research Foundation will request current Final Project and Closeout Report guidelines from the Kentucky Division of Water no less than six months prior to the project end date. The Final Project Report will present the data and analysis of each assessment site in a clear and standard format. The data from each of the assessment sites will be stored in a database that will be submitted to the Kentucky Division of Water. The Kentucky Division of Water, Nonpoint Source Section, will receive a hard copy and an electronic copy of the data. The report will also present and describe the regional data that represent bankfull geomorphic characteristics. A Closeout Report will be prepared and submitted as required by the US EPA.

A4.3 Biological Data

Biological Monitoring will also occur in Year 1 to establish a baseline for the existing habitat. Biological sampling will follow the Kentucky Division of Water's *Methods for Assessing the Biological Integrity of Surface Waters in Kentucky* (2002) and will be conducted during the index period for wadabel streams. Natural substrate (surface area > 12 cm^2; HISS, 2006) to assess the algal community in these study reaches. Ash free dry mass, chlorophyll a and taxa composition will be assessed from samples removed from these substrates. Macroinvertebrate samples will taken using 600 μm kick nets for riffle samples and d-frame nets for the multihabitat collections.

All data will be collected in accordance with the Quality Assurance Project Plan (QAPP) as presented herein.

Post construction monitoring will occur to measure success of any improvement project recommended by the WBP and implemented within the duration of this project (6 ½ years). A post construction monitoring plan will be developed as a part of the WBP.

Figure A-1 shows the locations of all sampling locations summarized in Table A-1.

Sampling Site	Stream	X-COORDINATE	Y-COORDINATE	Fecal Coliform, TSS, BOD_5, Nutrients, and Metals	pH, Temperature, DO, and Conductivity	Flow and TSS	Geomorphic Assessment	Biological Monitoring	Post Construction Monitoring
CF1	Curry's Fork	1297766.68	296914.58	x	x				To be determined during watershed based plan development
CF2	Curry's Fork	1296137.32	295262.17	x	x	x	x	x	
TB1	Tributary	1296952.00	296968.38	x	x	x	x	x	
CF3	Curry's Fork	1301074.12	314447.26	x	x				
NC1	North Curry	1299789.82	315085.97	x	x	x	x	x	
SC1	South Curry	1300133.22	314234.35	x	x	x	x	x	
NC2	North Curry	1320514.85	329662.68	x	x				
SC2	South Curry	1316713.15	318053.27	x	x				

Table A-1 Proposed Stream Sampling Sites and Schedule

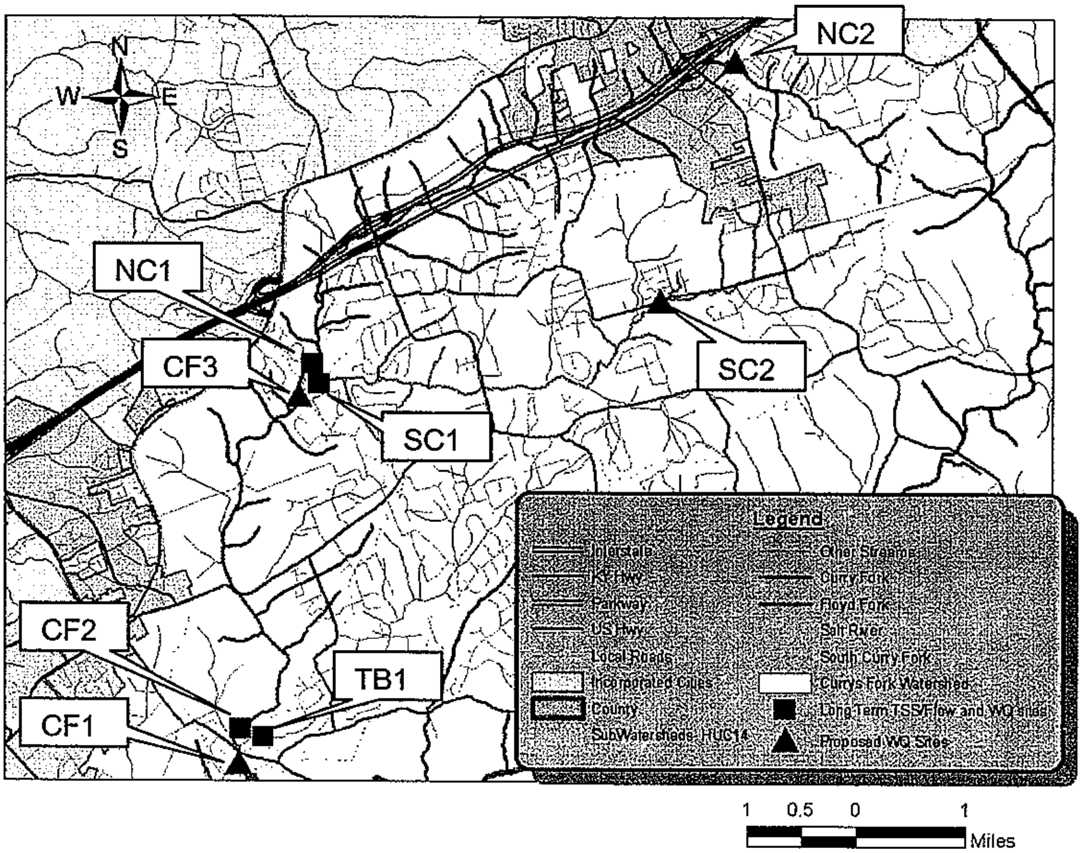


Figure A-1 Map of Proposed Stream Sampling Sites

A5. Quality Objectives and Criteria

A5.1 Water Chemistry Data

Table A-2 summarizes the quality objectives and criteria for the water quality monitoring.

Type of QA/QC Check	Frequency Required	Total Number of Analyses	Acceptance Criteria
Matrix Spike (MS)	One sample per stream per year	One per year	Percent recovery should be greater than or equal to 20%
Matrix Spike Duplicate (MSD)	One sample per stream per year	One per year	Relative Percent Difference should less than or equal to 71%
Laboratory Blank	One per twenty samples analyzed or one at the beginning of the week	Subject to change, absolute minimum of three	No false positive
Laboratory Ongoing precision and recovery (OPR)	One per twenty samples analyzed or one at the beginning of the week	Subject to change, absolute minimum of three	Percent recovery should be greater than or equal to 20%

Table A-2 Summary of Quality Objectives and Criteria

The percent recovery will be computed by the following formula:

R = 100 x ([Nsp - Ns] / T)

Where:

- R is the percent recovery;
- Nsp is the number of colonies detected in the spiked sample;
- Ns is the number of colonies detected in the unspiked sample;
- T is the number of colonies added to the spiked sample (during the spiking process).

The relative percent difference (RPD), which is a quantitative measure of the laboratory's precision and difference in interference between the MS and the MSD sample matrix, will be calculated by the following formula:

RPD = 100 x ([=RMS - RMSD=] / $X_{(mean)}$)

Where:

- RPD is the relative percent difference
- RMS is the number of colonies detected in the matrix spike sample
- RMSD is the number of colonies detected in the matrix spike duplicate sample
- $X_{(mean)}$ is the mean of the MS and MSD recoveries

A5.2 Geomorphic Data

The objective of the geomorphic assessment is to determine the primary causes of sediment and habitat impairment. An evaluation of in-channel sediment sources will be obtained from estimates of bank erosion rates and estimated rates of sediment production from other sources such as roadway ditches, construction sites and agricultural lands. Assessment of habitat will be evaluated based on EPA rapid bioassessment procedures conducted in a separate part of this project. Three basic groups of data will be collected: sediment samples, streambank samples, and stream geometric characteristics.

Surveying techniques that provide accuracy of about 1 cm in all directions will be used with the total station equipment that will be employed for stream geometric data collection. Also standard sieve analysis procedures employed by the geomechanics laboratory using standard ASTM techniques for fine and coarse aggregates will provide data for sediment size gradation to high precision. Large variations in geometric characteristics (typically on the order of 0.3 m) are associated with the subjective selection of bankfull elevations based on field indicators; therefore all bankfull indicators will be measured and flow levels associated with each indicator will be reported. These indicators include tops of coarse bar deposits, tops of fine bar deposits, low vegetation lines, tops of banks and floodplain elevations.

Sediment sampling in coarse bed channels is limited by the ability to only sample a very small portion of the streambed. Four techniques will be used to assess sediment in gravel and cobble bed streams:

1) pebble counts on each riffle studied
2) riffle subsurface bulk samples
3) bar bulk samples
4) 30 largest particles on the bar

Amounts of gravel required to characterize the active streambed will be determined according to Bunte and Abt (2001), Rosgen (1996) and Kappesser (2002).

To ensure consistency in the selection of sampling locations for bankfull indicators, for collection of geometric stream characteristics and for sampling of bar materials, the QA manager will conduct on-site quality checks.

A5.3 Biological Data

Assessment of habitat will be evaluated based on EPA rapid bioassessment procedures. There will be quality objectives and controls on all biological sample types. Sampling effort for macroinvertebrates will be equalized across all sampling sites. All samples will be labeled immediately upon collection and at least five (5) percent of samples collected will be duplicated to evaluate precision and repeatability. All sampling gear will be thoroughly cleaned between site visits and at the beginning and close of daily sampling. Logbooks will be maintained indicating the date, location and crew for each sample collected. Ten percent of all sorted samples will be examined by a qualified biologist to ensure that all organisms have been accounted for. If fewer than ten organisms are found in the sorting pan, the sample is considered valid. If more than ten organisms are found, then the sample fails and another successive pan will be checked. This will continue until the sorter passes the procedure. At least five (5)% of all samples will be reprocessed by an outside authority; 90% similarity will be considered acceptable. All macroinvertebrate samples will be maintained in 75% ethanol for at least five years as vouchers. Laboratory bench sheets will also be maintained for at least five (5) years at the University of Louisville.

Procedures for the periphyton (algae) samples will be similar with the exception that 75% similarity will be considered acceptable for the QA/QC process per KDOW standards (2006). Prepared slides will be stored under appropriate conditions for at least five years.

Ten (10)% of the site logbooks and electronic spreadsheets will be chosen for quality assurance/quality control assessment by a random numbers generator with 95% similarity being a "passing" grade for data entry. Individuals whose entries fail to meet this standard will be retrained until they meet the 95% requirement. Data they have managed before that time will be subject to complete review.

A6. Special Training/Certification

A6.1 Water Chemistry Data

Sampling technicians will be given training and instruction on the proper collection of environmental samples according to the procedure outlined in Section 2.2. An experienced sampling technician will direct the training. Laboratories conducting analytical work must be certified by US EPA and pass annual Kentucky Performance Evaluations.

A6.2 Geomorphic Data

The QA manager and project team have academic as well as professional training in applied morphology and the techniques necessary to collect and analyze the required geomorphic data. This training includes extensive academic and professional training in surveying, sediment sampling, hydraulic and hydrologic modeling, and geomorphic assessment.

A6.3 Biological Data

All potential biological crew members will be interviewed by the project at the University of Louisville. Each member will have to demonstrate competence (combination of education, training, experience) in the field of their assignment. The demanding physical nature of the project will be stressed and all crew members will be encouraged to become proficient in basic first aid and field safety procedures. A sampling crew will always include at least 2 people. All on-the-job accidents will be immediately reported to a supervisor. The supervisor will follow procedures outlined by the Worker's Compensation Insurance carrier and personnel policy of the University of Louisville. The Biology and Human Resources departments of the University of Louisville will maintain records of all injuries. All personnel undergo an annual review process following University of Louisville Human Resources guidelines. During this process, employees are interviewed by their direct supervisor who assess strengths and identify areas for corrective action or future professional development.

A7. Documents and Records

Paul Maron of Strand Associates will be the party responsible for ensuring appropriate project personnel has the most current approved version of the QA Project Plan. After the QA Project Plan has been approved by KDOW, it will be sent out to all appropriate personnel who will acknowledge their receipt and concurrence of the plan by signature. Should any revisions be necessary to the plan, the recipients will be sent the revised plan, a new receipt and concurrence sheet to sign, and will be required to return the old plan. Using this methodology, all parties will have the same plan and older, out dated versions will no longer be in circulation.

Analytical data from EnviroData will be reported to Strand Associates. At a minimum, the data report will include the following:

- Date and time samples were collected,
- Date and time samples were received,
- Date and time samples were analyzed,
- Sample name and location,
- Analysis name and method,
- Results of analysis,
- Units of results,
- Reporting limit of analysis,
- Initials of technician(s) performing analysis,
- Results of laboratory blanks and other QA/QC.

At a minimum, field sampling notes will include:

- Location of sample source,
- Names of sampling technicians,
- Narrative summary of field conditions, including general weather conditions, stream flow, and any other noteworthy observations,
- Results of stream temperature, pH conductivity and dissolved oxygen levels,
- Date and time samples were collected.

Data and reports sent to Strand Associates will be reduced into a technical report deliverable once all samples due that year have been collected. This technical report will serve as a chapter of the Watershed Based Plan. The report will include the following information:

- Data summary and interpretation,
- Baseline conditions of waters in the Currys Fork Watershed,
- Effects of Watershed Based Plan,
- Summaries of any problems and observations during sample collection and analysis,
- Complete listings of all collected data and chains of custody.

Technical reports, data, and the final Watershed Based Plan will be submitted to the Oldham Count Fiscal Court, Kentucky Division of Water, and stored at Louisville, KY offices of Strand Associates for a period of not less than ten years.

B. DATA GENERATION AND ACQUISITION

B1. Sampling Design

In order to develop a Watershed Based Plan that will protect and enhance the water quality of the Curry's Fork Watershed, a comprehensive understanding of the baseline health of the watershed must be established. The data collection portion of this plan is meant to expand on existing information and provide sufficient data to identify impairments and methodologies to mitigate them.

Water quality samples will be taken at eight locations throughout the watershed. Each location was chosen to provide specific information. Sampling sites at headwaters will provide initial water quality. By comparing results from these sites to others downstream, a judgment can be made on whether water quality is improving, degrading or staying the same as a result of passing through the area under question. This method will allow the project team to identify areas where implementing water quality improving strategies or structures could prove to be beneficial. Furthermore, by sampling two streams upstream of their confluence and then comparing to a third sample located downstream, the project team will be able to evaluate the effects the two streams are having on one another.

Grab samples will be taken every two weeks during the recreational contact season (May through October). Every effort will be made to sample on the same days of the month (i.e. the 7th and 21st of every month) however, work schedules, holidays, and other factors will necessitate some flexibility on when samples are actually taken. Initial monitoring will include analyses for fecal coliform, TSS, BOD-5, Nutrients, and a Metals scan along with pH, temperature, DO, and conductivity measurements. Sample suites may be modified after the initial months of data collection to better target identified pollutants.

Total Suspended Solids (TSS) and stream flow data will be collected during wet weather events to develop information on sediment sources and transport in the watershed. The total fine-grained (particles less than 2 mm) load will be estimated using measurements of TSS and flow data. Sampling site locations for TSS will be located on the tributaries to Curry's Fork and on the main stem near its confluence with Floyd's Fork (downstream limit of impaired reach). The precise sampling locations will be determined after visual assessment has been completed to target reaches that show evidence of high load sources.

Sources loading of in-channel fine-grained sediment will be estimated from estimates of bank erosion along the main stem and tributary channels. The estimates will be developed based on sampling of bank erosion rates at representative sites over the period for which TSS samples are obtained. Extrapolation of the measured bank erosion to the remaining stream channel length will be accomplished using the BEHI method developed by Rosgen (2003).

Source loading from roadways, construction sites and land use activities will be based on published estimates.

Combined with the geomorphology data, the results will indicate if sediment in the streams is coming from bank erosion, bed loss, or overland run-off. The biological monitoring will be integrated to identify potential areas for stream bank restoration.

Biological sampling will follow the guidelines outlined in the Kentucky Division of Water's *Methods for Assessing Biological Integrity of the Surface Waters of Kentucky* (2002) and the KDOW's draft Standard Operating Procedures Manual (2006). In summary, a rapid habitat assessment will be performed at each site following KDOW guidelines. Two riffle/run and pool areas will be selected at random from a 100-m reach at each water quality site (total of eight in the project area.) Samples will be taken during periods of stable flow; no samples will be taken within two weeks of a major flow or drought event. Two longitudinal transects will be laid across each area and three natural substrates (approx. 10 cm diameter cobble) will be removed along the transect to quantify periphyton biomass and community structure. Substrates will be held on ice for transport to the laboratory and frozen at -20°C until ready for processing (this method is different from the field processing method used by KDOW but this procedure is necessary to process the biomass samples; see below). Algal mats, if present, will be sampled by forceps. The substrates will be thawed within 1 month of collection and scraped using a Teflon sponge to remove the periphyton. The periphyton will be split into four samples: one part will be used quantify the chlorophyll present by fluorimetry (standard methods; see below); the second will be dried in an oven and then combusted on ash-free paper in a muffle furnace to assess ash-free dry mass. The third part will be used to assess mat chemistries (N and P by standard methods; see below) and the fourth will be used to assess diatom species composition.

Diatoms will be identified to the lowest possible taxonomic level as per KDOW methods: acid-cleaned, from Naphrax mounts at 1000x using an Olympus BX50 microscope. Approximately 500 frustules will be counted per slide, and percent relative abundance of each taxon determined. Additionally, diatom biomass will be estimated as cell densities (cells/cm^2). A minimum of three slides will be examined for each site. Six (6) metrics will be derived for each sample based primarily on the percent relative abundance of each taxon: Total Number of diatom taxa (TNDT), Shannon Diversity Index, Pollution Tolerance Index (PTI), Siltation Index (%NNS), *Fragilaria* group richness (FGR) and *Cymbella* group richness (CGR). Individually, the above metrics provide valuable information with respect to the water quality of a particular reach of stream. Currently, the Kentucky Division of Water is developing a Diatom Bioassessment Index (DBI) for each ecoregion of Kentucky which incorporates all of these metrics into a single score. This single score will then be used to describe the health of the system in question.

The same stations will be sampled for macroinvertebrates once a year during the wadable streams index period (May-September). A riffle sample will be taken using a 600 μm mesh, one meter wide net in the riffle thalweg. Four (4) 0.25 m^2 samples will be taken following KDOW protocols (e.g. substrate disturbance, hand-washing of larger substrates) and the net will be thoroughly washed in a 600 mesh washbucket. The "multi-habitat sweep technique (D-frame net) will be used at each site as well to qualitatively sample root mats, undercut banks, emergent vegetation and other subhabitats identified by KDOW.

The collections from each station will be pooled and sorted in the field using a 600 μm mesh wash bucket and a gridded white enamel pan. Large substrates and debris will be thoroughly picked and returned to the stream; the picked bugs and the remaining material will be placed in a labeled sampling container with 95% ethanol for fixation and later transferred to 75% ethanol for preservation. In the laboratory, samples will be sorted using a combination of a circline lamp, dissecting scope and gridded white pans. Samples will generally be counted in their entirety; if sub-sampling is warranted, we will follow KDOW guidelines (KDOW 2002). The data will then be evaluated using a series of biological metrics recommended by KDOW: taxa richness, Ephmeoptera/Plecoptera/Trichoptera richness (EPT), modified Hilsenhoff Biotic Index, Modified Percent EPT Abundance (m%EPT), Percent Ephemeroptera (%Ephem), Percent Chironomidae+Oligochaeta (%Chir+%Olig), Percent Primary Clingers (%Clingers). These indices will be used to generate an IBI score which can be compared to reference streams in this ecoregion.

B2. Sampling Methods

B2.1 Water Chemistry Data

Water quality data will be generated using two methods: grab samples from stream banks or bridges and with auto-samplers connected to stream flow-meters. The following sections will describe the methods used to collect data for each method.

1. Sampling from Stream Banks or Bridges/Overpasses

Samples will be collected from stream banks or bridges to minimize safety concerns. The procedures described below assume that a two-person sampling team with some basic knowledge of the accepted procedures used to collect environmental samples will take the samples. The two-person team will have decided before beginning work who will be the "Clean hands" and who will be the "Dirty hands". The designation will determine the division of labor between them. In general, "Clean Hands" will be in charge of any activities that might involve direct contact with the sample, while "Dirty Hands" will handle equipment, take notes, and any other activities that do not involve direct contact with the sample. The specific duties of each individual are described below.

a. Before arriving on site both team members should have thoroughly washed and dried their hands and forearms. Soap and water should be kept on hand at all times in case a team member's hands become excessively dirty.

b. Immediately upon arriving on site both team members should set-up any necessary safety equipment such as lights or cones. In cases where the bank slope is steep or slippery, or whenever there is a risk of a team member falling, especially if falling could results in being swept away in a fast moving stream, it may be necessary to 'tie-off' to a static object. It is highly recommended that a self-retracting lifeline, with a built in winch, be used to decrease the risk of falling and, if necessary, pull a team member out of the stream and/or up the bank without exposing other team members to the same hazards. It may be necessary to have a third team member available to act as a safety supervisor and lifeline operator.

c. Once all of the necessary equipment is set-up and it is safe to begin work, "Clean Hands" should put on a fresh pair of non-talc latex gloves and begin triple rinsing the pre-cleaned sampling bucket. If metals are among the analtyes to be tested, then the bucket should be made from a non-reactive plastic such as Nalgene; otherwise the bucket should be made from stainless steel.

d. While "Clean Hands" rinses the sampling bucket, "Dirty Hands" should be filling out the necessary field paper work, including preparing the label for the sample bottle(s), and begin taking any environmental readings (temperature, DO, pH, etc.)

e. After the bucket has been properly rinsed and the paperwork completed, "Dirty Hands" should put on a pair of non-talc latex gloves to assist "Clean Hands" in the sample collection.

f. "Dirty Hands" should throw the bucket into the water body, while only holding onto the rope and being careful to not touch the bank, tree branches, or anything else. Once the bucket is filled, "Dirty Hands" may pull in the bucket, being extremely careful not to let the bucket touch the bank, to "Clean Hands" who will empty the bucket back into the water body. This process needs to be repeated twice more to "river rinse" the bucket. This can be a tedious and time-consuming task, so in cases where it is possible to fill and empty the bucket without pulling it back to the bank or having the bucket touch anything, it is recommended to do so.

g. Now that the bucket has been 'river rinsed', the sample can be collected. "Dirty Hands" should follow the same procedure to lower and raise the bucket in Step 6, so that "Clean Hands" can submerge the sample bottle into the bucket to collect the sample while minimizing, to the greatest extent possible, the amount of exposure the sample has to the open air. Whenever possible, it is preferable that the bucket be submerged and the sample pulled up from beneath the surface.

h. Now that the sample has been collected, "Dirty Hands" should label and store the sample on ice in a clean cooler while "Clean Hands" changes gloves.

i. For analyses that require more than one bottle for sampling to be completed Steps 7 and 8 should be repeated (including the replacement of gloves) until enough volume has been collected.

j. When the sample needs to be composited over time, or if the sample site is not in a good mixing zone and the sample needs to be composited across the stream, it will be necessary to use a churn splitter. In that case, "Clean Hands" will need to have triple washed the churn splitter using deionized water and, if possible, a river rinse from the water body, making sure that all surfaces (including the lid) that may come in contact with the sample are rinsed and purged. The spigot should be purged with each washing.

k. The general process will remain the same when collecting time composited samples except that when "Clean Hands" has control of the sampling bucket, he will pour the sample into the churn splitter and immediately close the lid. This process will repeat until enough samples have been collected over the specified period of time.

l. In cases where the samples must be composited from aliquots from the left bank, right bank, and middle of the stream, the bucket should be thrown to one section of the stream by "Dirty Hands", pulled across to "Clean Hands", who will pour it directly into the churn splitter and immediately close the lid. This will need to be repeated at the next section until a cross-section of the stream has been collected into the churn splitter.

m. Now that the sample is ready to be collected, "Dirty Hands" should 'churn' the sample using at least ten slow strokes of the churn. It is very important that the churn never breaks the surface of the sample as this can introduce additional oxygen into the sample.

n. "Clean Hands" should purge excess samples before filling the sample bottles.

The following guidelines will help reduce the opportunity for contamination to enter the sample:

i. Be sure to position the churn splitter so that it is fairly level and the spigot is not touching anything.

ii. Avoid resting the churn splitter under trees, wires, poles etc.

iii. Minimize the amount of time the lid of the churn splitter is not secured over the churn splitter.

iv. When rinsing the churn splitter, use copious amounts of de-ionized water.

v. Before arriving on site, the churn splitter should have been thoroughly washed and dried. The churn splitter still needs to be triple rinsed once the team has arrived on site. If a bucket will be used to transport sample from the water body, it should also be washed and dried before arriving on site, in addition to being triple rinsed before sampling.

vi. If multiple sites are going to be sampled using the same equipment, sample in the order of the site with the lowest expected concentrations to the one with the highest. For example, if samples are going to be taken near a discharge point, the upstream sample should be taken first, then the downstream sample, and finally the sample nearest the discharge point.

vii. The churn splitter must be triple rinsed between every sample. It is preferred that it be cleaned as close in time as possible to the collection of the sample.

2. <u>Collecting Samples Using a Flow Triggered Automatic Sampler</u>

The procedures described below assume that a two-person sampling team with some basic knowledge of the accepted procedures used to collect environmental samples will take the samples. The two-person team will have decided before beginning work who will be the "Clean hands" and who will be the "Dirty hands". The designation will determine the division of labor between them. In general, "Clean Hands" will be in charge of any activities that might involve direct contact with the sample, while "Dirty Hands" will handle equipment, take notes, and any other activities that do not involve direct contact with the sample. The specific duties of each individual are described below. The procedure described in this protocol assumes that the automatic sampler will be left in place at the sampling site and that a sampling team will collect the samples some time after an event is completed. Please refer to the user manual for information on setting-up and programming specific pieces of equipment.

1. Before arriving on site both team members should have thoroughly washed and dried their hands and forearms. Soap and water should be kept on hand at all times in case a team member's hands become excessively dirty.

2. Immediately upon arriving on site both team members should set-up any necessary safety equipment such as lights, cones, or traffic barricades.

3. Once all of the necessary equipment is set-up and it is safe to begin work, "Clean Hands" should put on a fresh pair of non-talc latex gloves.

4. "Dirty Hands" should fill out the necessary field paper work, including preparing the label for the sample bottle(s), and begin taking any environmental readings (temperature, DO, pH, etc.) Once that is completed, "Dirty Hands" should put on a fresh pair of non-talc latex gloves to assist in the sample collection.

5. "Dirty Hands" should unlock the sample bottle compartment and open up the automatic sampler so that "Clean Hands" has free and easy access to the sample bottles.

6. "Dirty Hands" should then open the bags containing the automatic sampler bottle caps but should not actually touch the caps. "Clean Hands" should reach into the bags and bring out each cap for the bottles.

7. After all of the sample bottles have been sealed, they can be removed from the automatic sampler, labeled, and stored on ice in a clean cooler.

8. In cases where the sample must be transferred to a "traditional" sample bottle, the sample should be carefully poured from the automatic sampler bottle into the "traditional" sample bottle. At no time should the automatic sampler bottle touch the "traditional" bottle. The use of a funnel is strongly discouraged however if it is necessary the funnel should be pre-cleaned thoroughly and stored in at least two airtight bags made of non-reactive plastic.

9. If several bottles are going to be composited for analysis the use of a churn splitter will be necessary. In that case, "Clean Hands" will need to have triple washed the churn splitter using deionized water, paying close attention to be sure that all surfaces, including the lid, that may come in contact with the sample are rinsed and purged the spigot with each washing.

10. The appropriate automatic sampler bottles should be poured into the churn splitter and the lid closed immediately.

11. Now that the sample is ready to be collected, "Dirty Hands" should 'churn' the sample using at least ten slow strokes of the churn. It is very important that the churn never breaks the surface of the sample as this can introduce additional oxygen into the sample.

12. "Clean Hands" should purge with excess sample before filling the sample bottles.

The following guidelines will help reduce the opportunity for contamination to enter the sample:

i. Be sure to position the churn splitter so that it is fairly level and the spigot is not touching anything.

ii. Avoid resting the churn splitter under trees, wires, poles etc.

iii. Minimize the amount of time the lid of the churn splitter is not secured over the churn splitter.

iv. When rinsing the churn splitter, use copious amounts of de-ionized water.

v. Before arriving on site, the churn splitter should have been thoroughly washed and dried. The churn splitter still needs to be triple rinsed once the team has arrived on site. If a bucket will be used to transport sample from the water body, it should also be washed and dried before arriving on site, in addition to being triple rinsed before sampling.

vi. If multiple sites are going to be sampled using the same equipment, sample in the order of the site with the lowest expected concentrations to the one with the highest. For example, if samples are going to be taken near a discharge point, the upstream sample should be taken first, then the downstream sample, and finally the sample nearest the discharge point.

vii. The churn splitter must be triple rinsed between every sample. It is preferred that it be cleaned as close in time as possible to the collection of the sample.

The following general guidelines should be followed to insure the highest quality results are achieved when using automatic samplers:

i. Automatic samplers should be cleaned and maintained regularly according to their manufacturer's recommendation. Careful attention should be paid to the tubing running to and from the sampler and the pump when being cleaned as they come in direct contact with the sample. In cases where ultra-low detection levels are called for it may be necessary to install pre-cleaned tubing and pump right before sampling is set to begin.

ii. The bottles in the automatic sampler should be pre-cleaned before being set-up.

iii. The bottle storage compartment should be closed tight enough so that no possible contaminant such as rain, leaves, or other debris could enter the sample bottle.

iv. Automatic samplers should be placed to the greatest extent possible in a flat, dry location with the smallest chance of the sampler being submerged.

v. Caps to the automatic sampler bottles can be left in the automatic sampler, or carried with the sampling team. In either case they should be pre-cleaned and stored in at least two airtight bags made from a non-reactive plastic.

vi. When opening and closing the sample bottle compartment, be careful not to accidentally knock any dirt or debris that may be attached to the automatic sampler into a sample bottle. Additionally, the top of the automatic sampler should not be placed down so that the bottom rim is in the dirt or mud.

The automatic samplers will be triggered by flow meters that will simultaneously collect flow date from the streams during sample collection. Flow data will be collected by connected to the flow meter via a laptop computer or other device and downloaded using the appropriate software. Flow data should be reviewed in the field to verify that the flow meter is working correctly. Field crews should attempt to correct any malfunctions in the field as soon as possible to return the meter to a calibrated state before leaving the site. If time does not allow for adjustments to be made then the field team should return as soon as possible to address the flow meter.

B2.2 Geomorphic Assessment

Sampling for this project can be grouped into two categories: (1) surveying for channel geometric characteristics and (2) sediment sampling. Table B-1 describes the types of data to be sampled and the methods used to sample.

Table B-1 Geomorphic Sampling Methods

Type of Data	Method	Reference
Channel cross section	Total station survey	Rosgen (1996)
Channel profile	Total station survey	Rosgen (1996)
Channel planform	Total station survey	Rosgen (1996)
Riffle surface sediment grain size distribution	Wolman pebble counting	Bunte and Abt (2001)
Subsurface sediment grain size distribution	Fine and coarse sieve analysis	Bunte and Abt (2001)
Bar sediment grain size distribution	Fine and coarse sieve analysis	Rosgen (1996) and Bunte and Abt (2001)

Survey data will be checked during the surveying process by intermittently checking elevations at monumented locations. Any error in survey information will be apparent by following standard professional surveying procedures. A resurvey will be initiated when errors occur.

Total sediment weight before and after sieve analysis will be used to determine the error in sieve analysis procedures. Samples with an error greater than 8% will not be used, and the reasons for the errors will be determined and corrective action will be taken. The QA manager will be responsible for reviewing the sediment grain size distribution error analysis to determine the need to repeat the analysis.

Survey errors are most often apparent in the field when control points are recorded. Maximum errors at control points will be recorded. Surveys will be repeated where the errors at monuments are greater than 2 cm. The QA manager will review survey error measures at each site to ensure that inaccurate surveys are repeated.

B2.3 Biological Sampling

Biological data collection will follow quality assurance and control protocols adopted by the Kentucky Division of Water, Ecological Support Branch (KDOW 2006). Briefly, precision of the habitat analysis will be assessed by comparing field personnel score with an expert score for each site. Personnel scores should be within 95% of the expert score for that site. All field staff will receive annual habitat training performed according to Biological Assessment Methods Manual (KDOW 2006).

Sampling effort for macroinvertebrates will be equalized across all sampling sites. All samples will be labeled immediately upon collection and at least five (5) percent of samples collected will be duplicated to evaluate precision and repeatability. All sampling gear will be thoroughly cleaned between site visits and at the beginning and close of daily sampling. Logbooks will be maintained indicating the date, location and crew for each sample collected. Ten percent of all sorted samples will be examined by a qualified biologist to ensure that all organisms have been accounted for. If fewer than ten organisms are found in the sorting pan, the sample is considered valid (KDOW 2006). If more than ten organisms are found, then the sample fails and another successive pan will be checked. This will continue until the sorter passes the procedure. At least five (5)% of all samples will be reprocessed by an outside authority; 90% similarity will be considered acceptable. All macroinvertebrate samples will be maintained in 75% ethanol for at least five years as vouchers. Laboratory bench sheets will also be maintained for at least five (5) years at the University of Louisville.

Procedures for the periphyton (algae) samples will be similar with the exception that 75% similarity will be considered acceptable for the QA/QC process per KDOW standards (2006). Prepared slides will be stored under appropriate conditions for at least five years.

B3. Sampling Handling and Custody

B3.1 Water Chemistry Data

Once samples are collected, a member of the sampling team will drop off the samples to a representative of the EnviroData Group to be transported for analysis. Transport time from the project area to the analytical lab is approximately 60 to 90 minutes. Samples will be kept in coolers on ice before and during transport. Copies of all paperwork, including field sheets and chains of custody, will be signed and exchanged. Figure B-1 shows an example of a sample label and Figure B-2 shows an example of a chain of custody that will be used.

Client:____________________
Sample ID:____________________
Location:____________________
Collection Time:____________________
Collection Date:____________________
Analysis:____________________
Preservation:____________________

Figure B-1 Example Sample Label

COC#

CHAIN OF CUSTODY

PAGE 1 OF 1

Client:
Project Name:
Project # : Acct # :
Quote # : P.O. # :
Project Contact:
Phone # :
Collected By :
Landfill License # : / PWS ID # :

EnviroData Group
2520 Regency Road, Lexington KY 40503-2421
Phone: 859-276-3506
Toll Free: 1-800-489-3506
Fax: 859-278-5665

Mail Report To:
Company:
Address:
City/State/Zip:
Invoice To:
Company:
Address:
City/State/Zip:

Shipped Via: Fed-Ex / UPS / Courier / *HES*
Airbill # :
COC Seal # :
Turnaround Time:
10-Day / 5-Day / 3-Day / 24-Hours / Other
Date / Time Needed
QC Level

* Matrix
A - Air
DW - Drinking Water
GW - Ground Water
L - Liquid
SE - Sediment
S - Soil
LS - Liquid Sludge
ST - Stormwater
SS - Solid Sludge
SU - Surface Water
WW - Wastewater
W - Water
O - Other

** Preservation Type

Requested Analysis

Field Measurements: Temp. (C) | pH | Cond. (umhos/cm) | DO (mg/L)

* * Preservation Code
AA - Ascorbic Acid
AC - NH4Cl
E - EnCore
HA - HCl
M - Methanol
NA - HNO3
SA - H2SO4
SH - NaOH
SS - Na2SO3
ST - Na2S2O3
ZA - Zinc Acetate
O - Other

Sample ID | Location | Collection Date | Collection Time | Matrix | Grab/Comp | Field Filt. | ... | Comments

Relinquished By | Date / Time | Received By | Date / Time

Notes:

Properly Preserved: (Yes / No) Headspace: (Yes / No)
COC Seals Intact: (Yes / No / NA) Bottles Intact: (Yes / No)
Temp. Upon Receipt (C) ______ By: ______
Field Document Attached: (Yes / No)

Figure B-2 Example Chain of Custody Form

B3.2 Geomorphic Data

Total station survey data will be collected in electronic format on data loggers and downloaded each day to a laptop computer.

Pebble count and other sediment data will be recorded on data forms and typed into a database.

Sediment samples will be labeled in the field and transported directly to the geomechanics laboratory. Grain size analysis will be conducted in the laboratory within one month of sample collection. Grain size analysis will be completed and data will be directly entered into a computer database.

The data will be archived by the project QA manager.

B3.3 Biological Data

For biological samples, chain of custody procedures will be adapted from those of the Kentucky Natural Resources and Environmental Protection Cabinet. Forms include entries, to be filled by the sampler, of sample number, date and time, station description, method, type, size, type of preservation, and analysis requested. The sampler will carry the samples and records to either the lab, or a courier, who must also sign the form. The lab staff member designated to receive the samples, either the shift supervisor or assistant, will then sign the form. At all transactions, both the relinquishing and receiving parties will sign the chain of custody form. Sample labels and chain of custody forms are included in the packet.

B4. Analytical Methods

B4.1 Water Chemistry Data

Table B-2 summarizes the potential analytical testing that may be required for this project. The table includes the analytical method, reporting limit, preservation, and holding time for each of the possible parameters that may be involved in this project.

Parameter	Method	Reporting Limit	Preservation	Holding Time
BOD_5	EPA 405.1	1 mg/L	Unpreserved	48 Hours
Total Suspended Solids	EPA 160.2	3 mg/L	Unpreserved	Seven Days
Nutrients	EPA 300.0 and 350	Varies	H_2SO_4 (as necessary)	28 Days
Metals	EPA 200.7	Varies	HNO_3	Six Months
Fecal Coliform	SM 9222D	1 colonies/100 mL	$Na_2S_2O_3$	Six Hours

Table B-2 Summary of Analytical Testing

B4.2 Geomorphic Data

Survey data will be analyzed and reduced using AutoCAD. Cross section and stream profile characteristics will be extracted from the AutoCAD data for further analysis using Microsoft Excel. The data will be entered into a Microsoft Access database following quality control checks during data processing and confirmation of satisfactory quality through spreadsheet analysis.

Grain size analysis to obtain standard parameters for characterizing bed and bank sediments will be completed. Grain sizes will be split into coarse sediments greater than 2 mm (gravel and cobbles) and fine-grained sediments less than 2 mm (sand, silt and clay).

B4.3 Biological Data

Beyond the water chemistry methods already specified, Chlorophyll a/SUVA will be analyzed via the SM 10200 H method with units of µg/L and a minimum detection level (MDL) of 0.5.

B5. Quality Control

B5.1 Water Chemistry Data

Water chemistry samples will be duplicated in the laboratory as a part of their internal quality control procedures. Field duplicates may be employed along with equipment blanks and field blanks if laboratory duplicates indicate a potential bias is being introduced due to collection techniques. Due to the large volume of samples that will be collected, data gaps should be easily managed if some samples are suspect.

B5.2 Geomorphic Data

Bulk sediment sample weights will be compared before and after sieve analysis to determine the percentage lost in the sieving process. A loss of less that 8 % will be considered adequate for the sampling required to characterize the bed sediments.

Standard surveying practices will be employed to ensure that survey location error is less than 1 cm.

B5.3 Biological Data

Randomly selected macroinvertebrate and algal samples from each sampling period (10% of total samples) will be sent to outside authorities for independent taxonomic confirmation (macroinvertebrates: Dr. Scott Grubbs, Mr. Skip Call; algae: Dr. Roger Sweets). Voucher species along with reference details and authorities consulted will be maintained in the laboratory.

B6. Instrument/Equipment Testing, Inspection, and Maintenance

B6.1 Water Chemistry Data

Before any test is run, laboratory technicians will run an initial test to demonstrate that the capabilities to run the test per method is there. Equipment is checked and maintained according to manufacturers' standards, or testing standards, whichever is more stringent.

B6.2 Geomorphic Data

Survey equipment and scales will be maintained to ensure proper function. This equipment will be tested against standards before and after field reconnaissance. The equipment will be sent to a local survey company for recalibration if found to be inaccurate or out of calibration

Sieves are cleaned after each use. Damaged sieves will be replaced.

B6.3 Biological Data

All machines for biological analysis will be tested against known standards prior to each sample run. If at any time a machine fails to meet detection limits or produce the expected standard curve, factory-trained service personnel will be called to bring the machine back into operation within factory-specific parameters. Additionally, all maintenance, including preventative maintenance, will be performed by factory-trained personnel.

B7. Instrument Calibration & Frequency

B7.1 Water Chemistry Data

Analytical equipment will be calibrated by manufacturer-authorized personnel at a minimum frequency of the manufacturer's required calibration schedule. Should an instrument fall out of calibration or a specific test require, equipment will be calibrated more frequently.

B7.2 Geomorphic Data

Survey equipment will be calibrated every six months, although it may be calibrated more frequently if found to be out of calibration during testing.

B7.3 Biological Data

Laboratory equipment calibration will be performed by manufacturer-authorized service personnel at frequencies equal to or greater than the manufacturer-specified schedules.

B8. Inspection/Acceptance of Supplies and Consumable

For chemical and biological data collection, all sample containers will be inspected for defects and will only be accepted with a certification of proper cleaning. This section does not apply to geomorphic data collection.

B9. Non-direct Measures

For geomorphic data collection, annual peak flows and gage station rating curves will be obtained from the US Geological Survey (USGS). Strict and rigorous QA and QC have been established by the USGS to ensure the quality of these data. Ratings are given to flow data such that measurements of rating less than good will not be accepted for use in the project.

Non-direct measures are not anticipated for the chemical or biological data collection in this project.

B10. Data Management

B10.1 Water Chemistry Data

Data results from analytical testing will be entered into the laboratory's LIMS system after an initial review of the data against method criteria. A secondary reviewer then reviews the data before it is released to Strand Associates. Should errors arise in the laboratory, a non-conformance report/corrective action report is generated. This report identifies the problem or error, gives planned corrective action and corrective action follow-up procedures. This form is reviewed and agreed to by the laboratory section manager, project manager, QA manager, and analyst. All completed forms are kept in the QA Manager's possession.

Upon receipt of the data, Strand Associates will perform a review of the quality assurance checks and report any variances back to the laboratory for rectification. Should no variances arise, the data will be accepted and used.

B10.2 Geomorphic Data

Geomorphic data will be archived in paper format and entered into an Excel spreadsheet.

B10.3 Biological Data

Data handling depends in large part on the method of output from the machine in question. In the case of machines where the output is paper only, raw data from the machine is transferred to lab data sheets and then to Excel spreadsheets. In the case of other machines, data is digitally preserved directly as an Excel spreadsheet via the attached PC workstation.

In all cases, original paper and digital data is maintained by the EAL for the life of the project or for five years, whichever is longer. Data is backed up on disks which are independent of the PC workstation.

C. ASSESSMENT AND OVERSIGHT

C1. Assessments and Response Actions

C1.1 Water Chemistry Data

By following the procedures described herein, the integrity of the water chemistry data will be ensured. Field personnel will be thoroughly trained on the procedures, and the QA manager will perform unannounced site visits during data collection to verify sampling is being executed according to protocol. In the unlikely event that collection procedures are not being followed properly, the QA manager will have full authority to issue the personnel with a notice of improper data collection, give a tutorial on the correct procedures, and instruct them to repeat the data collection.

The certified laboratory performing the analyses will follow their internal QA procedures, inspected and audited by their QA manager in accordance with their accreditation procedures. Should any procedural or analytical errors occur, the laboratory QA manager will take steps to discuss the errors and ensure that they can be minimized or eliminated in the future.

C1.2 Geomorphic Data

Assessment of geomorphic data quality will be conducted at several levels. Survey equipment will be examined to determine its accuracy by laying out a known measurement distance and through repeat measurements each time the equipment is taken into the field.

The QA data manager will make visits to field sites during part of each field reconnaissance to ensure that procedures described here are being followed. The project team will discuss procedures and assess errors in measurements at least biannually. Data collection will be repeated if necessary.

Accuracy of the surveying equipment is imperative for high quality field measurements. At least one backup instrument will be made available to ensure that a calibrated instrument is used.

C1.3 Biological Data

It is critical that field and laboratory personnel understand the importance of following the quality procedures described herein. Not only will the staff be properly trained, but the QA manager will perform unannounced field and laboratory inspections of their work. Biological monitoring efforts will follow quality assurance and control protocols adopted by the Kentucky Division of Water, Ecological Support Branch (KDOW 2006). Precision of the habitat analysis will be assessed by comparing field personnel score with an expert score for each site. Personnel scores should be within 95% of the expert score for that site. All field staff will receive annual habitat training performed according to Biological Assessment Methods Manual (KDOW 2006). Ten percent of all sorted samples will be examined by a qualified biologist to ensure that all organisms have been accounted for. If fewer than ten organisms are found in the sorting pan, the sample is considered valid (KDOW 2006). If more than ten organisms are found, then the sample fails and another successive pan will be checked. This will continue until the sorter passes the procedure. At least five (5)% of all samples will be reprocessed by an outside authority; 90% similarity will be considered acceptable. Procedures for the periphyton (algae) samples will be similar with the exception that 75% similarity will be considered acceptable for the QA/QC process per KDOW standards (2006). Ten (10)% of the site logbooks and electronic spreadsheets will be chosen for quality assurance/quality control assessment by a random numbers generator with 95% similarity being a "passing" grade for data entry. Individuals whose entries fail to meet this standard will be retrained until they meet the 95% requirement. Data they have managed before that time will be subject to complete review. If field or laboratory handling of samples or data does do not meet quality objectives, re-training will be performed by the by project PIs or other designated individuals as required (KDOW 2006). Follow up quality assurance will be performed to ensure that deficiencies have been corrected.

Appropriate meters will be used to determine pH, DO, temperature and conductivity. Equipment logbooks will be maintained recording instrument calibration, maintenance and repairs. Instruments will be calibrated and maintained according to factory specifications. Calibration may performed prior to leaving the laboratory or when in the field. When possible, equipment will be inspected and calibrated once every two years by an authorized technician. All meters will be calibrated at least once a quarter. De-ionized water will be used in the calibration and storage of equipment.

C2. Reports to Management

Strand Associates, on behalf of the Oldham County Fiscal Court, will compile a technical report for each sample collection year to be submitted to the Kentucky Division of Water (KDOW). The report will discuss the results of the monitoring, the quality of the data, any quality assurance problems and the steps taken to solve them. KDOW will then be able to comment on the report and make recommendations. The report will also suffice as a chapter of the Watershed Based Plan. The Watershed Based Plan and general summary of the project will be included in a final project report for KDOW upon project completion.

C2.1 Water Chemistry Data

The QA manager for the water chemistry data collection will be regularly involved in the project. In this light, any problems in the data collection will be addressed as quickly as possible. The same can be said for the water chemistry analysis. The

QA mangers will report violations and/or other quality issues to the project manager in their reports accompanied by the summary of the data collection and/or analytical results.

C2.2 Geomorphic Data

Verbal reports on the status of projects will be made weekly. Data collection procedures will be discussed, problems will be addressed and any necessary corrective actions will be taken on a weekly basis. The QA manager and field data collection team will meet to discuss QA and QC issues before each intensive field data collection period.

C2.3 Biological Data

Biological data collection and analysis will be evaluated regularly by the respective QA manager. All potential biological crew members will be interviewed by the project investigators at the Kentucky Division of Water and the University of Louisville. Each member will have to demonstrate competence (combination of education, training, experience) in the field of their assignment. The demanding physical nature of the project will be stressed and all crew members will be encouraged to become proficient in basic first aid and field safety procedures. A sampling crew will always include at least 2 people. All on-the-job accidents will be immediately reported to a supervisor. The supervisor will follow procedures outlined by the Worker's Compensation Insurance carrier and personnel policy of the University of Louisville. The Biology and Human Resources departments of the University of Louisville will maintain records of all injuries. All personnel undergo an annual review process following University of Louisville Human Resources guidelines. During this process, employees are interviewed by their direct supervisor who assess strengths and identify areas for corrective action or future professional development. This will isolate any problems such that they are corrected in the near term and not chronically repeated. Reports of quality issues will be included with the reports to the project manager discussing analytical results.

D. DATA VALIDATION AND USABILITY

D1. Data Review, Verification and Validation

D1.1 Water Chemistry Data

Quantitative and qualitative descriptions of the validity will be included in the technical reports. Data will be validated using principle data quality indicator's precision, bias, accuracy, and completeness. These will be reported as the relative standards deviation, relative percent difference (RPD), percent recovery, and percent complete. Data validity descriptions will also include the results of laboratory blanks.

D1.2 Geomorphic Data

Spot checks of data using a simple level line and tape will be made to ensure that survey data are within an acceptable range for characterizing geomorphic parameters. Most problems with data error will be addressed at the time of data collection.

D1.3 Biological Data

Sampling effort for macroinvertebrates will be equalized across all sampling sites. All samples will be labeled immediately upon collection and at least five (5) percent of samples collected will be duplicated to evaluate precision and repeatability. All sampling gear will be thoroughly cleaned between site visits and at the beginning and close of daily sampling. Logbooks will be maintained indicating the date, location and crew for each sample collected. Ten percent of all sorted samples will be examined by a qualified biologist to ensure that all organisms have been accounted for. If fewer than ten organisms are found in the sorting pan, the sample is considered valid (KDOW 2006). If more than ten organisms are found, then the sample fails and another successive pan will be checked. This will continue until the sorter passes the procedure. At least five (5)% of all samples will be reprocessed by an outside authority; 90% similarity will be considered acceptable. All macroinvertebrate samples will be maintained in 75% ethanol for at least five years as vouchers. Laboratory bench sheets will also be maintained for at least five (5) years at the University of Louisville.

Procedures for the periphyton (algae) samples will be similar with the exception that 75% similarity will be considered acceptable for the QA/QC process per KDOW standards (2006). Prepared slides will be stored under appropriate conditions for at least five years.

Ten (10)% of the site logbooks and electronic spreadsheets will be chosen for quality assurance/quality control assessment by a random numbers generator with 95% similarity being a "passing" grade for data entry. Individuals whose entries fail to meet this standard will be retrained until they meet the 95% requirement. Data they have managed before that time will be subject to complete review.

D2. Verification and Validation Methods

D2.1 Water Chemistry Data

After the QA manager checks the data precision, bias, accuracy, and completeness, they will declare the data usable or unusable with comments. If unusable, the comments will specify the corrective actions needed to make the data usable. Once the data is declared usable, it will be transferred to the project manager, who will distribute to the data users accordingly.

Paperwork associated with the water chemistry data (chain-of-custodies, field sheets, laboratory results, etc) shall be retained by the QA manager for the life of the project.

D2.2 Geomorphic Data

The geomorphic data for this project will be compared to those of other similar projects of regional geomorphic characteristics. Data incorporated in the database will be reviewed and tested by the QA manager. Although large variation in geomorphic parameters is anticipated, unusual deviations will be examined carefully to ensure that they represent variation in geomorphic characteristics and not error of data collection and analysis procedures.

D2.3 Biological Data

Data will be managed following KDOW's SOP (KDOW 2006) with the following exceptions. Field data sheets, other field notes and chain of custody forms will be stored in a centralized file along with the laboratory bench sheets. Data will also be kept on backup hard drives in two locations in the Department of Biology, University of Louisville.

Appropriate meters will be used to determine pH, DO, temperature and conductivity. Equipment logbooks will be maintained recording instrument calibration, maintenance and repairs. Instruments will be calibrated and maintained according to factory specifications. Calibration may be performed prior to leaving the laboratory or when in the field. When possible, equipment will be inspected and calibrated once every two years by an authorized technician. All meters will be calibrated at least once a quarter. De-ionized water will be used in the calibration and storage of equipment.

If field or laboratory handling of samples or data does do not meet quality objectives, re-training will be performed by the by project PIs or other designated individuals as required (KDOW 2006). Follow up quality assurance will be performed to ensure that deficiencies have been corrected.

D3. Reconciliation with User Requirements

The respective data collection managers will coordinate with the project manager, such that every effort is taken to ensure that the data being collected is what is needed for the project, and that it is in a usable form for the users of the data. Assumptions and limitations will be communicated and discrepancies in data usability will be resolved.

STRAND
ASSOCIATES, INC.®
ENGINEERS

Waterfront Plaza
Suite 710
325 West Main Street
Louisville, KY 40202
Phone: 502-583-7020
Fax: 502-583-7026

Office Locations

Madison, WI
Joliet, IL
Louisville, KY
Lexington, KY
Mobile, AL
Columbus, IN
Columbus, OH
Indianapolis, IN
Milwaukee, WI
Cincinnati, OH
Phoenix, AZ

www.strand.com

May 7, 2009

Beth Stuber, P.E.
Oldham County Fiscal Court
100 W. Jefferson Street, Suite 3
La Grange, Kentucky 40031

Re: Curry's Fork Comprehensive Watershed Based Plan
Project ID Number: C9994861-06
Quality Assurance Project Program Plan Revisions

Dear Ms. Stuber:

The 2007 recreational contact season was particularly dry with below average rainfall amounts and drought conditions throughout the Curry's Fork Watershed. There is concern that these unusual conditions may impact the water quality sampling process taken in support of the Watershed Based Plan development. To quantify the impact of the drought conditions, we are requesting that additional sampling be conducted in the 2009 recreational contact season.

We recommend the same sampling sites be monitored every two weeks from May 1 to July 15 for total suspended solids, nutrients, and fecal coliform. The data from these samples will be compared to the data collected in 2007. If the results are similar, no further sampling will be done. If the results indicate bias because of weather conditions, sampling will continue every two weeks through the end of the recreational contact season.

In addition, we recommend collecting wet weather samples. We would target a two-month, one-hour recurrence storm and collect fecal coliform samples within the first hour of rainfall, then at hours four, and 12 at nine sampling locations. The data collected during this event would assist us in developing load duration curves.

During all of the additional sampling events, physical measurements of the streams pH, temperature, dissolved oxygen, conductivity, and flow will be collected. Sampling procedures will not be altered from those described in the Quality Assurance Project Program Plan (QAPP). Revisions to the QAPP will be limited to additional sampling locations, wet weather sampling approach, and project team modifications.

Revisions to the QAPP are described in the following paragraphs:

1. Update Figure 1.01-1 with existing and new sampling locations. The new locations are located in the North Curry's Subwatershed and Asher Run Subwatershed.

2. Revise Table 1.01-1 with the enclosed sampling schedule.

3. Add the following text to sampling design (page 2-1, paragraph 4 after Total Suspended Solids paragraph):

   "Additional sampling will be collected in Year 3. Water quality samples will be taken at the original eight sample sites and three new sites. Grab samples will follow the same protocol as year one sampling. Field testing will be the same as year one including pH, temperature, dissolved oxygen, and conductivity measurements. Lab testing will include fecal coliform, total suspended solids, and nutrients. Rain event sampling will be collected for up to three rain events. Samples will be targeted to be collected within the first hour of rainfall, then at hours 4 and 12 after rainfall has begun. The targeted rain event will be equivalent to a two-month one-hour storm. Rain event sampling will be collected at nine sampling sites. NC2 and NC1b are excluded because of safety and accessibility issues."

4. Insert text and enclosed organizational chart in Appendix A.

   Beth Stuber, P.E.
   Oldham County Fiscal Court, County Engineer
   100 West Jefferson Street
   LaGrange, KY 40031

   Paul Maron, P.E., Project Manager
   Strand Associates, Inc.
   325 West Main Street, Suite 710
   Louisville, KY 40202

   John Lyons, P.E., Quality Assurance Manager
   Strand Associates, Inc.
   325 West Main Street, Suite 710
   Louisville, KY 40202

Andrea Rogers, Environmental Data Collection Manager
Strand Associates, Inc.
325 West Main Street, Suite 710
Louisville, KY 40202

Ralph Rabish, Laboratory Analysis Project Manager
Microbac Laboratories
3323 Gilmore Industrial Blvd.
Louisville, KY 40213

If you have any questions or concerns about the above revisions, feel free to contact me at 502-583-7020.

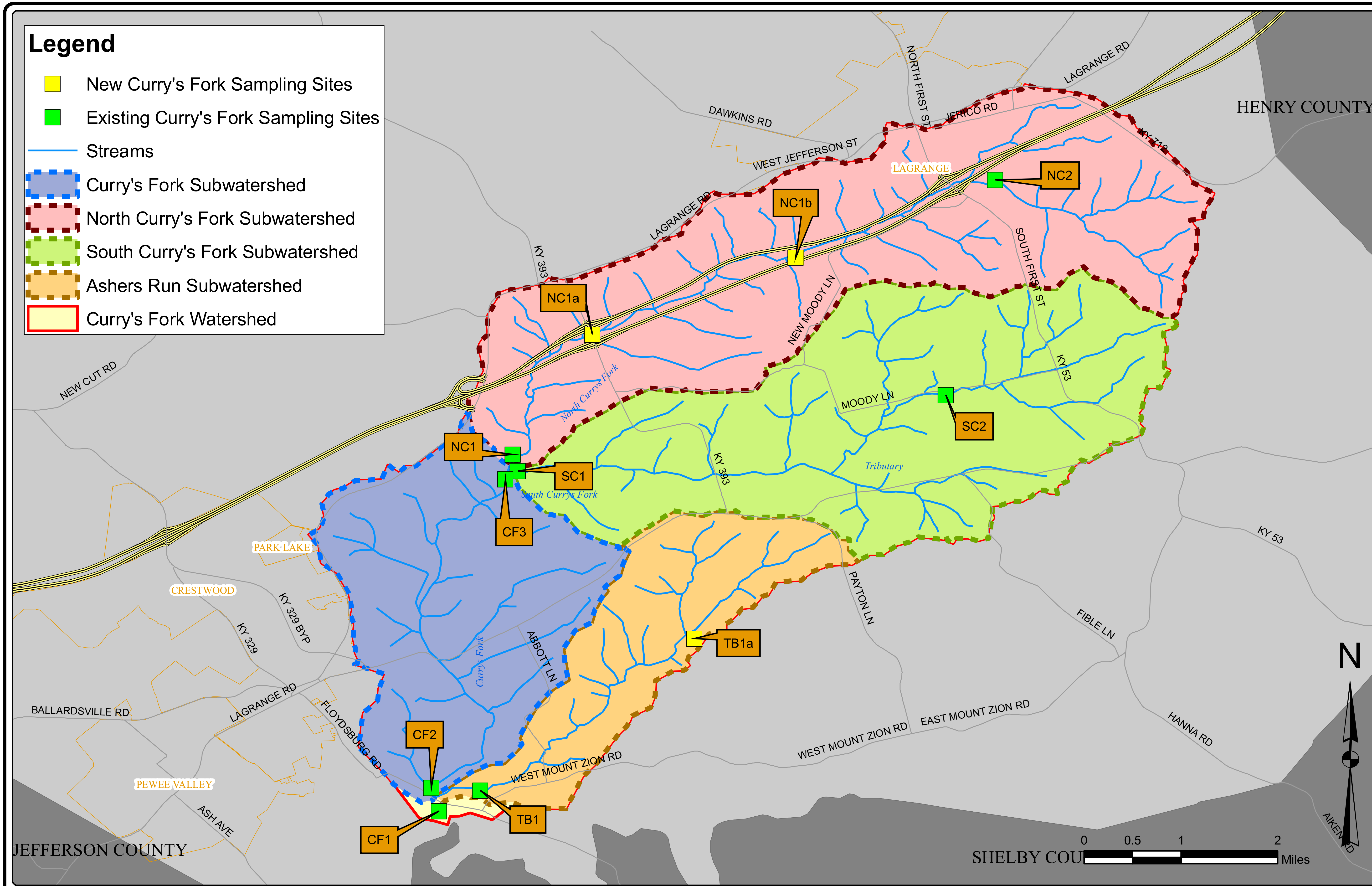
Sincerely,

STRAND ASSOCIATES, INC.®

Paul G. Maron, P.E.

Enclosure(s)

c/enc.: Corrine Mulberry



CURRY'S FORK SAMPLING SITE LOCATIONS

CURRY'S FORK COMPREHENSIVE WATERSHED BASED PLAN
OLDHAM COUNTY FISCAL COURT
LA GRANGE, KENTUCKY

STRAND ASSOCIATES, INC.® ENGINEERS

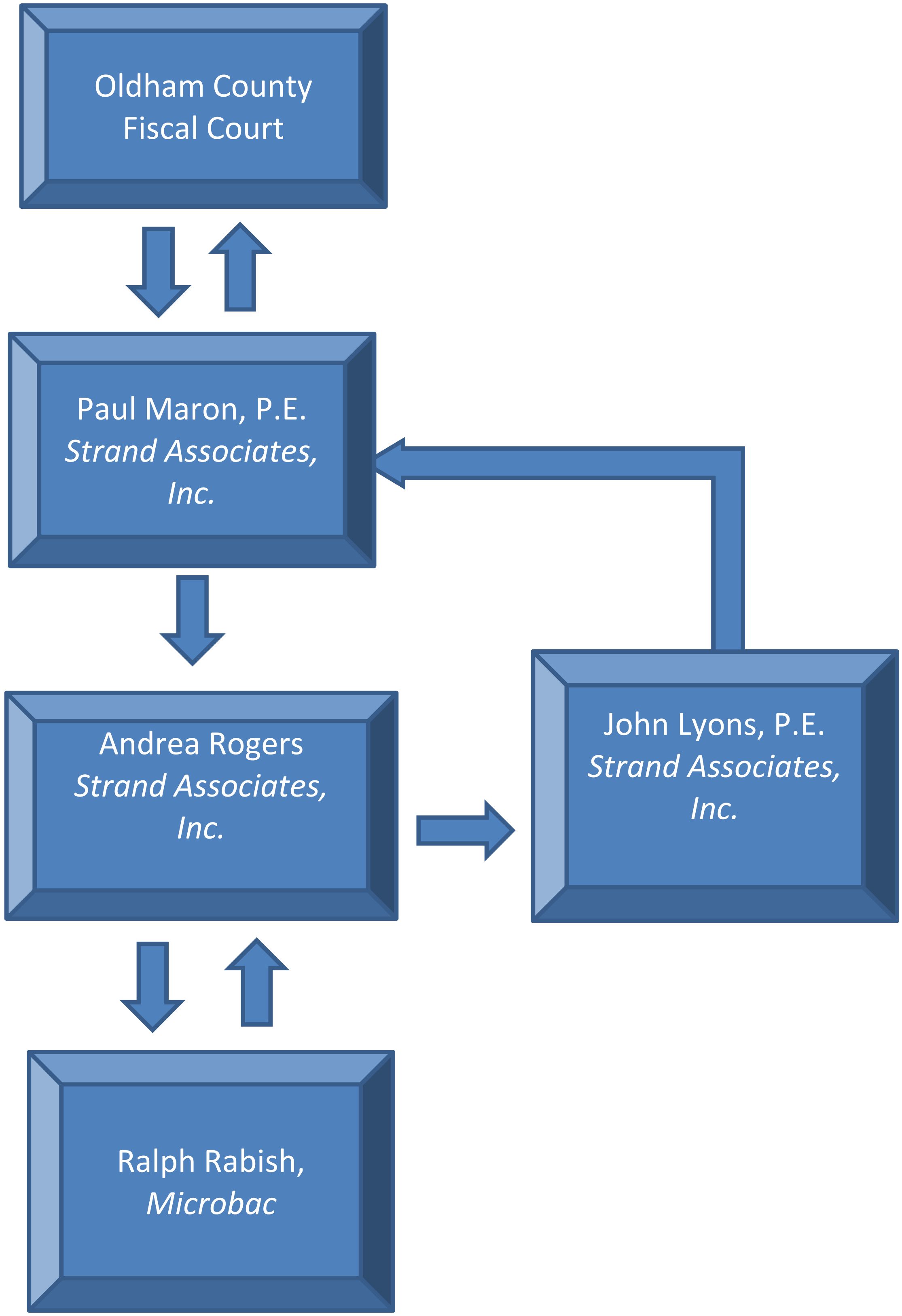
Figure 1.01-1
5994.100

SAMPLING SITES AND SCHEDULE

Sampling Site	Stream	X-Coordinate	Y-Coordinate	Lab Tests Fecal Coliform, TSS, BOD5, Nutrients, Metals	Field Tests pH, Temp, DO, Conductivity	Flow and TSS	Geomorphic Assessment	Biolgoical Monitoring	**Lab Tests Fecal, TSS, Nutrients**	**Field Tests pH, Temp, DO, Conductivity**	**Rain Event Lab Tests Fecal, TSS, Nutrients**	**Rain Event Field Tests pH, Temp, DO, Conductivity**	Post Construction Monitoring
				Year 1 (2007)					**Year 3 (2009)**				Year 6
CF1	Curry's Fork	1297766.68	296914.58	X	X				**X**	**X**	**X**	**X**	To be determined during watershed plan development
CF2	Curry's Fork	1296137.32	295262.17	X	X	X	X	X	**X**	**X**	**X**	**X**	
TB1	Asher Run	1296952.00	296968.38	X	X	X	X	X	**X**	**X**	**X**	**X**	
CF3	Curry's Fork	1301074.12	314447.26	X	X				**X**	**X**	**X**	**X**	
NC1	North Curry	1299789.82	315085.97	X	X	X	X	X	**X**	**X**	**X**	**X**	
SC1	South Curry	1300133.22	314234.35	X	X	X	X	X	**X**	**X**	**X**	**X**	
NC2	North Curry	1320514.85	329662.68	X	X				**X**	**X**			
SC2	South Curry	1316713.15	318053.27	X	X				**X**	**X**	**X**	**X**	
NC1a	**North Curry**	**1302870.97**	**321608.08**						**X**	**X**	**X**	**X**	
NC1b	**North Curry**	**1311657.29**	**325685.50**						**X**	**X**			
TB1a	**Asher Run**	**1307041.64**	**304965.82**						**X**	**X**	**X**	**X**	

* Bold indicates new sampling sites and schedule.

CURRY'S FORK WATERSHED BASED PLAN
ORGANIZATION CHART



APPENDIX F
SECONDARY KDOW PHYSIOCHEMICAL PATHOGEN

Secondary KDOW Sampling Data

Organization	Station ID	Location	Sample Date	Sample Type	Result	Units
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Alkalinity, Carbonate as CaCO3	239	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Alkalinity, Carbonate as CaCO3	207	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Alkalinity, Carbonate as CaCO3	217	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Alkalinity, Carbonate as CaCO3	197	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Alkalinity, Carbonate as CaCO3	175	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Alkalinity, Carbonate as CaCO3	227	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Alkalinity, Carbonate as CaCO3	125	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Alkalinity, Carbonate as CaCO3	194	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Alkalinity, Carbonate as CaCO3	161	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Alkalinity, Carbonate as CaCO3	181	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Alkalinity, Carbonate as CaCO3	170	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Alkalinity, Carbonate as CaCO3	203	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Alkalinity, Carbonate as CaCO3	248	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Alkalinity, Carbonate as CaCO3	185	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Alkalinity, Carbonate as CaCO3	206	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Aluminum	18	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Aluminum	718	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Aluminum	251	ug/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Aluminum	129	ug/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Aluminum	95	ug/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Aluminum	135	ug/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Aluminum	178	ug/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Aluminum	18	ug/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Aluminum	648	ug/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Aluminum	429	ug/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Aluminum	935	ug/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Aluminum	52	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Aluminum	28.2	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Aluminum	3000	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Aluminum	170	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Arsenic	2	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Arsenic	2	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Arsenic	2	ug/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Arsenic		ug/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Arsenic	3	ug/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Arsenic	3	ug/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Arsenic	2	ug/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Arsenic		ug/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Arsenic		ug/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Arsenic		ug/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Arsenic		ug/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Arsenic		ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Arsenic	0.83	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Arsenic	1.38	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Arsenic	0.908	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Barium	33	ug/l

Secondary KDOW Sampling Data

Organization	Station ID	Location	Sample Date	Sample Type	Result	Units
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Barium	53	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Barium	69	ug/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Barium	57	ug/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Barium	66	ug/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Barium	76	ug/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Barium	49	ug/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Barium	51	ug/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Barium	43	ug/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Barium	39	ug/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Barium	41	ug/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Barium	38	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Barium	41.4	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Barium	50.4	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Barium	49.4	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Cadmium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Cadmium		
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Cadmium		
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Cadmium		
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Calcium	72	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Calcium	60.8	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Calcium	66.5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Calcium	66.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Calcium	59	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Calcium	66	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Calcium	56	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Calcium	65.4	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Calcium	68.9	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Calcium	69.7	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Calcium	65.5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Calcium	70	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Calcium	74.6	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Calcium	54.8	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Calcium	58.5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Carbon, Total Organic (Toc)	3.15	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Carbon, Total Organic (Toc)	4.85	mg/l

Secondary KDOW Sampling Data

Organization	Station ID	Location	Sample Date	Sample Type	Result	Units
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Carbon, Total Organic (Toc)	4.68	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Carbon, Total Organic (Toc)	3.9	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Carbon, Total Organic (Toc)	0.44	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Carbon, Total Organic (Toc)	7.7	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Carbon, Total Organic (Toc)	6.4	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Carbon, Total Organic (Toc)	7.55	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Carbon, Total Organic (Toc)	5.91	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Carbon, Total Organic (Toc)	3.26	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Carbon, Total Organic (Toc)	2.42	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Carbon, Total Organic (Toc)	3.46	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Carbon, Total Organic (Toc)	3.12	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Carbon, Total Organic (Toc)	6.12	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Carbon, Total Organic (Toc)	3.68	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Chloride	33.4	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Chloride	31.7	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Chloride	46.9	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Chloride	40.6	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Chloride	82.5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Chloride	110	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Chloride	37.6	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Chloride	84	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Chloride	66.8	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Chloride	28.8	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Chloride	25.7	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Chloride	50.2	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Chloride	30	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Chloride	22.1	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Chloride	38.8	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Chromium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Chromium	2	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Chromium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Chromium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Chromium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Chromium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Chromium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Chromium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Chromium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Chromium	1	ug/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Chromium	1	ug/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Chromium		ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Chromium	0.27	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Chromium	2.29	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Chromium	0.205	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Copper	1	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Copper	3	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Copper	1	ug/l

Secondary KDOW Sampling Data

Organization	Station ID	Location	Sample Date	Sample Type	Result	Units
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Copper	2	ug/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Copper	3	ug/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Copper	4	ug/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Copper	3	ug/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Copper	3	ug/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Copper	4	ug/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Copper	2	ug/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Copper	1	ug/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Copper	2	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Copper	1.77	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Copper	3.04	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Copper	2.27	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Dissolved oxygen (DO)	14.2	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Dissolved oxygen (DO)	6	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Dissolved oxygen (DO)	6.4	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Dissolved oxygen (DO)	6.1	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Dissolved oxygen (DO)	10.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Dissolved oxygen (DO)	7.2	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Dissolved oxygen (DO)	19.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Dissolved oxygen (DO)	11.8	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Dissolved oxygen (DO)	14.6	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Dissolved oxygen (DO)	11.9	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Dissolved oxygen (DO)	14.8	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/26/1999	Fecal Coliform	90	cfu/100ml
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Fecal Coliform	500	cfu/100ml
KDOW	SRW008	Currys Fork near Crestwood	7/28/1999	Fecal Coliform	1800	cfu/100ml
KDOW	SRW008	Currys Fork near Crestwood	8/30/1999	Fecal Coliform	280	cfu/100ml
KDOW	SRW008	Currys Fork near Crestwood	9/29/1999	Fecal Coliform	520	cfu/100ml
KDOW	SRW008	Currys Fork near Crestwood	9/30/1999	Fecal Coliform	550	cfu/100ml
KDOW	SRW008	Currys Fork near Crestwood	10/27/1999	Fecal Coliform	60	cfu/100ml
KDOW	SRW008	Currys Fork near Crestwood	10/28/1999	Fecal Coliform	50	cfu/100ml
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Hardness, Ca + Mg	286	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Hardness, Ca + Mg	245	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Hardness, Ca + Mg	270	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Hardness, Ca + Mg	272	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Hardness, Ca + Mg	238	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Hardness, Ca + Mg	272	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Hardness, Ca + Mg	211	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Hardness, Ca + Mg	255	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Hardness, Ca + Mg	255	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Hardness, Ca + Mg	262	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Hardness, Ca + Mg	248	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Hardness, Ca + Mg	267	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Hardness, Ca + Mg	307	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Hardness, Ca + Mg	220	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Hardness, Ca + Mg	238	mg/l

Secondary KDOW Sampling Data

Organization	Station ID	Location	Sample Date	Sample Type	Result	Units
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Iron	38	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Iron	1370	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Iron	264	ug/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Iron	136	ug/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Iron	138	ug/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Iron	149	ug/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Iron	246	ug/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Iron	38	ug/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Iron	670	ug/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Iron	450	ug/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Iron	1070	ug/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Iron	93	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Iron	0.0653	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Iron	3.62	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Iron	0.164	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Lead		ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Lead	2	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Lead		ug/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Lead		ug/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Lead		ug/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Lead		ug/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Lead		ug/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Lead		ug/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Lead		ug/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Lead		ug/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Lead		ug/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Lead		ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Lead		
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Lead	1.4	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Lead		
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Magnesium	25.7	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Magnesium	22.7	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Magnesium	25.2	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Magnesium	26	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Magnesium	22	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Magnesium	26	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Magnesium	17.2	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Magnesium	22.2	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Magnesium	23	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Magnesium	21.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Magnesium	20.5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Magnesium	22.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Magnesium	29.4	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Magnesium	20.2	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Magnesium	22.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Manganese	5	ug/l

Secondary KDOW Sampling Data

Organization	Station ID	Location	Sample Date	Sample Type	Result	Units
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Manganese	157	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Manganese	59	ug/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Manganese	16	ug/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Manganese	21	ug/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Manganese	33	ug/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Manganese	42	ug/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Manganese	5	ug/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Manganese	37	ug/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Manganese	26	ug/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Manganese	35	ug/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Manganese	16	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Manganese	14.2	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Manganese	69	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Manganese	23	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Mercury		ng/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Mercury	0.72	ng/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Mercury	5.3	ng/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Mercury	1.56	ng/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Nickel	1.03	ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Nickel	2.31	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Nickel	1.93	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Nitrogen, ammonia (NH3) as NH3		mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Nitrogen, ammonia (NH3) as NH3		mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Nitrogen, ammonia (NH3) as NH3	0.069	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Nitrogen, ammonia (NH3) as NH3		mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Nitrogen, ammonia (NH3) as NH3		mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Nitrogen, ammonia (NH3) as NH3		mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Nitrogen, ammonia (NH3) as NH3		mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Nitrogen, ammonia (NH3) as NH3		mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Nitrogen, ammonia (NH3) as NH3		mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Nitrogen, ammonia (NH3) as NH3		mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Nitrogen, ammonia (NH3) as NH3		mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Nitrogen, ammonia (NH3) as NH3		mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Nitrogen, ammonia (NH3) as NH3		
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Nitrogen, ammonia (NH3) as NH3		

Secondary KDOW Sampling Data

Organization	Station ID	Location	Sample Date	Sample Type	Result	Units
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Nitrogen, ammonia (NH3) as NH3		
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Nitrogen, Kjeldahl	0.333	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Nitrogen, Kjeldahl	0.912	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Nitrogen, Kjeldahl	0.78	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Nitrogen, Kjeldahl	0.688	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Nitrogen, Kjeldahl	0.87	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Nitrogen, Kjeldahl	0.896	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Nitrogen, Kjeldahl	0.752	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Nitrogen, Kjeldahl	0.467	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Nitrogen, Kjeldahl	0.79	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Nitrogen, Kjeldahl	0.47	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Nitrogen, Kjeldahl	0.354	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Nitrogen, Kjeldahl	0.398	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Nitrogen, Kjeldahl	0.223	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Nitrogen, Kjeldahl	0.187	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Nitrogen, Kjeldahl	0.39	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	0.007	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	0.972	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	1.36	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	2.95	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	5.57	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	2.23	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	2.02	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	0.367	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	7.63	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	2.55	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	2.14	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	1.55	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	0.438	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	0.568	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	3.13	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	pH	8.4	None
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	pH	7.5	None
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	pH	7.8	None
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	pH	8	None
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	pH	7.8	None
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	pH	8	None
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	pH	7.6	None
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	pH	8.3	None
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	pH	7.8	None
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	pH	8	None
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	pH	7.8	None
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	pH	8	None
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Phosphorus as P	0.103	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Phosphorus as P	0.269	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Phosphorus as P	0.252	mg/l

Secondary KDOW Sampling Data

Organization	Station ID	Location	Sample Date	Sample Type	Result	Units
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Phosphorus as P	0.168	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Phosphorus as P	0.248	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Phosphorus as P	0.243	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Phosphorus as P	0.668	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Phosphorus as P	0.727	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Phosphorus as P	0.981	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Phosphorus as P	0.116	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Phosphorus as P	0.111	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Phosphorus as P	0.155	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Phosphorus as P	0.133	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Phosphorus as P	0.165	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Phosphorus as P	0.118	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Potassium	1.55	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Potassium	4.67	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Potassium	5.69	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Potassium	4.7	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Potassium	8.69	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Potassium	13.1	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Potassium	7.77	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Potassium	11.5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Potassium	7.35	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Potassium	2.77	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Potassium	2.64	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Potassium	2.62	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Potassium	2.5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Potassium	4.07	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Potassium	4.48	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Selenium	2.74	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Selenium		
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Selenium		
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Selenium		
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Selenium		
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Selenium		
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Sodium	21.9	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Sodium	19.7	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Sodium	31.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Sodium	29.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Sodium	57.2	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Sodium	88.4	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Sodium	31.9	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Sodium	64.8	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Sodium	52.1	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Sodium	16.1	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Sodium	15.5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Sodium	25.4	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Sodium	18.6	mg/l

Secondary KDOW Sampling Data

Organization	Station ID	Location	Sample Date	Sample Type	Result	Units
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Sodium	13.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Sodium	24.8	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Solids, Fixed		mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Solids, Fixed	46	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Solids, Fixed	6	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Solids, Fixed	2	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Solids, Fixed	3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Solids, Fixed	2	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Solids, Fixed	5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Solids, Fixed	2	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Solids, Fixed	5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Solids, Fixed		mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Solids, Fixed	11	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Solids, Fixed		mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Solids, Fixed	1.5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Solids, Fixed	26	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Solids, Fixed	4	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Specific conductance	590	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Specific conductance	578	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Specific conductance	605	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Specific conductance	615	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Specific conductance	766	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Specific conductance	962	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Specific conductance	524	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Specific conductance	838	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Specific conductance	765	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Specific conductance	529	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Specific conductance	508	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Specific conductance	653	uS/cm
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Sulfur, sulfate (SO4) as SO4	45.5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Sulfur, sulfate (SO4) as SO4	38.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Sulfur, sulfate (SO4) as SO4	52.4	mg/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Sulfur, sulfate (SO4) as SO4	41.1	mg/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Sulfur, sulfate (SO4) as SO4	71.9	mg/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Sulfur, sulfate (SO4) as SO4	79.5	mg/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Sulfur, sulfate (SO4) as SO4	54.7	mg/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Sulfur, sulfate (SO4) as SO4	83.4	mg/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Sulfur, sulfate (SO4) as SO4	80.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Sulfur, sulfate (SO4) as SO4	52.1	mg/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Sulfur, sulfate (SO4) as SO4	40.9	mg/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Sulfur, sulfate (SO4) as SO4	55.3	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Sulfur, sulfate (SO4) as SO4	41.1	mg/l
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Sulfur, sulfate (SO4) as SO4	33.7	mg/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Sulfur, sulfate (SO4) as SO4	34	mg/l
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Temperature, water	8.9	deg C
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Temperature, water	18.8	deg C

Secondary KDOW Sampling Data

Organization	Station ID	Location	Sample Date	Sample Type	Result	Units
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Temperature, water	22	deg C
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Temperature, water	20.8	deg C
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Temperature, water	19.4	deg C
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Temperature, water	19.2	deg C
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Temperature, water	14.8	deg C
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Temperature, water	5.76	deg C
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Temperature, water	7.6	deg C
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Temperature, water	2.2	deg C
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Temperature, water	8.1	deg C
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Temperature, water	7	deg C
KDOW	SRW008	Currys Fork near Crestwood	4/17/1999	Zinc		ug/l
KDOW	SRW008	Currys Fork near Crestwood	5/6/1999	Zinc		ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/10/1999	Zinc		ug/l
KDOW	SRW008	Currys Fork near Crestwood	7/14/1999	Zinc		ug/l
KDOW	SRW008	Currys Fork near Crestwood	8/10/1999	Zinc		ug/l
KDOW	SRW008	Currys Fork near Crestwood	9/26/1999	Zinc		ug/l
KDOW	SRW008	Currys Fork near Crestwood	10/13/1999	Zinc		ug/l
KDOW	SRW008	Currys Fork near Crestwood	11/17/1999	Zinc	11	ug/l
KDOW	SRW008	Currys Fork near Crestwood	12/10/1999	Zinc	15	ug/l
KDOW	SRW008	Currys Fork near Crestwood	1/12/2000	Zinc		ug/l
KDOW	SRW008	Currys Fork near Crestwood	2/23/2000	Zinc	10	ug/l
KDOW	SRW008	Currys Fork near Crestwood	3/14/2000	Zinc	67	ug/l
KDOW	SRW008	Currys Fork near Crestwood	4/21/2004	Zinc		
KDOW	SRW008	Currys Fork near Crestwood	5/18/2004	Zinc	5.8	ug/l
KDOW	SRW008	Currys Fork near Crestwood	6/21/2004	Zinc	2.3	ug/l

Secondary KDOW Sampling Data

Site ID	Stream Name	Date	% Saturation	Alkalinity (mg/l)	NH_3 (mg/l)	Chloride (mg/l)	DO (mg/l)	Hardness (mg/l)	Nitrate (mg/l)	pH	Specific Conductance	Sulfate (mg/l)	TDS (mg/l)	Temp	TKN (mg/l)	Total P (mg/l)	TSS (mg/l)	Turbidity
12028002	CURRYS FORK	11/11/1981		234.4	0.15	20.6		262.2	0.175			58.6	336		0.65	0.226	4	
12028002	CURRYS FORK	11/11/1981					11.6			8.2	511			8				1.5
12028002	CURRYS FORK	7/27/1999			0.05				2.19						0.628	0.0462		
12028002	CURRYS FORK	7/27/1999	93.8				7.5			8.05	568			25.22				
12028003	NORTH FORK	11/17/1981		243.4	0.25	29.1		320.2	0.015			90.7	426		0.84	0.151	3	
12028003	NORTH FORK	11/17/1981					10.8			8.2	628			7				
		Average	**93.8**	**238.9**	**0.15**	**24.85**	**10.0**	**291.2**	**0.7933**	**8.15**	**569**	**74.65**	**381**	**13.407**	**0.706**	**0.14107**	**3.5**	**1.5**

Secondary KDOW Sampling Data

AKGWA NUMB	SITE NUM	STANDARD N	NUM SAMPLE	NUM BELOW	UNITS	MAX VALUE	MAX VALUE	MAX VALUE Date	RECENT VAL	RECENT V 1	RECENT V 2	MEDIAN VAL
90002173	238090	Alachlor	1	1	mg/L		0.00	4/4/2001		0.00	4/4/2001	0.00
90002170	238094	Alachlor	15	15	mg/L	<	0.00	7/10/2002	<	0.00	4/2/2003	0.00
90002173	238090	Alkalinity	1	0	mg/L as CaCO3		277.00	4/4/2001		277.00	4/4/2001	277.00
90002170	238094	Alkalinity	15	0	mg/L as CaCO3		389.00	10/3/2001		290.00	4/2/2003	302.00
90002173	238090	Ammonia-Nitrogen	2	2	mg/L as N	<	0.02	4/4/2001	<	0.02	4/4/2001	0.00
90002170	238094	Ammonia-Nitrogen	25	4	mg/L as N		0.75	10/2/2002	<	0.04	4/2/2003	0.17
90002173	238090	Arsenic	2	2	mg/L	<	0.00	4/4/2001	<	0.00	4/4/2001	0.00
90002170	238094	Arsenic	24	21	mg/L		0.00	7/3/2001	<	0.00	4/2/2003	0.00
90002173	238090	Atrazine	2	2	mg/L	<	0.00	4/4/2001	<	0.00	4/4/2001	0.00
90002170	238094	Atrazine	30	8	mg/L		0.00	7/3/2001		0.00	4/2/2003	0.00
90002173	238090	Barium	2	0	mg/L		0.03	4/4/2001		0.03	4/4/2001	0.03
90002170	238094	Barium	30	0	mg/L		0.07	10/3/2001		0.06	4/2/2003	0.06
90002173	238090	Benzene	1	1	mg/L		0.00	4/4/2001		0.00	4/4/2001	0.00
90002170	238094	Benzene	11	11	mg/L	<	0.00	2/6/2002	<	0.00	4/2/2003	0.00
90002173	238090	Cadmium	2	2	mg/L	<	0.00	4/4/2001	<	0.00	4/4/2001	0.00
90002170	238094	Cadmium	24	24	mg/L	<	0.00	12/7/1999	<	0.00	4/2/2003	0.00
90002173	238090	Calcium	2	0	mg/L		57.90	4/4/2001		57.90	4/4/2001	57.50
90002170	238094	Calcium	30	0	mg/L		109.00	10/3/2001		94.90	4/2/2003	88.45
90002173	238090	Chloride	1	0	mg/L		3.30	4/4/2001		3.30	4/4/2001	3.30
90002170	238094	Chloride	15	0	mg/L		89.80	2/5/2003		83.00	4/2/2003	65.70
90002173	238090	Chromium	2	0	mg/L		0.01	4/4/2001		0.01	4/4/2001	0.01
90002170	238094	Chromium	24	21	mg/L		0.00	7/3/2001	<	0.00	4/2/2003	0.00
90002173	238090	Conductivity	2	0	µS/cm		490.00	4/4/2001		490.00	4/4/2001	245.00
90002170	238094	Conductivity	24	0	µS/cm		900.00	4/2/2003		900.00	4/2/2003	0.00
90002173	238090	Copper	2	2	mg/L	<	0.00	4/4/2001	<	0.00	4/4/2001	0.00
90002170	238094	Copper	25	16	mg/L		0.01	7/3/2001		0.00	4/2/2003	0.00
90002173	238090	Cyanazine	1	1	mg/L		0.00	4/4/2001		0.00	4/4/2001	0.00
90002170	238094	Cyanazine	15	15	mg/L	<	0.00	12/7/1999	<	0.00	4/2/2003	0.00
90002173	238090	Ethylbenzene	1	1	mg/L		0.00	4/4/2001		0.00	4/4/2001	0.00
90002170	238094	Ethylbenzene	11	11	mg/L	<	0.00	10/3/2001	<	0.00	4/2/2003	0.00
90002173	238090	Fluoride	1	0	mg/L		0.09	4/4/2001		0.09	4/4/2001	0.09
90002170	238094	Fluoride	15	1	mg/L		0.17	4/21/1999	<	0.02	4/2/2003	0.12
90002173	238090	Iron	2	1	mg/L		0.12	4/4/2001		0.12	4/4/2001	0.12
90002170	238094	Iron	30	8	mg/L		1.23	7/3/2001		0.12	4/2/2003	0.07
90002173	238090	Lead	2	2	mg/L	<	0.00	4/4/2001	<	0.00	4/4/2001	0.00

Secondary KDOW Sampling Data

AKGWA NUMB	SITE NUM	STANDARD N	NUM SAMPLE	NUM BELOW	UNITS	MAX VALUE	MAX VALUE	MAX VALUE Date	RECENT VAL	RECENT V 1	RECENT V 2	MEDIAN VAL
90002170	238094	Lead	25	24	mg/L		0.00	7/3/2001	<	0.00	4/2/2003	0.00
90002173	238090	Magnesium	2	0	mg/L		35.50	4/4/2001		35.50	4/4/2001	35.40
90002170	238094	Magnesium	30	0	mg/L		52.90	10/3/2001		49.60	4/2/2003	43.55
90002173	238090	Manganese	2	0	mg/L		0.01	4/4/2001		0.01	4/4/2001	0.01
90002170	238094	Manganese	30	0	mg/L		0.11	7/3/2001		0.03	4/2/2003	0.02
90002173	238090	Mercury	2	2	mg/L	<	0.00	4/4/2001	<	0.00	4/4/2001	0.00
90002170	238094	Mercury	23	23	mg/L	<	0.00	7/10/2002	<	0.00	4/2/2003	0.00
90002173	238090	Metolachlor	1	1	mg/L		0.00	4/4/2001		0.00	4/4/2001	0.00
90002170	238094	Metolachlor	15	2	mg/L		0.00	5/8/2002		0.00	4/2/2003	0.00
90002173	238090	Nitrate-Nitrogen	2	0	mg/L as N		2.60	4/4/2001		2.60	4/4/2001	1.60
90002170	238094	Nitrate-Nitrogen	25	0	mg/L as N		50.00	10/3/2001		10.00	4/2/2003	9.99
90002173	238090	Nitrite-Nitrogen	2	0	mg/L as N		0.00	4/4/2001		0.00	4/4/2001	0.00
90002170	238094	Nitrite-Nitrogen	24	4	mg/L as N		0.08	7/3/2001		0.02	2/5/2003	0.02
90002173	238090	Orthophosphate-Phosphorus	2	0	mg/L as P		0.00	4/4/2001		0.00	4/4/2001	0.00
90002170	238094	Orthophosphate-Phosphorus	24	3	mg/L as P		0.10	7/3/2001		0.00	2/5/2003	0.00
90002173	238090	pH	2	0	pH units		7.98	4/4/2001		7.98	4/4/2001	7.79
90002170	238094	pH	24	0	pH units		7.59	4/2/2003		7.59	4/2/2003	7.12
90002173	238090	Selenium	2	1	mg/L		0.00	4/4/2001		0.00	4/4/2001	0.00
90002170	238094	Selenium	24	22	mg/L		0.00	12/7/1999		0.00	4/2/2003	0.00
90002173	238090	Simazine	1	1	mg/L		0.00	4/4/2001		0.00	4/4/2001	0.00
90002170	238094	Simazine	15	14	mg/L		0.00	2/6/2002		0.00	4/2/2003	0.00
90002173	238090	Sodium	2	0	mg/L		4.50	4/4/2001		4.50	4/4/2001	4.43
90002170	238094	Sodium	30	0	mg/L		44.00	2/5/2003		38.20	4/2/2003	33.75
90002173	238090	Sulfate	1	0	mg/L		27.30	4/4/2001		27.30	4/4/2001	27.30
90002170	238094	Sulfate	15	0	mg/L		68.90	4/5/2001		64.10	4/2/2003	63.10
90002173	238090	Toluene	1	1	mg/L		0.00	4/4/2001		0.00	4/4/2001	0.00
90002170	238094	Toluene	11	11	mg/L	<	0.00	2/6/2002	<	0.00	4/2/2003	0.00
90002173	238090	Total Dissolved Solids	2	1	mg/L		316.00	4/4/2001		316.00	4/4/2001	316.00
90002170	238094	Total Dissolved Solids	30	4	mg/L		624.00	7/3/2001		540.00	4/2/2003	435.00
90002173	238090	Total Phosphorus	1	1	mg/L as P		0.10	4/4/2001		0.10	4/4/2001	0.00
90002170	238094	Total Phosphorus	15	4	mg/L as P		0.20	10/3/2001		0.00	4/2/2003	0.10
90002173	238090	Xylenes	2	2	mg/L	<	0.00	4/4/2001	<	0.00	4/4/2001	0.00
90002170	238094	Xylenes	22	22	mg/L	<	0.00	2/5/2003	<	0.00	4/2/2003	0.00

APPENDIX G
SECONDARY SRWW SAMPLING DATA

Secondary SRWW Sampling Data

Site ID	Time	Date	Fecal Coliform (cfu / 100 ml)	E. Coli (cfu / 100 ml)
S62		2002	2,800	453
S62	11:35	7/10/2004	4,000	
S62		11/2/2005		933
S62	8:10	7/14/2007		1,259
		Site Geometric Mean	**3,347**	**810**
S130		2002	7,100	1,091
S130	11:35	7/10/2004	20	
S130		11/2/2005		24,196
S130	7:40	7/8/2006		2,420
S130	8:10	7/14/2007		146
		Site Geometric Mean	**377**	**1,748**
S139	11:35	7/10/2004	2,640	
S139		11/2/2005		1,274
S139	8:35	7/14/2007		708
		Site Geometric Mean	**2,640**	**950**
S140	11:35	7/10/2004	1,360	
S140		11/2/2005		134
S140	7:50	7/14/2007		1,670
		Site Geometric Mean	**1,360**	**473**

Secondary SRWW Sampling Data

Site ID	Time	Date	DO (mg/l)	pH	Temp °C	Specific Conductance (µS/cm)
S25		9/1/1998				
Site Average						
S62		9/1/2000				749
S62		9/1/2001	6.6	7.8	14.5	784
S62	8:00	9/14/2002	3.8	7.9	20	939
S62	8:15	9/11/2004	6.8	7.7	17	906
S62		11/2/2005				539
S62		10/24/2006	7.8	7.8	16	593.5
S62	7:08	9/8/2007				1011
Site Average			**6.3**	**7.8**	**16.9**	**789**
S130	8:40	9/14/2002	20.0	8.0	20	406
S130	8:15	9/20/2003		5.5	15	315
S130		11/2/2005				303.3
S130		10/24/2006	8	7.5	16	316
S130	9:06	9/8/2007				279
Site Average			**14.0**	**7.0**	**17**	**324**
S139		11/2/2005				859
S139		10/24/2006	8	7.0	17	798
S139	7:40	9/8/2007				1019
Site Average			**8.0**	**7.0**	**17**	**892**
S140		11/2/2005				542
S140		10/24/2006	8.2	7.5	16	585.5
S140	8:00	9/8/2007				481
Site Average			**8.2**	**7.5**	**16**	**536**

Secondary SRWW Sampling Data

Site	Time	Date	$NO_3 + NO_2$ (mg/l)	NH_3 (mg/l)	TN (mg/l)	TP (mg/l)	TKN (mg/l)	TDS (mg/l)	Chloride (mg/l)	TSS (mg/l)	Hardness (mg/l)	DOC (mg/l)	SO_4 (mg/l)
S25		9/1/1998	21.10	0.050		1.910	2.590		113.0	11.0	280		67.9
Site Average			**21.10**										
S62		9/1/2000	8.07	0.093		1.35	1.00	601	97.3	16.8	308	6.3	
S62		9/1/2001	9.98	0.040		1.380	1.790	712	62.9	15.0	304	5.9	
S62	8:00	9/14/2002	17.90	0.07		3.30	1.49	764	124.0	4.7	256	6.1	
S62	8:15	9/11/2004	22.72	0.13	46.58	2.81	22.90		110.9	22.9	282		97.6
S62		11/2/2005	1.02	0.02		0.23	1.77		32.0	36.4	248		
S62		10/24/2006	0.85	0.02		0.19	1.65		28.1	15.9	268		65.9
S62	7:08	9/8/2007	27.12	0.05		4.91	41.06		118.8	60.9	280		122.9
Site Average			**12.52**	**0.06**	**46.58**	**2.02**	**10.24**	**692**	**82.0**	**24.7**	**278**	**6.1**	**95.5**
S130	8:40	9/14/2002	0.24	0.03		0.07	0.42	372	18.4	2.6	208	3.1	
S130	8:15	9/20/2003	0.35	0.07		0.13		234	11.1	131.8	170	6.2	
S130		11/2/2005	0.05	0.06		0.05	0.65		7.8	9.2	160		
S130		10/24/2006	0.31	0.09		0.05	0.91		8.6	18.9	152		15.2
S130	9:06	9/8/2007	0.01	0.03		0.02	0.35		11.8	37.1	144		17.1
Site Average			**0.19**	**0.06**		**0.06**	**0.58**	**303**	**11.5**	**39.9**	**167**	**4.6**	**16.2**
S139		11/2/2005	21.00	0.02		4.51	25.78		90.0	5.7	274		
S139		10/24/2006	18.48	0.03		2.45	23.47		82.7	4.2	274		90.2
S139	7:40	9/8/2007	34.93	0.04		4.53	50.18		115.7	5.9	288		122.4
Site Average			**24.80**	**0.03**		**3.83**	**33.15**		**96.2**	**5.3**	**279**		**106.3**
S140		11/2/2005	1.19	0.02		0.17	1.76		32.2	3	244		
S140		10/24/2006	0.96	0.02		0.18	1.71		28.6	3.3	266		46.8
S140	8:00	9/8/2007	0.03	0.22		0.16	0.82		30.2	64.1	214		47.2
Site Average			**0.73**	**0.08**		**0.17**	**1.43**		**30.3**	**23.5**	**241**		**47.0**

Secondary SRWW Sampling Data

Site ID	Time	Date	Rainfall	Flow	D.O.	pH	Temp	Conductivity	Triazines	Metolachlor	2,4-D
S62	7:00 AM	5/11/2002	0.00	3.0	8.0	8.0	14		0.08	0.1	Less Than MDL
S62	10:00 AM	5/17/2003	GW	5.0	7.5	7.5	17	250	1.8	0.17	5.32
S62	11:00 AM	5/14/2004	0.1	2	7.8	8	21	540	0.11	Less Than MDL	
S62		11/2/2005								0.56	0.45
S62		5/19/2007							0.14		0.91
Site Average					**7.8**	**7.7**	**17.3**	**395.0**	**0.5**	**0.3**	**2.2**
S130	11:30 AM	5/25/2004		3					0.07	0.08	
S130		11/2/2005								0.07	0.45
S130		5/19/2007							0.03		0.45
Site Average									**0.05**	**0.075**	**0.45**
S139	1:48 PM	5/13/2004	0.1	3	6.2	8	20	780	0.14	Less Than MDL	
S139		11/2/2005								0.08	0.45
S139		5/19/2007							0.17		0.45
Site Average											
S140	8:10 AM	5/15/2004	0.1	3	7.25	9	20	500	0.07	Less Than MDL	
S140		11/2/2005								0.45	0.45
S140		5/19/2007							0.11		0.45
Site Average					**7.25**	**9**	**20**	**500**	**0.09**	**0.45**	**0.45**

APPENDIX H
SECONDARY USGS SAMPLING DATA

Site	Site Name	USGS Site ID	Date	Time	Weather	Reference Point	Discharge (cfs)	Visible Bacteria Sources				Oil / Grease	Atm. Odor	Detergent Suds	Fish Kill	Floating Garbage	Floating Debris	Floating Algal Mats	Turbidity
	Parameter code						00061	Geese	Dogs	Human	Other	01300	01330	01305	01340	01320	01345	01325	01350
AR-1	Ashers Run at Abott Lane	03297875	7/31/2008	1125	WET				X		burro	0	0	0	0	0	0	0	2
AR-1	Ashers Run at Abott Lane	03297875	7/16/2008	1030	DRY	6.25			X			0	0	0	0	0	0	0	1
AR-1	Ashers Run at Abott Lane	03297875	6/23/2008	1310	DRY	6.24						0	0	0	0	0	0	0	0
AR-1	Ashers Run at Abott Lane	03297875	6/10/2008		DRY							0	0	0	0	0	0	0	0
AR-1	Ashers Run at Abott Lane	03297875	4/30/2008	1405	DRY	6.15					next to borrow pen (2 burrows)	0	0	1	0	0	1	1	0
AR-1	Ashers Run at Abott Lane	03297875	1/30/2008	1050	WET	0.6	8.43					0	0	0	0	0	0	0	2
AR-1	Ashers Run at Abott Lane	03297875	10/23/2007	1115	WET	4.82						0	0	0	0	0	0	0	0
AR-1	Ashers Run at Abott Lane	03297875	10/16/2007		WET							0	0	0	0	0	0	0	0
AR-1	Ashers Run at Abott Lane	03297875	9/20/2007	1135	DRY							0	0	0	0	0	0	0	0
AR-1	Ashers Run at Abott Lane	03297875	9/6/2007	1300	DRY							0	0	0	0	0	0	0	0
AR-1	Ashers Run at Abott Lane	03297875	8/14/2007		DRY							0	0	0	0	0	0	0	0
AR-1	Ashers Run at Abott Lane	03297875	7/31/2007	1350	DRY	0.05						0	0	0	0	0	0	0	0
AR-1	Ashers Run at Abott Lane	03297875	7/17/2007	1240	DRY	0.75						0	0	0	0	0	0	0	0
AR-1	Ashers Run at Abott Lane	03297875	6/25/2007	1315	WET	0.12						0	0	0	0	0	0	0	0
CF-1	Currys Fork at KY 1408	03297880	8/19/2008	1120	DRY	25.27						0	0	3	0	1	1	0	0
CF-1	Currys Fork at KY 1408	03297880	7/31/2008	1200	WET							0	0	0	0	0	0	0	3
CF-1	Currys Fork at KY 1408	03297880	7/16/2008	1140	DRY	25	4.3644					0	2	2	0	0	0	0	1
CF-1	Currys Fork at KY 1408	03297880	6/23/2008	1330	DRY	25.25						0	0	0	0	0	1	0	0
CF-1	Currys Fork at KY 1408	03297880	6/10/2008	1240	DRY	25.13					several dead crayfish	0	0	2	0	0	0	0	0
CF-1	Currys Fork at KY 1408	03297880	4/30/2008	1430	DRY	24.79						0	1	1	0	0	1	1	0
CF-1	Currys Fork at KY 1408	03297880	1/30/2008	1120	WET	24.15	84.7					0	0	0	0	0	0	0	2
CF-1	Currys Fork at KY 1408	03297880	10/23/2007	1410	WET	21.28						0	0	0	0	0	0	0	0
CF-1	Currys Fork at KY 1408	03297880	10/16/2007	1220	WET	25.1						0	0	0	0	0	0	0	0
CF-1	Currys Fork at KY 1408	03297880	9/20/2007	1155	DRY	15.28						0	0	1	0	0	1	0	0
CF-1	Currys Fork at KY 1408	03297880	9/6/2007	1315	DRY							0	0	0	0	0	0	0	0
CF-1	Currys Fork at KY 1408	03297880	8/14/2007	1120	DRY	25.28						0	0	1	0	0	1	0	1
CF-1	Currys Fork at KY 1408	03297880	7/31/2007	1440	DRY	25.22	2.06					0	0	0	0	0	0	0	0
CF-1	Currys Fork at KY 1408	03297880	7/17/2007	1325	DRY	23.03						0	0	1	0	0	1	2	1
CF-1	Currys Fork at KY 1408	03297880	6/25/2007	1335	WET	25.06						0	0	1	0	0	0	1	1
CF-1	Currys Fork at KY 1408	03297880	6/11/2007	1225	DRY	25.18						0	0	2	0	0	1	0	1
CF-1	Currys Fork at KY 1408	03297880	5/23/2007	1425	DRY	25.08						0	0	0	0	0	0	2	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	8/19/2008	0810	DRY	13.72						0	0	1	0	0	0	0	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	7/31/2008	0945	WET	12.95	30.3					0	0	0	0	0	0	0	3
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	7/16/2008	0800	DRY	13.6	3.1924					0	0	2	0	0	0	0	1
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	6/23/2008	1005	DRY	13.67						0	0	0	0	0	0	0	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	6/10/2008	900	DRY	13.93						0	0	1	0	0	0	0	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	4/30/2008	1000	DRY	13.56						0	0	1	0	0	0	1	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	1/29/2008	950	WET	13.6						0	0	0	0	0	0	0	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	10/24/2007	1410	WET	12.57						0	0	0	0	0	0	0	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	10/16/2007	1025	WET	13.67						0	0	0	0	0	0	0	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	9/20/2007	0830	DRY	13.73						0	0	0	0	0	0	0	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	9/6/2007	0935	DRY	13.72						0	0	0	0	0	0	0	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	8/14/2007	0750	DRY	13.78						0	0	0	0	0	0	0	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	7/31/2007	0950	DRY	13.78	1.487					0	0	0	0	0	0	0	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	7/17/2007	0910	DRY	13.7						0	0	0	0	0	0	0	0
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	6/25/2007	0935	WET	13.7						0	0	1	0	0	0	0	1
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	6/11/2007	0827	DRY	13.73			X	X		0	2	0	0	0	0	0	1
NFCF-1	North Fork Currys Fork at Stone Ridge Road	03297860	5/23/2007	1000	DRY	13.6						0	0	0	0	0	0	1	0

Site	Site Name	USGS Site ID	Date	Time	Weather	Reference Point	Discharge (cfs)	Visible Bacteria Sources				Oil / Grease	Atm. Odor	Detergent Suds	Fish Kill	Floating Garbage	Floating Debris	Floating Algal Mats	Turbidity
	Parameter code						00061	Geese	Dogs	Human	Other	01300	01330	01305	01340	01320	01345	01325	01350
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	8/19/2008	0930	DRY	4.02					baby snapping turtle near water	0	0	2	0	1	1	0	1
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	7/16/2008	0930	DRY	4.04	0.785					0	0	3	0	0	0	0	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	6/23/2008	1120	DRY	4						0	0	0	0	0	0	0	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	6/10/2008	1040	DRY	4					1 small dead fish on bank	0	0	0	0	0	0	0	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	4/30/2008	1118	DRY	3.92						0	0	1	0	0	0	1	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	1/29/2008	1245	WET							0	0	1	0	0	0	0	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	10/24/2007	1255	WET	2.76						0	0	0	0	0	0	0	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	10/16/2007	0920	WET	0.59						0	0	0	0	0	0	2	1
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	9/20/2007	1020	DRY	0.56						0	0	0	0	0	3	3	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	9/6/2007	1055	DRY	0.53						0	0	2	0	0	3	3	1
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	8/14/2007	0910	DRY	0.51						0	0	0	0	0	0	0	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	7/31/2007	1210	DRY	0.48	0.088					0	2	0	0	0	0	0	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	7/17/2007	1025	DRY	0.5						0	0	0	0	0	0	0	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	6/25/2007	1035	WET	0.52						0	0	0	0	0	0	0	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	6/11/2007	0955	DRY	0.51						0	0	0	0	0	0	0	0
SFCF-1	South Fork Currys Fork at Waino Drive	03297850	5/23/2007	1115	DRY							0	0	0	0	0	0	0	0
SFCF-2	South Fork Currys Fork at KY 393	03297855	8/19/2008	0855	DRY	14.5						1	0	0	0	0	1	0	0
SFCF-2	South Fork Currys Fork at KY 393	03297855	7/31/2008	1040	WET							0	0	0	0	0	0	0	2
SFCF-2	South Fork Currys Fork at KY 393	03297855	7/16/2008	0840	DRY	14.35						0	0	1	0	0	0	0	1
SFCF-2	South Fork Currys Fork at KY 393	03297855	6/23/2008	1050	DRY	14.4						0	0	0	0	0	0	0	0
SFCF-2	South Fork Currys Fork at KY 393	03297855	6/10/2008	1000	DRY	14.39					raccoon / oppos<m	0	0	0	0	0	1	0	0
SFCF-2	South Fork Currys Fork at KY 393	03297855	4/30/2008	1041	DRY	14.24						0	0	1	1	0	0	0	0
SFCF-2	South Fork Currys Fork at KY 393	03297855	1/29/2008	1100	WET	14.15						0	0	0	0	0	0	0	0
SFCF-2	South Fork Currys Fork at KY 393	03297855	10/24/2007	1015	WET	13.4						0	0	0	0	0	0	0	0
SFCF-2	South Fork Currys Fork at KY 393	03297855	10/16/2007	0955	WET	14.72						0	0	0	0	0	0	0	0
SFCF-2	South Fork Currys Fork at KY 393	03297855	9/20/2007	0920	DRY	14.6						1	0	0	0	0	0	0	1
SFCF-2	South Fork Currys Fork at KY 393	03297855	9/6/2007	1020	DRY	14.59						4	0	0	0	0	2	0	2
SFCF-2	South Fork Currys Fork at KY 393	03297855	8/14/2007	0840	DRY	14.64						0	0	0	0	0	2	0	1
SFCF-2	South Fork Currys Fork at KY 393	03297855	7/31/2007	1100	DRY	14.48	0.319					0	0	0	0	0	0	0	0
SFCF-2	South Fork Currys Fork at KY 393	03297855	7/17/2007	0950	DRY	14.34						0	0	0	0	0	0	0	1
SFCF-2	South Fork Currys Fork at KY 393	03297855	6/25/2007	1005	WET	14.44						0	0	0	0	0	0	0	1
SFCF-2	South Fork Currys Fork at KY 393	03297855	6/11/2007	0915	DRY	14.49			X			0	0	0	0	0	0	0	1
SFCF-2	South Fork Currys Fork at KY 393	03297855	5/23/2007	1035	DRY	14.42						0	0	0	0	0	1	2	0

NOTES
E = Estimated
TX = Exceeded holding time due to analyst error
PT = Improper preservative and exceeded holding time
D = Reanalyzed at higher dilution
T = Exceeded holding time
< = less than

Site	Date	Time	Weather	Water temp	DO	pH	Turbidity	Specific conductance	Air Temp	barometric pressure	CBOD	TSS	TOC	NH3	TKN	NO2 + NO3	TP	ORTHOP	Suspended Sediment	BOD	E. coli (cfu / 100ml)
				00010	**00300**	**00400**	**62398**	**00095**		**00025**	**80082**	**00530**	**00680**	**00608**	**00625**	**00631**	**00665**	**00671**	**80154**	**00310**	**90902**
AR-1	7/31/2008	1125	WET	22.45	7.42	7.93	109.6	245	23.26	743.3	3.43	77	7.86	0.0672	1.52	0.816	0.281	0.0978	3	5	21000
AR-1	7/16/2008	1030	DRY	21.4	7.25	8.03	7.9	401			< 2	6.5	5.2	E 0.0474	0.772	0.322	0.0696	E 0.0108	12	< 5	2600
AR-1	6/23/2008	1310	DRY	21.9	11.45	8.23	7.5	377	19.8	750.7	<T 2	16	3.8	E 0.0441	0.636	0.193	0.0654	< 0.01	11	< 5	>8000
AR-1	6/10/2008		DRY																		
AR-1	4/30/2008	1405	DRY	14.9	13.04	8.33	3	453	19	751	< 2	2.5	2.78	< 0.025	E 0.243	< 0.01	0.0214	E 0.0106	5		
AR-1	1/30/2008	1050	WET	-0.09	12	7.93	33.2	406		747	<QX 2	23	4.71	T 0.0543	0.654	1.13	0.116	0.0212	31		
AR-1	10/23/2007	1115	WET	16.88	8.82	7.68	84.6	225	15.88	739.5	2.89	79	8.73	< 0.025	1.02	1.72	0.356	0.184	126	< 5	9400
AR-1	10/16/2007		WET																		
AR-1	9/20/2007	1135	DRY																		
AR-1	9/6/2007	1300	DRY																		
AR-1	8/14/2007		DRY																		
AR-1	7/31/2007	1350	DRY	25.26		8.28	10.5	0.266	29.19	749.2	< 2	10.5	4.96	E 0.0342	E 0.425	0.171	0.045	E 0.0167	7	< 5	740
AR-1	7/17/2007	1240	DRY																		
AR-1	6/25/2007	1315	WET	24.74	3.62	8.22	15.8	433			< 2	15.5	5.49	E 0.0278	E 0.409	0.399	0.0683	< 0.01	25	< 5	390
Site Average				**18.43**	**9.09**	**8.08**	**34.0**	**318**	**21.43**	**746.8**	**2.29**	**28.8**	**5.44**	**0.041**	**0.710**	**0.595**	**0.128**	**0.045**	**28**	**5**	**3,253**
CF-1	8/19/2008	1120	DRY	18.31	6.59	8.05	0.2	799		750	< 2	4.5	4.44	< 0.025	< 0.2	D 14.6	0.9	D 0.673		< 5	330
CF-1	7/31/2008	1200	WET	22.8	7.41	7.98	460.1	225	23.36	744.8	3.31	278	6.45	E 0.0271	2.12	0.978	0.736	0.145	421	< 5	20000
CF-1	7/16/2008	1140	DRY	22.6	9.25	8.47	14	457			< 2	12	4.31	E 0.0272	1.04	1.59	0.366	0.16	11	< 5	440
CF-1	6/23/2008	1330	DRY	22.2	10	8.28	3.2	643	21.1		< 2	12	3.96	E 0.0441	0.629	D 5.79	0.494	0.314	12	< 5	310
CF-1	6/10/2008	1240	DRY	24.8	8.79	8.32	6.4	588			< 2	6	4.03	J 0.0385	0.554	3.05	0.262	0.16	7	< 5	260
CF-1	4/30/2008	1430	DRY	13.5	16.19	8.65	2	549	18.5	752	< 2	3.5	3.59	< 0.025	E 0.453	0.799	0.263	0.139	1		
CF-1	1/30/2008	1120	WET	0.6	13.5	8.05	76	417			-- --	72	4.86	TX 0.0831	0.85	1.31	0.194	0.0518	61		
CF-1	10/23/2007	1410	WET	16.64	9.03	7.8	385	292	14.31		2.67	200	7.71	0.0723	1.14	1.48	0.392	0.126	227	6	16000
CF-1	10/16/2007	1220	WET	16.48	7.2	7.51	6.9	872	17.5	748.5	2.22	TX 6.5	D 7.29	E 0.0373	< 0.2	D 12.9	1.62	D 1.22	3	< 5	3300
CF-1	9/20/2007	1155	DRY	17.86	10.07	8.05	6.2	916	25	751	< 2	5	D 5.46	E 0.0375	E 0.262	D 15.5	1.39	D 0.991	3	< 5	370
CF-1	9/6/2007	1315	DRY	22.63	9.93	8.14	4.8	800		751	< 2	10	D 5.18	E 0.0269	0.521	D 10	0.842	D 0.734	16	< 5	450
CF-1	8/14/2007	1120	DRY	21	9.19	7.9	7.5	599	28	749.1	< 2	7.5	4.91	E 0.0323	0.67	1.81	0.364	0.263	6	< 5	210
CF-1	7/31/2007	1440	DRY	25.42		8.56	8.8	0.609	29.92	748.9	< 2	8.5	5.13	E 0.0309	0.695	3.56	0.799	D 0.659	8	< 5	250
CF-1	7/17/2007	1325	DRY	23.4	12.08	8.36	9.2	581	25.1		< 2	10	PT 5.18	<PT 0.025	PT 0.622	PT 2.54	PT 0.378	0.197	7	22	214
CF-1	6/25/2007	1335	WET	23.85	11	8.39	12.3	536			< 2	15	4.91	< 0.025	0.767	1.55	0.367	0.21	15	< 5	430
CF-1	6/11/2007	1225	DRY	21.2	11.2	7.8		696	21.2	749.1	< 2	9	5.19	E 0.0337	0.637	1.91	0.315	0.173	9	< 5	450
CF-1	5/23/2007	1425	DRY	22.6	13.4	8.3		5.96		755.6	< 2	5.5	4.22	E 0.0284	0.653	1.27	0.141	--- ---	3	< 5	92
Site Average				**19.76**	**10.30**	**8.15**	**66.8**	**528**	**22.4**	**750.0**	**2.138**	**39.1**	**5.11**	**0.036**	**0.707**	**4.743**	**0.578**	**0.388**	**51**	**6.2**	**595**
NFCF-1	8/19/2008	0810	DRY	17.4	6.8	7.73	0.8	860			< 2	12	4.88	0.331	< 0.025	D 18.6	2.18	D 0.77		< 5	280
NFCF-1	7/31/2008	0945	WET	22.91	7.29	7.4	222	282	23.37	743	2.36	196	5.61	E 0.044	1.47	1.91	0.563	0.217	202	< 5	14000
NFCF-1	7/16/2008	0800	DRY	20.4	6.96	8.04	12.1	561			< 2	16	4.08	0.067	E 0.364	D 5.96	0.834	D 0.598	14	< 5	640
NFCF-1	6/23/2008	1005	DRY	18.2	8.28	7.81	8.2	875		748.5	<T 2	29	4.22	0.199	< 0.2	D 15.6	1.73	D 0.992	9	< 5	610
NFCF-1	6/10/2008	900	DRY	22.7	6.08	7.83	10.1	829			< 2	8.5	5.41	0.0615	< ND	D 17.5	1.51	D 1.14	7	< 5	600
NFCF-1	4/30/2008	1000	DRY	9.17	12.56	7.9	2	700	16	751	< 2	3.5	4.43	0.109	0.833	3.22	0.909	D 0.565	1		
NFCF-1	1/29/2008	950	WET	0.45	14.2	7.75	3.6	677	8	728.8	<QX 2	6	3.66	T 0.0827	0.674	D 4.95	0.609	D 0.473	6		
NFCF-1	10/24/2007	1410	WET	15.44	9.6	7.89	48	431			2.24	TX 25	5.89	0.271	1.27	1.23	0.199	0.0614	47	< 5	8500
NFCF-1	10/16/2007	1025	WET	16.35	6.87	7.36	4.6	937	16.55	742.9	2.01	TX 3	D 6.37	E 0.0388	< 0.2	D 28.3	3.61	D 2.1	2	< 5	2800
NFCF-1	9/20/2007	0830	DRY	16.49	6.51	7.56	3.5	1020	16.5	745.3	< 2	3	D 5.72	E 0.0448	< 0.2	D 29	3.83	D 2.84	3	< 5	1900
NFCF-1	9/6/2007	0935	DRY	21.28	6.61	7.52	5.3	1023	21.32	748.1	< 2	20	D 5.24	< 0.025	< 0.2	D 30	3.6	D 2.47	7	< 5	300
NFCF-1	8/14/2007	0750	DRY	19.94	6.02	6.78	10	985	20.5	745	< 2	13.5	5.43	1.21	< 0.2	D 23.5	3.07	D 1.89	11	< 5	2100
NFCF-1	7/31/2007	0950	DRY	21.16		7.8	14.1	0.721	25.9	748.5	< 2	13.5	4.78	E 0.0775	0.348	D 9.37	1.74	D 1.37	12	< 5	580
NFCF-1	7/17/2007	0910	DRY	20.43	8.34	7.48	12.9	942	22	744	< 2	19.5	D 4.9	E 0.0451	< 0.2	D 23.2	2.72	D 1.52	44	< 5	550
NFCF-1	6/25/2007	0935	WET	20.86	7.27	7.87		899	31	750	< 2	39	D 4.92	0.0562	< 0.2	D 16.9	2.34	D 1.58	17	< 5	E 918
NFCF-1	6/11/2007	0827	DRY	18.4	7.05	7.62		718	16.6	745.1	< 2	32	5.31	E 0.0348	0.767	D 9.09	1.31	D 0.898	30	< 4	580
NFCF-1	5/23/2007	1000	DRY	17.45	8.71	7.44		839		750.5	< 2	2.5	4.59	E 0.0364	< 0.2	D 10.7	1.05	--- ---	123	< 5	92
Site Average				**17.59**	**8.07**	**7.63**	**25.5**	**740**	**19.79**	**745.4**	**2.036**	**26.0**	**5.03**	**0.161**	**0.459**	**14.649**	**1.871**	**1.218**	**33**	**4.933**	**942**

Site	Date	Time	Weather	Water temp	DO	pH	Turbidity	Specific conductance	Air Temp	barometric pressure	CBOD	TSS	TOC	NH3	TKN	NO2 + NO3	TP	ORTHOP	Suspended Sediment	BOD	E. coli (cfu / 100ml)
				00010	**00300**	**00400**	**62398**	**00095**		**00025**	**80082**	**00530**	**00680**	**00608**	**00625**	**00631**	**00665**	**00671**	**80154**	**00310**	**90902**
SFCF-1	8/19/2008	0930	DRY	21.8	6.61	7	5	726	25.8	747	3.04	15.5	5.75	0.0826	1.59	D 10.6	1.87	D 1.11		< 5	12
SFCF-1	7/16/2008	0930	DRY	21.4	5.72	7.12	5.5	621	27.4	765	< 2	18.5	3.85	0.124	1.02	D 5.1	1.09	D 0.874	39	< 5	550
SFCF-1	6/23/2008	1120	DRY	22.3	6.1	7.05	5.5	723	21.1	749.2	T 2.94	19	5.98	1.51	2.79	D 7.64	2.69	D 2.01		5	10
SFCF-1	6/10/2008	1040	DRY	24.7	5.38	7.04	11.7	698			2.85	18	6.01	1.5	3.1	D 6.54	2.63	D 1.54	19	< 5	72
SFCF-1	4/30/2008	1118	DRY	11.3	12.35	7.85	3.3	522	16.6	749	2.32	14	4.17	1.2	2.65	3.71	1.17	D 0.886	6		
SFCF-1	1/29/2008	1245	WET	1.53	17.1	7.88	5.5	433	8.46	726	<QX 2	4.5	2.32	<T 0.025	< 0.2	1.78	0.276	0.164	18		
SFCF-1	10/24/2007	1255	WET	14.41	9.47	7.8	21.5	294	9.62	741.5	< 2	TX 16	7.56	< 0.025	0.555	1.39	0.265	0.203	14	< 5	3300
SFCF-1	10/16/2007	0920	WET	18.39	7.91	6.77	4.5	710											22	< 5	170
SFCF-1	9/20/2007	1020	DRY	20.9	6.21	7.47	21.9	591	19.1	747	2.57	8	4.5	0.059	1.92	D 5.36	1.73	D 1.19	7	< 5	100
SFCF-1	9/6/2007	1055	DRY	24.58	5.99	7.19	13.5	678	22.92	746.9	2.11	24	4.5	E 0.0407	1.21	D 5	1.99	D 1.59	5	< 5	12
SFCF-1	8/14/2007	0910	DRY	24.5	5.78	7.34	5.76	677	22.9		2.07	35	4.27	0.108	0.894	D 5.88	2.49	D 1.76	63	< 5	4
SFCF-1	7/31/2007	1210	DRY	24.55		7.18	2	615	24.92	746.3	< 2	7.5	4.17	E 0.0469	0.622	D 6.24	2.33	D 2	5	< 5	16
SFCF-1	7/17/2007	1025	DRY	24.56	6.58	7.3	2.6	645	23.56	744.4	< 2	15.5	PT 4.41	PT 0.0543	PT 0.714	PT 3.28	PT 2.7	D 1.57	7	< 5	E 28
SFCF-1	6/25/2007	1035	WET	23	5.61	7.3	20	672	24.1	749	< 2	5.5	4.49	0.324	1.04	0.708	3.4	D 2.49	18	< 5	56
SFCF-1	6/11/2007	0955	DRY	21.8	7.14	7.27		669	19	744.4	< 2	8	4.73	0.0707	0.958	1.23	3.32	D 2.04	14	< 4	314
SFCF-1	5/23/2007	1115	DRY	20.56	6.7	7.27		6.59		751.1	< 2	8	4.19	0.278	0.829	D 6.97	2.64	--- ---	9	< 5	1700
Site Average				**20.02**	**7.64**	**7.30**	**9.2**	**580**	**20.42**	**746.7**	**2.26**	**14.5**	**4.73**	**0.363**	**1.339**	**4.762**	**2.039**	**1.388**	**18**	**4.929**	**75**
SFCF-2	8/19/2008	0855	DRY	18.3	4.81	7.91	0	479	21.5	748	< 2	26.5	4.01	0.0625	0.714	0.302	0.0614	E 0.013		< 5	110
SFCF-2	7/31/2008	1040	WET	22.08	7.48	7.73	132.3	289	23.2	742.2	2.61	114	7.99	E 0.0424	1.57	0.919	0.304	0.0552	109	< 5	22000
SFCF-2	7/16/2008	0840	DRY	20.5	5.25	8.11	20	479	23.6	765	< 2	17	3.78	E 0.0355	0.694	0.444	0.108	0.0213	14	< 5	<4
SFCF-2	6/23/2008	1050	DRY	19.5	6.14	7.8	25	474	19.7	747.5	<T 2	35.5	3.75	0.0843	0.635	0.147	0.0816	< 0.01	12	< 5	720
SFCF-2	6/10/2008	1000	DRY	23.8	3.93	7.8	11.3	533			< 2	14	3.75	0.0854	0.507	0.222	0.106	0.0273	23	< 5	640
SFCF-2	4/30/2008	1041	DRY	10.13	10.76	7.82	2	498	16.5	749	< 2	1.5	2.9	< 0.025	E 0.348	0.0319	0.0266	0.0205	3		
SFCF-2	1/29/2008	1100	WET	0.16	19.2	7.85	2	523	8.23	728.7	<QX 2	5	2.09	<T 0.025	< 0.2	0.696	0.0595	0.0245	4		
SFCF-2	10/24/2007	1015	WET	14.78	9.27	7.86	36.7	299			< 2	TX 5	7.46	< 0.025	0.715	1.34	0.222	0.11	33	< 5	4300
SFCF-2	10/16/2007	0955	WET	15.75	5.19	7.06	14.6	616	15.95	742.1	3.45	TX 15	9.26	< 0.025	0.877	0.033	0.188	0.0505	11	< 5	56
SFCF-2	9/20/2007	0920	DRY	15.7	3.23	7.63	8.7	580	17.3	746.9	2.17	7.5	7.02	E 0.0357	0.776	E 0.0105	0.12	0.0285	10	< 5	250
SFCF-2	9/6/2007	1020	DRY	20.54	2.53	7.61	12.4	543	22.48	747.2	2.62	15	D 5.98	E 0.0362	0.91	0.0308	0.158	E 0.0146	18	< 5	28
SFCF-2	8/14/2007	0840	DRY	19.75	6.14	7.46	8.7	4.99	20.2		< 2	16	5.26	0.0841	0.776	0.0222	0.1	< 0.01	28	< 5	140
SFCF-2	7/31/2007	1100	DRY	21.8		7.83	20.2	0.515	24.05	747.3	< 2	16	4.53	0.0656	0.597	0.302	0.118	0.0444	17	< 5	450
SFCF-2	7/17/2007	0950	DRY	21.2	6.51	7.6	15.8	567	22.9	744	< 2	20	PT 4.24	0.0716	PT 0.547	PT 0.18	PT 0.0938	< 0.01	11	< 5	580
SFCF-2	6/25/2007	1005	WET	21.01	5.38	7.88	6.8	514	22.8	749.2	< 2	15	4.78	0.077	0.671	0.265	0.111	0.0219	8	< 5	550
SFCF-2	6/11/2007	0915	DRY	18.9	5.01	7.62		555	19.2	744.7	< 2	18.5	5.45	0.104	0.947	0.289	0.123	0.0242	20	< 4	461
SFCF-2	5/23/2007	1035	DRY	18.3	6.1	7.53		3.82		750.2	< 2	5.5	4	E 0.0424	0.721	0.0626	0.0515	--- ---	4	< 5	190
Site Average				**17.78**	**6.68**	**7.71**	**21.1**	**409**	**19.83**	**746.6**	**2.168**	**20.4**	**5.07**	**0.055**	**0.718**	**0.312**	**0.120**	**0.030**	**20**	**4.933**	**298**

NOTES

E = Estimated

TX = Exceeded holding time due to analyst error

PT = Improper preservative and exceeded holding time

D = Reanalyzed at higher dilution

T = Exceeded holding time

< = less than

APPENDIX I
ISCO UNIT WET WEATHER EVENT FLOW AND SAMPLING DATA

ISCO Wet Weather Event Data Event Triggering Summary

Event Date	NC1	TB1	CF2	SC1
November 22, 2007			1	
November 26, 2007	1	1		
December 9, 2007	1	1	1	
February 5, 2008		1	1	
February 12, 2008	1			
March 4, 2008		1		1
March 18, 2008	1	1	1	1
March 27, 2008	1	1	1	1
April 3, 2008	1			1
April 11, 2008			1	
May 3, 2008	1			
May 11, 2008	1			1
May 14, 2008	1	1		1
June 3, 2008		1		
July 31, 2008		1		
Total Events Sampled	**9**	**9**	**6**	**6**

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
NC1	1	11/26/2007	15:09	0:00	46.8	220	2,315	0
NC1	2	11/26/2007	15:59	0:50	261.2	410	24,064	10,991
NC1	3	11/26/2007	16:39	0:40	238.2	480	25,698	27,578
NC1	4	11/26/2007	17:24	0:45	262.4	370	21,816	45,396
NC1	5	11/26/2007	18:09	0:45	94.6	230	4,890	55,411
NC1	6	11/26/2007	18:54	0:45	36.2	170	1,381	57,763
NC1	7	11/26/2007	19:39	0:45	0.0	120	0	58,281
NC1	8	11/26/2007	20:24	0:45	2.4	86	46	58,298
NC1	9	11/26/2007	21:09	0:45	0.0	63	0	58,315
NC1	10	11/26/2007	21:54	0:45	1.3	45	13	58,320
NC1	11	11/26/2007	22:39	0:45	0.0	41	0	58,325
NC1	12	11/26/2007	23:24	0:45	0.0	36	0	58,325
NC1	13	11/27/2007	0:09	0:45	0.0	37	0	58,325
NC1	14	11/27/2007	0:54	0:45	0.0	26	0	58,325
NC1	15	11/27/2007	1:39	0:45	0.0	22	0	58,325
NC1	16	11/27/2007	2:24	0:45	0.0	24	0	58,325
NC1	17	11/27/2007	3:09	0:45	0.0	21	0	58,325
NC1	18	11/27/2007	3:54	0:45	0.5	19	2	58,326
NC1	19	11/27/2007	4:39	0:45	1.3	18	5	58,328
NC1	20	11/27/2007	5:24	0:45	0.0	18	0	58,330
NC1	21	11/27/2007	6:09	0:45	0.0	16	0	58,330
NC1	22	11/27/2007	6:54	0:45	2.8	16	10	58,334
NC1	23				0.0	0	0	58,334
NC1	24				0.0	0	0	58,334
Max					**262**	**480**	**25,698**	
Min					**0**	**0**	**0**	
Average					**39**	**104**	**3,343**	
Median					**0**	**37**	**0**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
NC1	1	12/9/2007	10:10	0:00	125.1	730	20,526	0
NC1	2	12/9/2007	10:55	0:45	385.7	840	72,804	34,999
NC1	3	12/9/2007	11:40	0:45	425.5	970	92,752	97,083
NC1	4	12/9/2007	12:25	0:45	194.6	560	24,492	141,049
NC1	5	12/9/2007	13:10	0:45	156.4	480	16,873	156,561
NC1	6	12/9/2007	13:55	0:45	205.5	240	11,082	167,044
NC1	7	12/9/2007	14:40	0:45	328.0	460	33,906	183,915
NC1	8	12/9/2007	15:25	0:45	512.2	630	72,525	223,826
NC1	9	12/9/2007	16:10	0:45	619.8	790	110,040	292,288
NC1	10	12/9/2007	16:55	0:45	427.3	520	49,932	352,278
NC1	11	12/9/2007	17:40	0:45	286.9	270	17,409	377,531
NC1	12	12/9/2007	18:25	0:45	191.9	200	8,625	387,294
NC1	13	12/9/2007	19:10	0:45	231.7	130	6,768	393,067
NC1	14	12/9/2007	19:55	0:45	28.1	100	631	395,841
NC1	15	12/9/2007	20:40	0:45	0.0	86	0	396,078
NC1	16	12/9/2007	21:25	0:45	15.4	68	235	396,166
NC1	17	12/9/2007	22:10	0:45	0.0	63	0	396,254
NC1	18	12/9/2007	22:55	0:45	0.0	63	0	396,254
NC1	19	12/9/2007	23:40	0:45	0.0	52	0	396,254
NC1	20	12/10/2007	0:25	0:45	0.0	63	0	396,254
NC1	21	12/10/2007	1:10	0:45	0.0	51	0	396,254
NC1	22	12/10/2007	1:55	0:45	0.0	41	0	396,254
NC1	23	12/10/2007	2:40	0:45	0.0	41	0	396,254
NC1	24	12/10/2007	3:25	0:45	0.0	36	0	396,254
Max					**620**	**970**	**110,040**	
Min					**0**	**36**	**0**	
Average					**172**	**312**	**22,442**	
Median					**141**	**165**	**7,697**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
NC1	1	2/12/2008	13:36	0:00	13.1	490	1,448	0
NC1	2	2/12/2008	13:46	0:10	0.1	170	3	121
NC1	3	2/12/2008	13:56	0:10	1.0	170	38	124
NC1	4	2/12/2008	14:06	0:10	32.5	160	1,168	225
NC1	5	2/12/2008	14:16	0:10	73.9	160	2,656	544
NC1	6	2/12/2008	14:26	0:10	21.1	160	759	828
NC1	7	2/12/2008	14:36	0:10	0.0	160	0	891
NC1	8	2/12/2008	14:46	0:10	0.6	160	23	893
NC1	9	2/12/2008	14:56	0:10	7.0	160	250	916
NC1	10	2/12/2008	15:06	0:10	5.7	150	192	953
NC1	11	2/12/2008	15:16	0:10	0.0	160	1	969
NC1	12	2/12/2008	15:26	0:10	0.3	140	9	970
NC1	13	2/12/2008	15:36	0:10	0.5	150	18	972
NC1	14	2/12/2008	15:46	0:10	0.7	140	22	976
NC1	15	2/12/2008	15:56	0:10	0.2	130	6	978
NC1	16	2/12/2008	16:06	0:10	0.0	130	0	978
NC1	17	2/12/2008	16:16	0:10	0.0	120	0	978
NC1	18	2/12/2008	16:26	0:10	0.0	120	0	978
NC1	19	2/12/2008	16:36	0:10	0.0	110	0	978
NC1	20	2/12/2008	16:46	0:10	1.7	110	43	982
NC1	21	2/12/2008	16:56	0:10	19.1	110	471	1,025
NC1	22	2/12/2008	17:06	0:10	15.6	100	350	1,093
NC1	23	2/12/2008	17:16	0:10	0.0	92	0	1,122
NC1	24	2/12/2008	17:26	0:10	0.0	92	0	1,122
Max					**74**	**490**	**2,656**	
Min					**0**	**92**	**0**	
Average					**8**	**152**	**311**	
Median					**1**	**145**	**20**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
NC1	1	3/18/2008	8:46	0:00	94.3	540	11,441	0
NC1	2	3/18/2008	8:56	0:10	80.1	550	9,907	1,779
NC1	3	3/18/2008	9:06	0:10	154.8	680	23,655	4,576
NC1	4	3/18/2008	9:16	0:10	285.7	740	47,512	10,506
NC1	5	3/18/2008	9:26	0:10	390.3	690	60,523	19,509
NC1	6	3/18/2008	9:36	0:10	464.6	760	79,347	31,165
NC1	7	3/18/2008	9:46	0:10	514.0	810	93,564	45,575
NC1	8	3/18/2008	9:56	0:10	521.9	820	96,170	61,386
NC1	9	3/18/2008	10:06	0:10	531.5	750	89,578	76,865
NC1	10	3/18/2008	10:16	0:10	540.7	620	75,346	90,608
NC1	11	3/18/2008	10:26	0:10	536.9	610	73,599	103,020
NC1	12	3/18/2008	10:36	0:10	535.1	580	69,749	114,966
NC1	13	3/18/2008	10:46	0:10	535.5	530	63,789	126,094
NC1	14	3/18/2008	10:56	0:10	543.2	520	63,484	136,700
NC1	15	3/18/2008	11:06	0:10	553.5	510	63,436	147,277
NC1	16	3/18/2008	11:16	0:10	566.3	500	63,635	157,866
NC1	17	3/18/2008	11:26	0:10	587.4	480	63,369	168,450
NC1	18	3/18/2008	11:36	0:10	609.7	480	65,773	179,212
NC1	19	3/18/2008	11:46	0:10	633.3	530	75,431	190,979
NC1	20	3/18/2008	11:56	0:10	661.3	420	62,417	202,466
NC1	21	3/18/2008	12:06	0:10	680.9	470	71,924	213,661
NC1	22	3/18/2008	12:16	0:10	688.6	430	66,543	225,200
NC1	23	3/18/2008	12:26	0:10	638.3	510	73,163	236,842
NC1	24	3/18/2008	12:36	0:10	654.8	510	75,053	249,193
Max					**689**	**820**	**96,170**	
Min					**80**	**420**	**9,907**	
Average					**500**	**585**	**64,100**	
Median					**539**	**535**	**66,158**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
NC1	1	3/27/2008	0:24	0:00	121.4	410	11,184	0
NC1	2	3/27/2008	0:34	0:10	181.1	350	14,243	2,119
NC1	3	3/27/2008	0:44	0:10	237.5	360	19,219	4,907
NC1	4	3/27/2008	0:54	0:10	273.5	350	21,513	8,302
NC1	5	3/27/2008	1:04	0:10	280.9	340	21,460	11,883
NC1	6	3/27/2008	1:14	0:10	248.7	340	19,004	15,255
NC1	7	3/27/2008	1:24	0:10	354.3	410	32,644	19,559
NC1	8	3/27/2008	1:34	0:10	422.9	410	38,970	25,527
NC1	9	3/27/2008	1:44	0:10	413.2	430	39,934	32,102
NC1	10	3/27/2008	1:54	0:10	452.0	400	40,629	38,815
NC1	11	3/27/2008	2:04	0:10	475.9	410	43,847	45,855
NC1	12	3/27/2008	2:14	0:10	469.5	390	41,147	52,938
NC1	13	3/27/2008	2:24	0:10	487.5	400	43,828	60,019
NC1	14	3/27/2008	2:34	0:10	499.6	400	44,909	67,414
NC1	15	3/27/2008	2:44	0:10	498.4	380	42,567	74,704
NC1	16	3/27/2008	2:54	0:10	490.2	320	35,256	81,189
NC1	17	3/27/2008	3:04	0:10	491.7	340	37,568	87,258
NC1	18	3/27/2008	3:14	0:10	508.7	290	33,155	93,151
NC1	19	3/27/2008	3:24	0:10	485.5	270	29,462	98,369
NC1	20	3/27/2008	3:34	0:10	471.0	290	30,696	103,382
NC1	21	3/27/2008	3:44	0:10	476.1	270	28,889	108,348
NC1	22	3/27/2008	3:54	0:10	500.8	240	27,011	113,006
NC1	23	3/27/2008	4:04	0:10	508.5	240	27,425	117,542
NC1	24	3/27/2008	4:14	0:10	487.4	220	24,099	121,836
Max					**509**	**430**	**44,909**	
Min					**121**	**220**	**11,184**	
Average					**410**	**344**	**31,194**	
Median					**473**	**350**	**31,670**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
NC1	1	4/3/2008	22:35	0:00	126.2	940	26,652	0
NC1	2	4/3/2008	22:50	0:15	252.9	2,500	142,095	21,093
NC1	3	4/3/2008	23:05	0:15	414.3	2,300	214,136	65,622
NC1	4	4/3/2008	23:20	0:15	570.9	2,000	256,621	124,467
NC1	5	4/3/2008	23:35	0:15	666.7	2,400	359,573	201,491
NC1	6	4/3/2008	23:50	0:15	681.7	1,900	291,090	282,824
NC1	7	4/4/2008	0:05	0:15	714.4	1,800	288,993	355,334
NC1	8	4/4/2008	0:20	0:15	753.2	1,600	270,841	425,313
NC1	9	4/4/2008	0:35	0:15	727.5	1,400	228,902	487,781
NC1	10	4/4/2008	0:50	0:15	703.1	1,100	173,811	538,120
NC1	11	4/4/2008	1:05	0:15	698.2	1,000	156,922	579,462
NC1	12	4/4/2008	1:20	0:15	674.6	790	119,764	614,048
NC1	13	4/4/2008	1:35	0:15	699.7	560	88,054	640,025
NC1	14	4/4/2008	1:50	0:15	651.1	460	67,312	659,446
NC1	15	4/4/2008	2:05	0:15	620.1	420	58,529	675,176
NC1	16	4/4/2008	2:20	0:15	528.5	330	39,194	687,391
NC1	17	4/4/2008	2:35	0:15	263.7	350	20,746	694,884
NC1	18	4/4/2008	2:50	0:15	562.2	320	40,432	702,531
NC1	19	4/4/2008	3:05	0:15	547.1	300	36,890	712,196
NC1	20	4/4/2008	3:20	0:15	506.7	310	35,299	721,220
NC1	21	4/4/2008	3:35	0:15	685.0	310	47,721	731,597
NC1	22	1/0/1900	3:50	0:00	715.8	0	0	731,597
NC1	23	1/0/1900	4:05	0:00	458.0	0	0	731,597
NC1	24	1/0/1900	4:20	0:00	243.2	0	0	731,597
Max					**753**	**2,500**	**359,573**	
Min					**126**	**0**	**0**	
Average					**561**	**962**	**123,482**	
Median					**636**	**675**	**77,683**	

ISCO Wet Weather Event Data

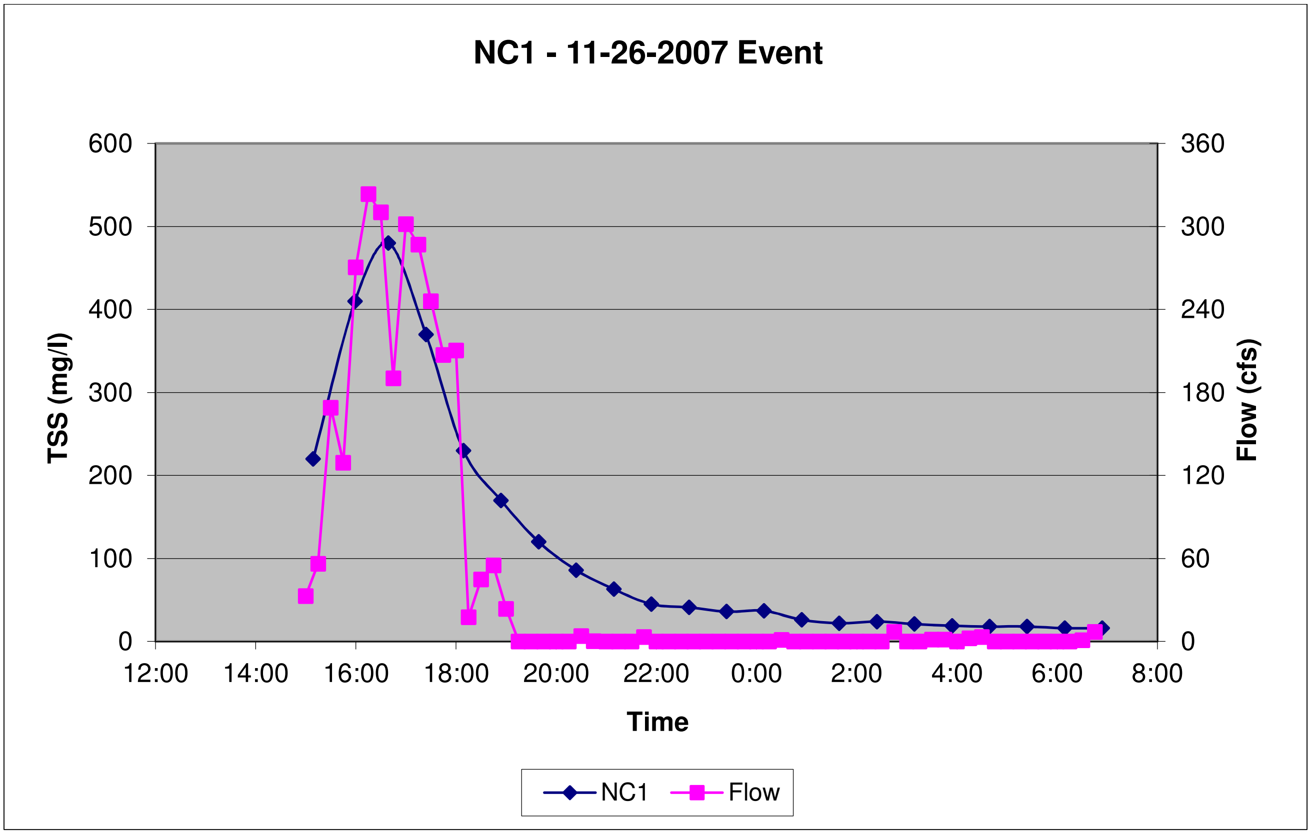
Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
NC1	1	5/3/2008	2:35	0:00	139.6	460	14,437	0
NC1	2	5/3/2008	2:45	0:10	185.2	530	22,059	3,041
NC1	3	5/3/2008	2:55	0:10	249.6	630	35,342	7,825
NC1	4	5/3/2008	3:05	0:10	299.3	620	41,706	14,245
NC1	5	5/3/2008	3:15	0:10	334.3	660	49,587	21,853
NC1	6	5/3/2008	3:25	0:10	353.1	670	53,172	30,417
NC1	7	5/3/2008	3:35	0:10	376.7	690	58,414	39,715
NC1	8	5/3/2008	3:45	0:10	405.0	650	59,164	49,514
NC1	9	5/3/2008	3:55	0:10	415.3	630	58,806	59,344
NC1	10	5/3/2008	4:05	0:10	405.9	580	52,909	68,654
NC1	11	5/3/2008	4:15	0:10	376.7	550	46,564	76,943
NC1	12	5/3/2008	4:25	0:10	360.7	540	43,775	84,472
NC1	13	5/3/2008	4:35	0:10	338.7	490	37,293	91,227
NC1	14	5/3/2008	4:45	0:10	310.5	440	30,708	96,894
NC1	15	5/3/2008	4:55	0:10	300.4	410	27,677	101,759
NC1	16	5/3/2008	5:05	0:10	287.7	380	24,573	106,114
NC1	17	5/3/2008	5:15	0:10	272.7	850	52,088	112,502
NC1	18	5/3/2008	5:25	0:10	255.3	320	18,362	118,373
NC1	19	5/3/2008	5:35	0:10	244.3	290	15,922	121,230
NC1	20	5/3/2008	5:45	0:10	239.6	270	14,538	123,768
NC1	21	5/3/2008	5:55	0:10	232.0	250	13,034	126,066
NC1	22	5/3/2008	6:05	0:10	227.3	240	12,257	128,173
NC1	23	5/3/2008	6:15	0:10	225.4	240	12,157	130,208
NC1	24	5/3/2008	6:25	0:10	224.9	480	24,261	133,243
Max					**415**	**850**	**59,164**	
Min					**140**	**240**	**12,157**	
Average					**294**	**495**	**34,117**	
Median					**294**	**510**	**33,025**	

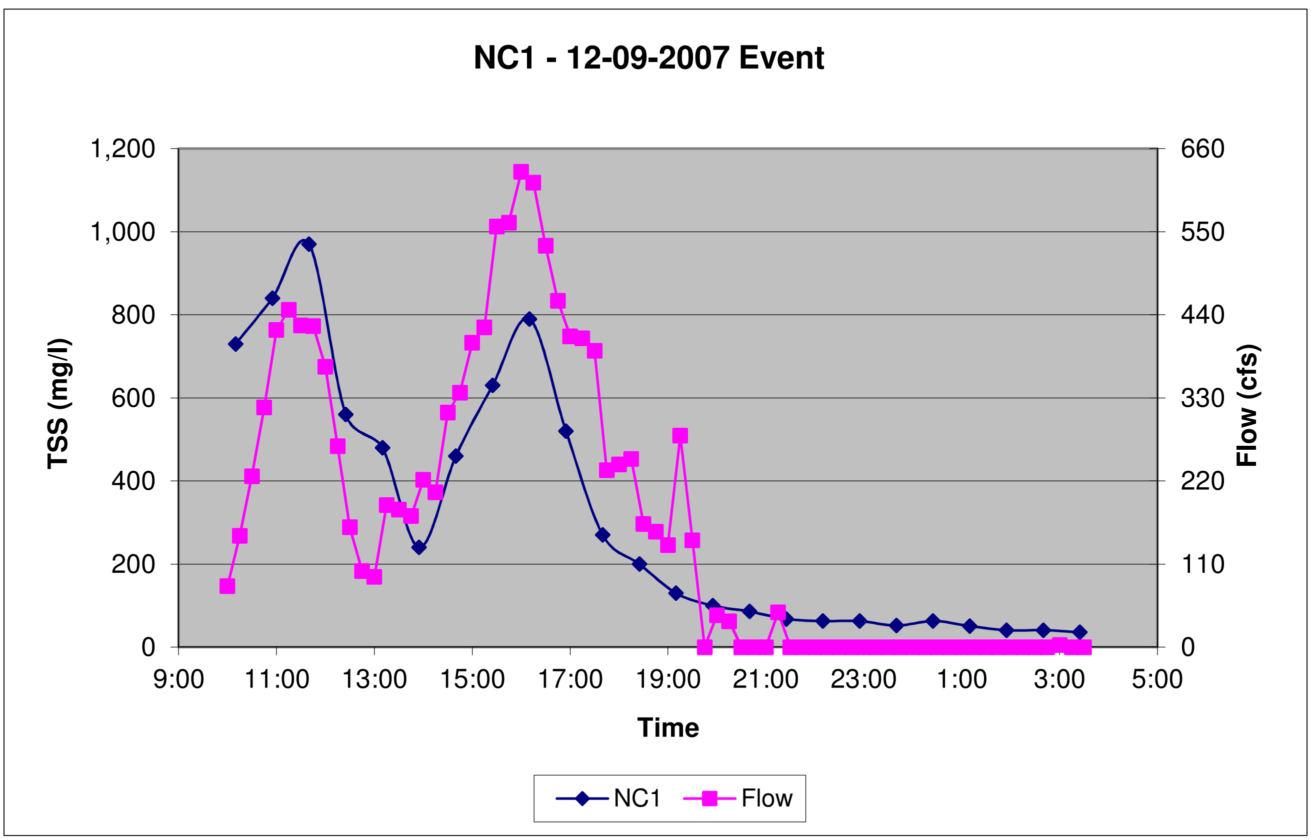
ISCO Wet Weather Event Data

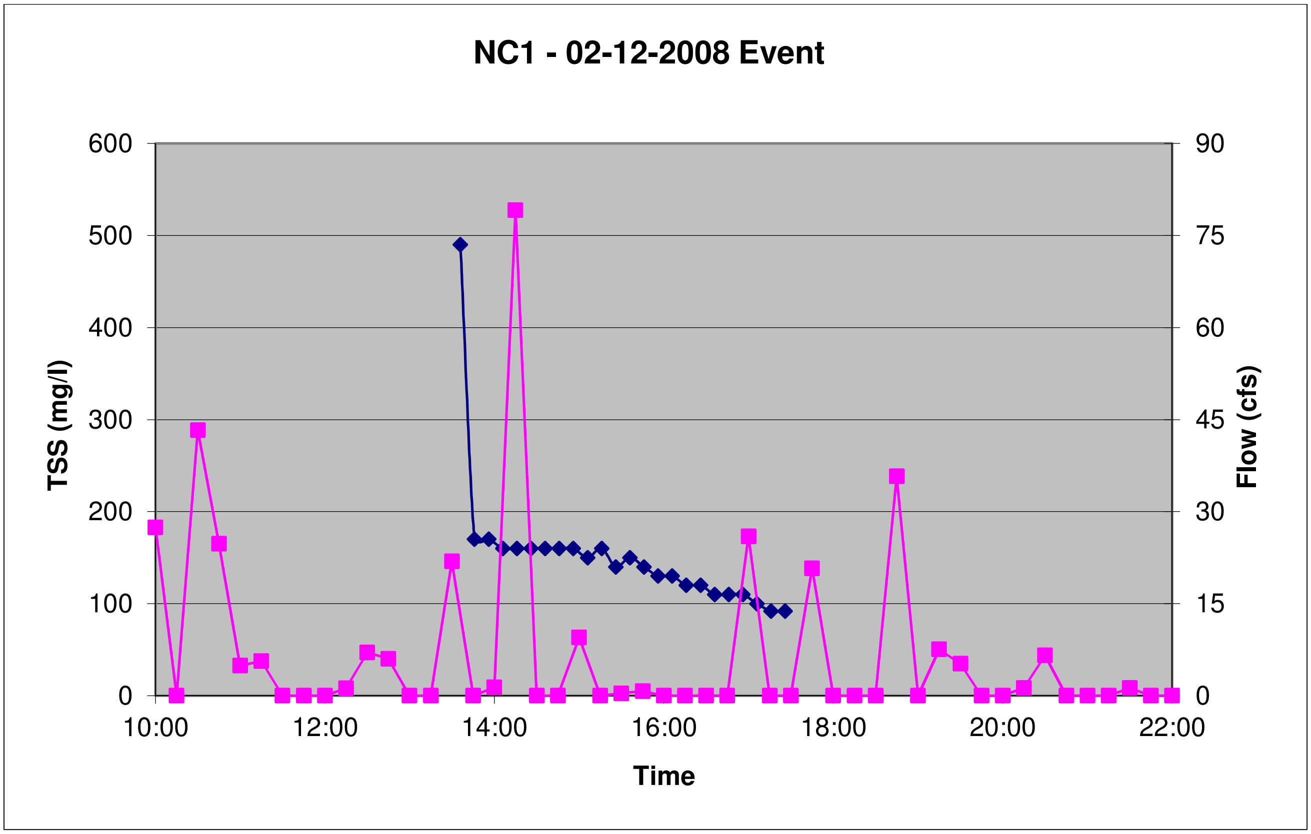
Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
NC1	1	5/11/2008	7:35	0:00	146.3	520	17,096	0
NC1	2	5/11/2008	7:45	0:10	170.1	530	20,260	3,113
NC1	3	5/11/2008	7:55	0:10	186.2	450	18,828	6,370
NC1	4	5/11/2008	8:05	0:10	205.5	400	18,476	9,479
NC1	5	5/11/2008	8:15	0:10	228.1	430	22,047	12,856
NC1	6	5/11/2008	8:25	0:10	249.8	520	29,193	17,126
NC1	7	5/11/2008	8:35	0:10	283.2	700	44,555	23,272
NC1	8	5/11/2008	8:45	0:10	328.4	750	55,348	31,597
NC1	9	5/11/2008	8:55	0:10	358.1	810	65,186	41,641
NC1	10	5/11/2008	9:05	0:10	383.6	890	76,732	53,468
NC1	11	5/11/2008	9:15	0:10	405.0	960	87,374	67,143
NC1	12	5/11/2008	9:25	0:10	401.1	960	86,531	81,635
NC1	13	5/11/2008	9:35	0:10	392.5	850	74,982	95,095
NC1	14	5/11/2008	9:45	0:10	379.3	570	48,591	105,393
NC1	15	5/11/2008	9:55	0:10	358.6	450	36,268	112,464
NC1	16	5/11/2008	10:05	0:10	331.3	680	50,633	119,706
NC1	17	5/11/2008	10:15	0:10	297.4	670	44,784	127,658
NC1	18	5/11/2008	10:25	0:10	271.1	580	35,340	134,335
NC1	19	5/11/2008	10:35	0:10	250.1	600	33,729	140,090
NC1	20	5/11/2008	10:45	0:10	234.5	600	31,615	145,536
NC1	21	5/11/2008	10:55	0:10	217.9	550	26,936	150,415
NC1	22	5/11/2008	11:05	0:10	205.1	520	23,970	154,657
NC1	23	5/11/2008	11:15	0:10	196.0	520	22,910	158,564
NC1	24	5/11/2008	11:25	0:10	189.1	490	20,820	162,208
Max					**405**	**960**	**87,374**	
Min					**146**	**400**	**17,096**	
Average					**278**	**625**	**41,342**	
Median					**261**	**575**	**34,534**	

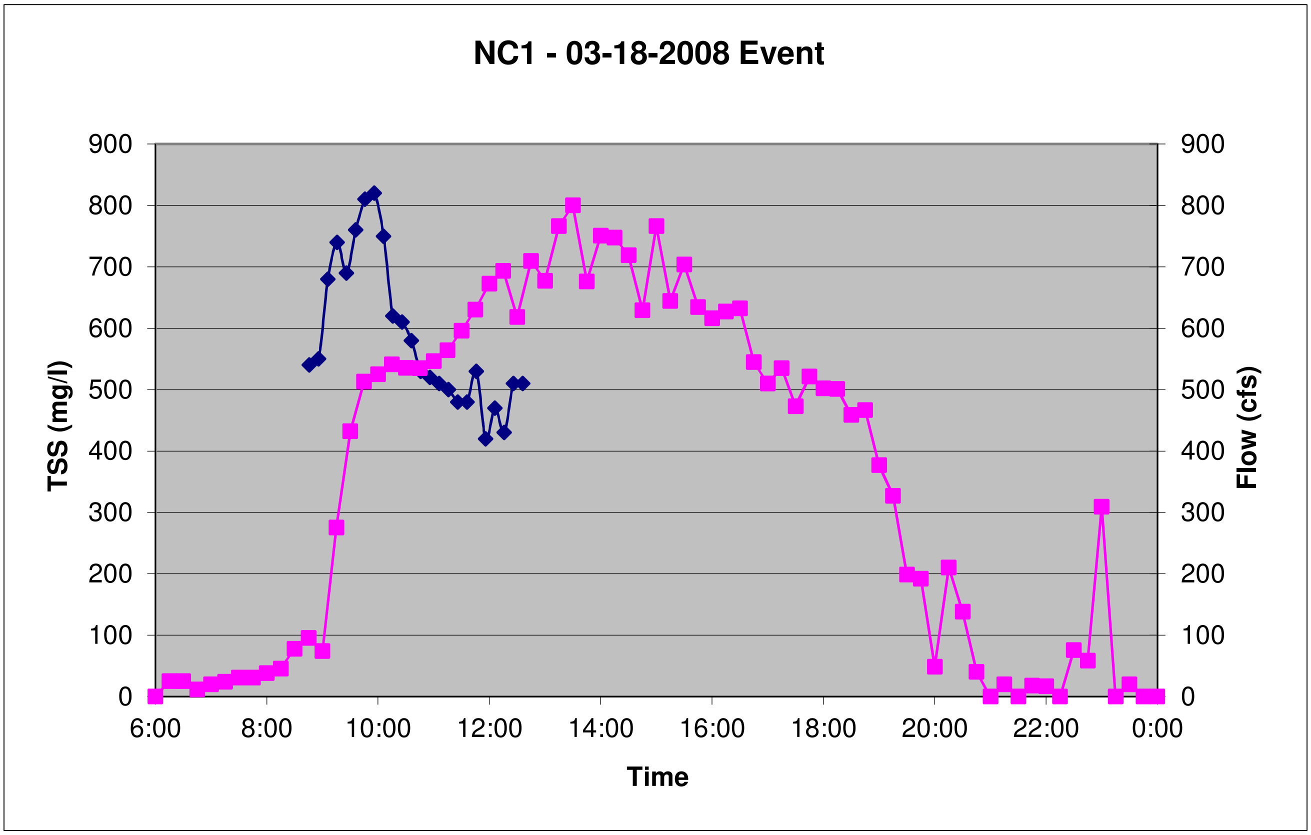
ISCO Wet Weather Event Data

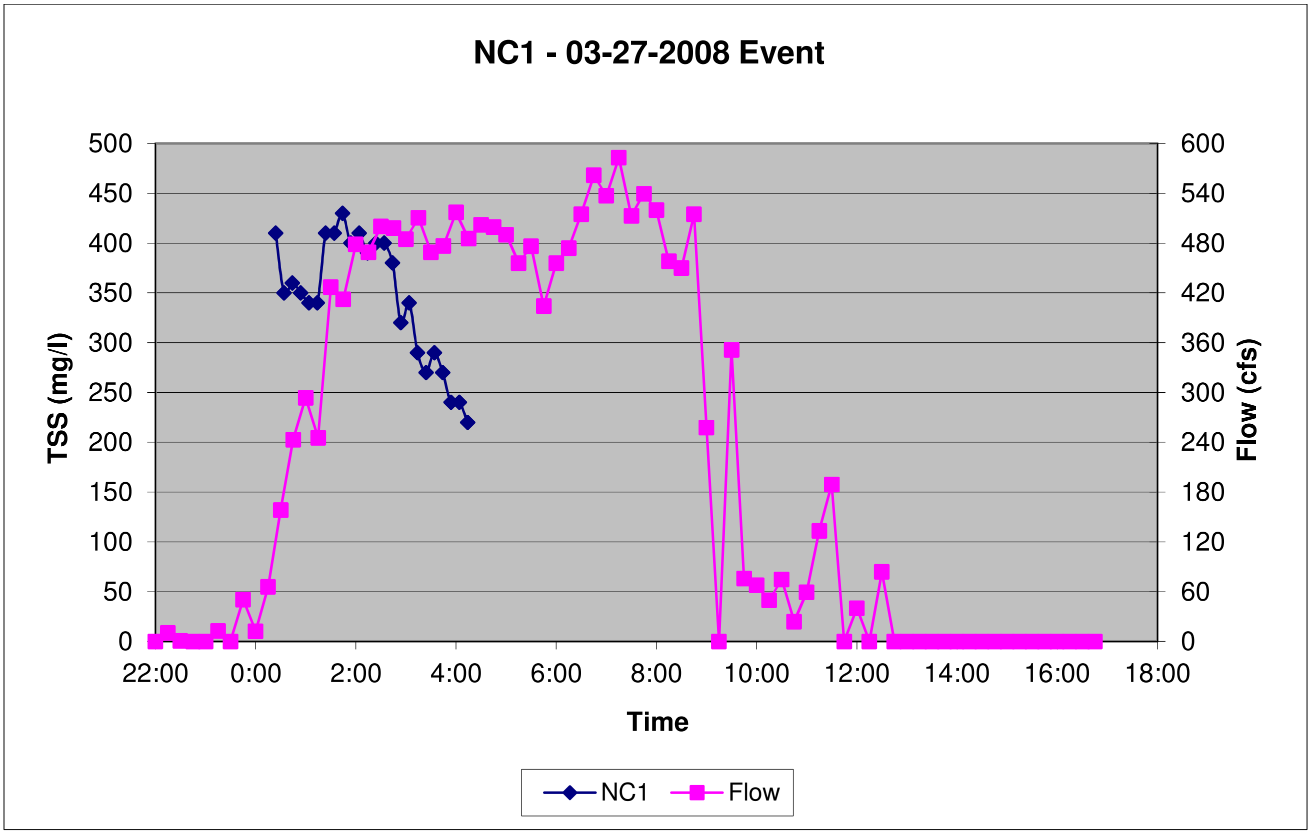
Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
NC1	1	5/14/2008	9:21	0:00	147.8	170	5,649	0
NC1	2	5/14/2008	9:31	0:10	189.3	190	8,085	1,144
NC1	3	5/14/2008	9:41	0:10	203.5	180	8,231	2,504
NC1	4	5/14/2008	9:51	0:10	207.3	210	9,785	4,005
NC1	5	5/14/2008	10:01	0:10	205.0	170	7,832	5,473
NC1	6	5/14/2008	10:11	0:10	208.5	200	9,373	6,907
NC1	7	5/14/2008	10:21	0:10	206.4	190	8,815	8,423
NC1	8	5/14/2008	10:31	0:10	200.8	180	8,122	9,834
NC1	9	5/14/2008	10:41	0:10	196.5	210	9,272	11,284
NC1	10	5/14/2008	10:51	0:10	191.5	180	7,747	12,702
NC1	11	5/14/2008	11:01	0:10	186.4	180	7,540	13,976
NC1	12	5/14/2008	11:11	0:10	183.7	180	7,431	15,223
NC1	13	5/14/2008	11:21	0:10	179.9	170	6,874	16,415
NC1	14	5/14/2008	11:31	0:10	175.2	180	7,089	17,579
NC1	15	5/14/2008	11:41	0:10	169.0	170	6,457	18,708
NC1	16	5/14/2008	11:51	0:10	160.7	160	5,779	19,728
NC1	17	5/14/2008	12:01	0:10	151.5	160	5,448	20,663
NC1	18	5/14/2008	12:11	0:10	146.4	150	4,934	21,528
NC1	19	5/14/2008	12:21	0:10	139.7	140	4,397	22,306
NC1	20	5/14/2008	12:31	0:10	132.4	130	3,869	22,995
NC1	21	5/14/2008	12:41	0:10	127.6	120	3,442	23,604
NC1	22	5/14/2008	12:51	0:10	121.9	120	3,287	24,165
NC1	23	5/14/2008	13:01	0:10	116.1	110	2,869	24,678
NC1	24	5/14/2008	13:11	0:10	115.9	120	3,125	25,177
Max					**209**	**210**	**9,785**	
Min					**116**	**110**	**2,869**	
Average					**169**	**165**	**6,477**	
Median					**178**	**170**	**6,981**	

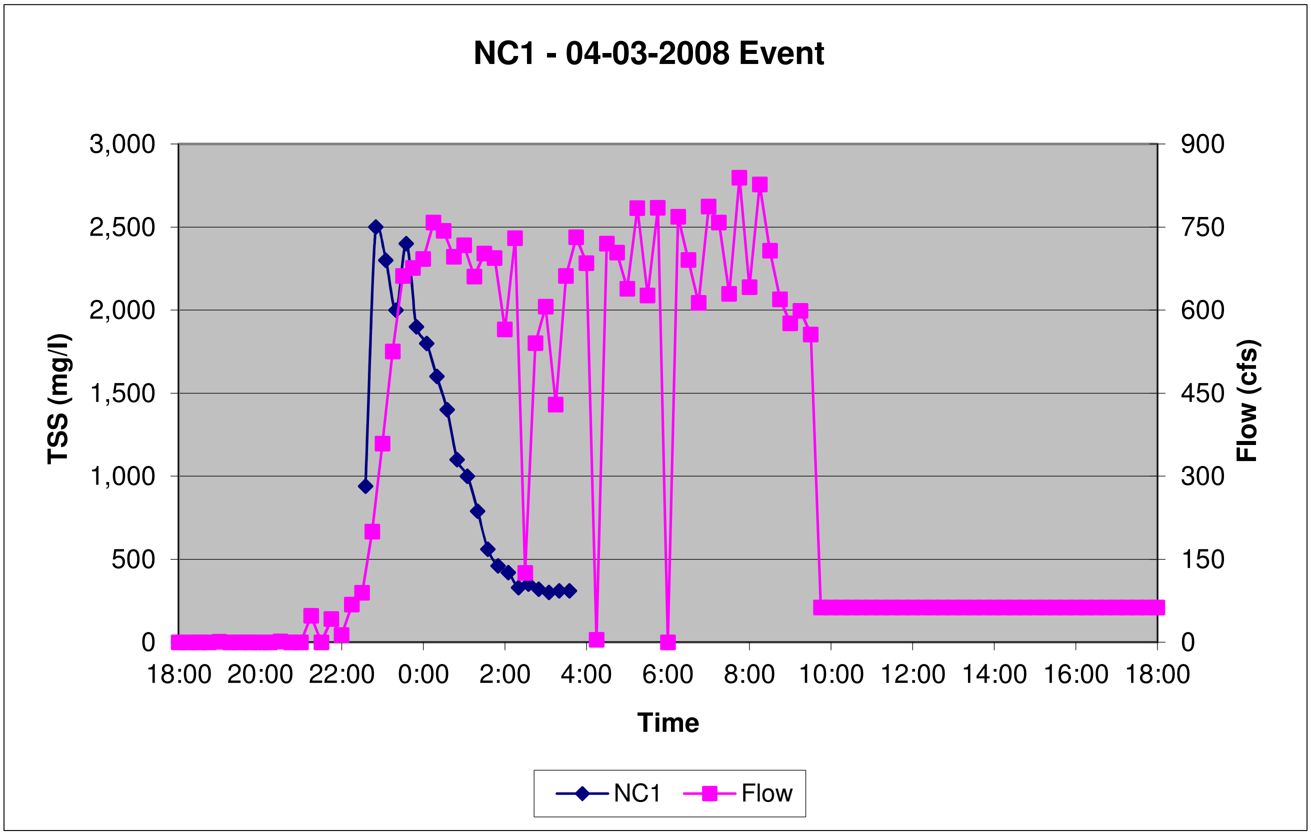

NC1 - 11-26-2007 Event
TSS (mg/l)
Flow (cfs)
600
500
400
300
200
100
0
360
300
240
180
120
60
0
12:00
14:00
16:00
18:00
20:00
22:00
0:00
2:00
4:00
6:00
8:00
Time
NC1
Flow

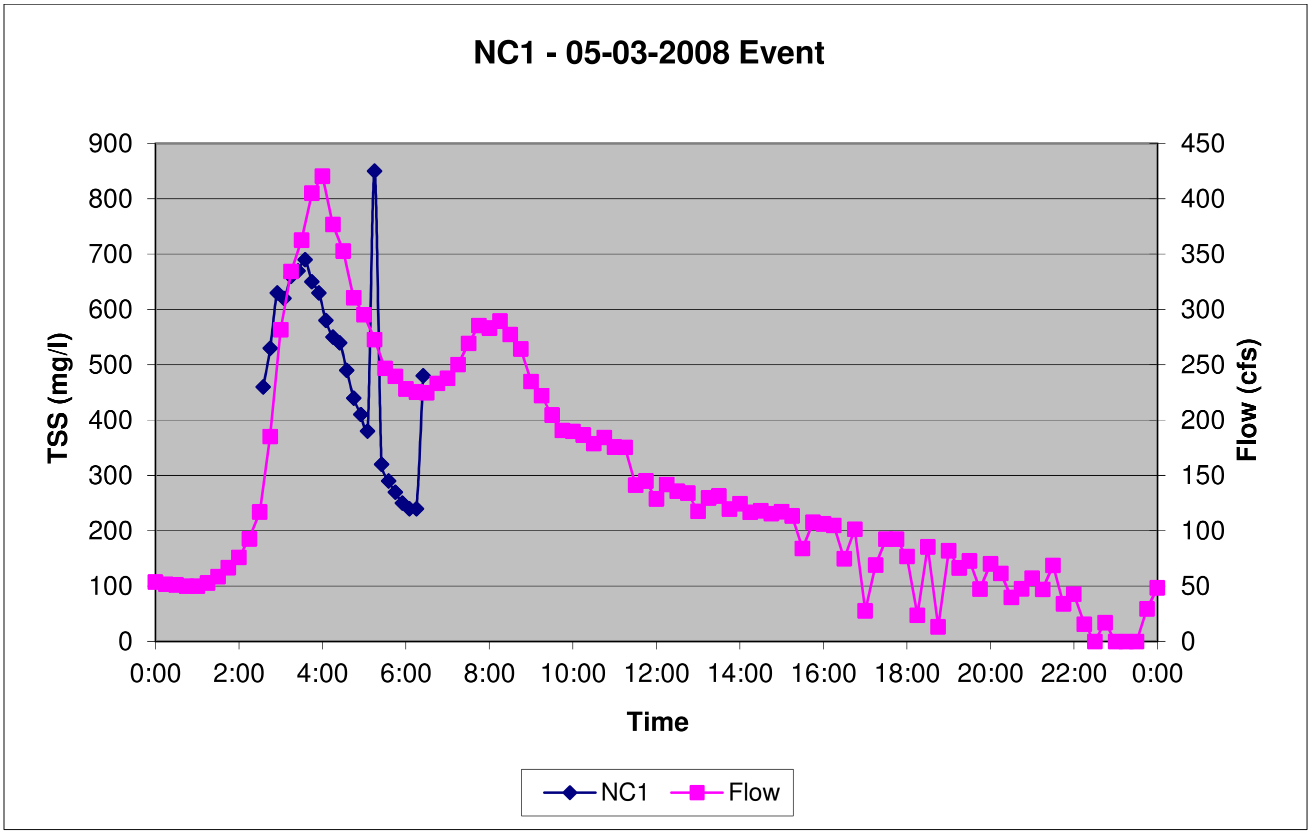

NC1 - 12-09-2007 Event
TSS (mg/l)
Flow (cfs)
1,200
1,000
800
600
400
200
0
660
550
440
330
220
110
0
9:00
11:00
13:00
15:00
17:00
19:00
21:00
23:00
1:00
3:00
5:00
Time
NC1
Flow

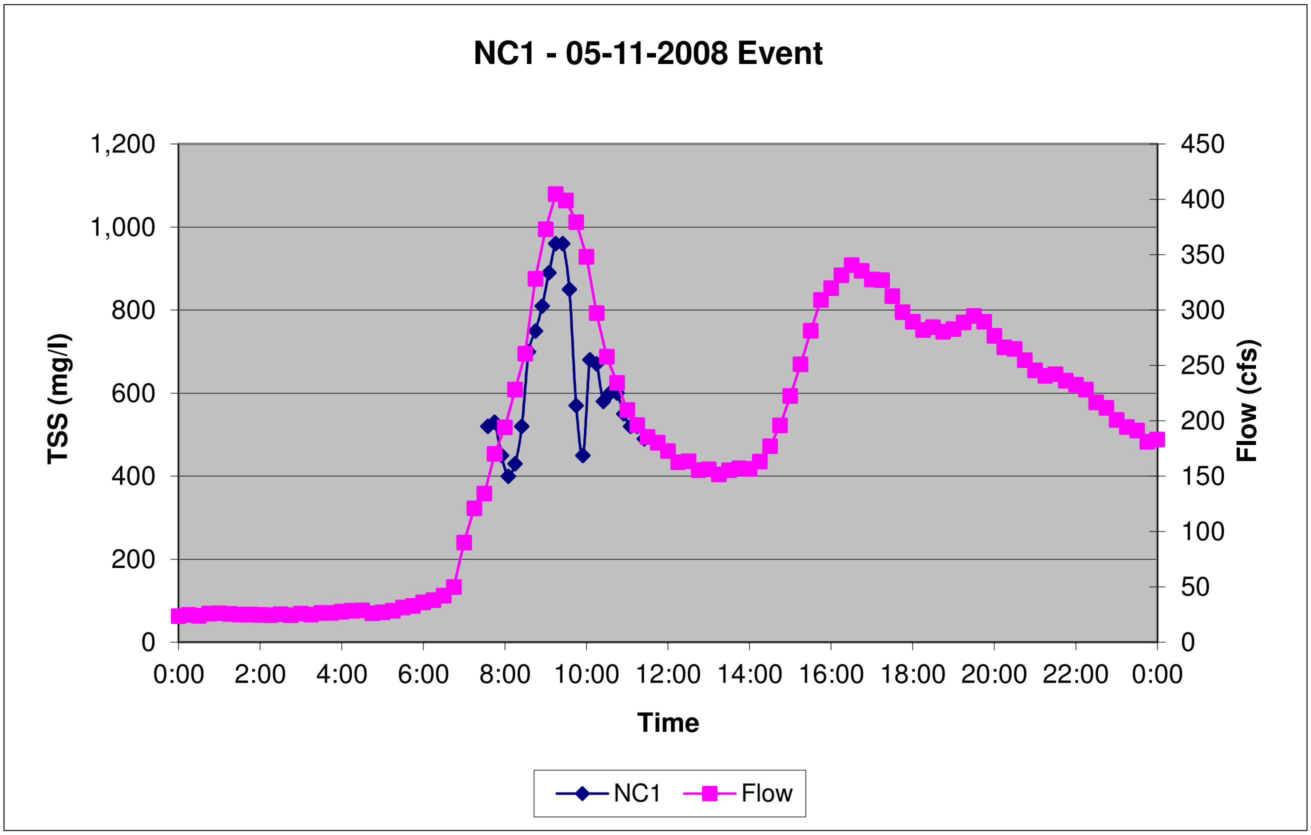

NC1 - 02-12-2008 Event
TSS (mg/l)
Flow (cfs)
Time
0
100
200
300
400
500
600
0
15
30
45
60
75
90
10:00
12:00
14:00
16:00
18:00
20:00
22:00

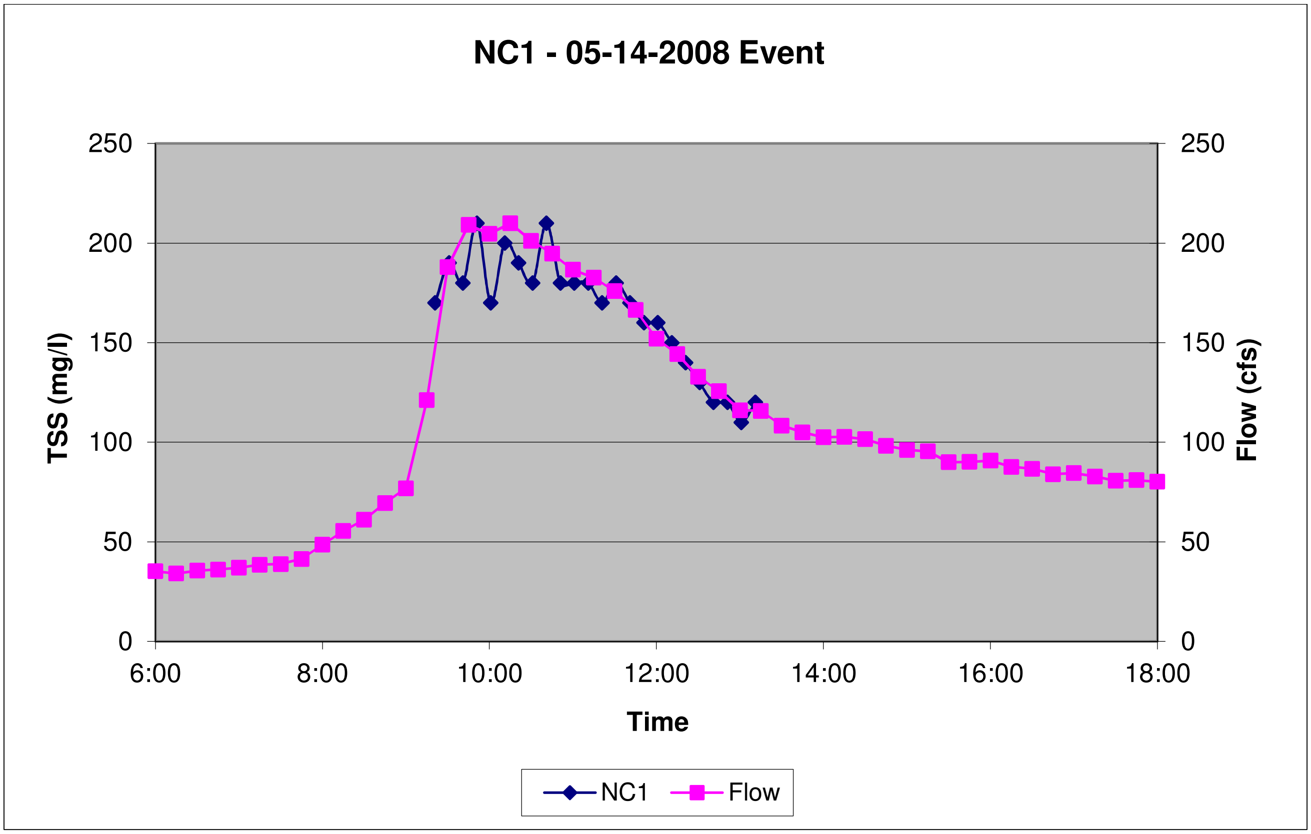

NC1 - 03-18-2008 Event
TSS (mg/l)
Flow (cfs)
Time
0
100
200
300
400
500
600
700
800
900
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00


NC1 - 03-27-2008 Event
TSS (mg/l)
Flow (cfs)
500
450
400
350
300
250
200
150
100
50
0
600
540
480
420
360
300
240
180
120
60
0
22:00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
Time
NC1
Flow


NC1 - 04-03-2008 Event
TSS (mg/l)
Flow (cfs)
3,000
2,500
2,000
1,500
1,000
500
0
900
750
600
450
300
150
0
18:00
20:00
22:00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
Time
NC1
Flow


NC1 - 05-03-2008 Event
TSS (mg/l)
Flow (cfs)
0
100
200
300
400
500
600
700
800
900
0
50
100
150
200
250
300
350
400
450
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time
NC1
Flow


NC1 - 05-11-2008 Event
TSS (mg/l)
Flow (cfs)
0
200
400
600
800
1,000
1,200
0
50
100
150
200
250
300
350
400
450
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time
NC1
Flow


NC1 - 05-14-2008 Event
TSS (mg/l)
Flow (cfs)
250
200
150
100
50
0
6:00
8:00
10:00
12:00
14:00
16:00
18:00
Time
NC1
Flow

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
TB1	1	11/26/2007	16:16	0:00	62.8	400	5,648	0
TB1	2	11/26/2007	17:01	0:45	82.6	480	8,910	5,459
TB1	3	11/26/2007	17:46	0:45	18.5	310	1,286	9,282
TB1	4	11/26/2007	18:31	0:45	23.1	210	1,092	10,174
TB1	5	11/26/2007	19:16	0:45	56.8	150	1,915	11,301
TB1	6	11/26/2007	20:01	0:45	0.0	110	0	12,019
TB1	7	11/26/2007	20:46	0:45	0.0	79	0	12,019
TB1	8	11/26/2007	21:31	0:45	23.7	59	315	12,137
TB1	9	11/26/2007	22:16	0:45	24.8	45	251	12,350
TB1	10	11/26/2007	23:01	0:45	36.5	37	303	12,558
TB1	11	11/26/2007	23:46	0:45	14.0	31	97	12,708
TB1	12	11/27/2007	0:31	0:45	42.1	27	255	12,840
TB1	13	11/27/2007	1:16	0:45	33.7	23	174	13,001
TB1	14	11/27/2007	2:01	0:45	33.4	23	173	13,131
TB1	15	11/27/2007	2:46	0:45	35.9	20	161	13,256
TB1	16	11/27/2007	3:31	0:45	33.3	17	127	13,365
TB1	17	11/27/2007	4:16	0:45	30.9	13	90	13,446
TB1	18	11/27/2007	5:01	0:45	29.9	16	108	13,520
TB1	19	11/27/2007	5:46	0:45	28.5	15	96	13,597
TB1	20	11/27/2007	6:31	0:45	29.1	12	79	13,662
TB1	21	11/27/2007	7:16	0:45	27.0	13	79	13,721
TB1	22	11/27/2007	8:01	0:45	27.0	14	85	13,783
TB1	23	11/27/2007	8:46	0:45	26.4	10	59	13,837
TB1	24	11/27/2007	9:31	0:45	26.3	9	53	13,879
Max					**83**	**480**	**8,910**	
Min					**0**	**9**	**0**	
Average					**31**	**88**	**890**	
Median					**29**	**25**	**144**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
TB1	1	12/9/2007	15:12	0:00	132.3	500	14,863	0
TB1	2	12/9/2007	15:57	0:45	335.9	1,100	83,034	36,711
TB1	3	12/9/2007	16:42	0:45	365.3	760	62,401	91,249
TB1	4	12/9/2007	17:27	0:45	315.5	450	31,905	126,614
TB1	5	12/9/2007	18:12	0:45	179.6	280	11,300	142,816
TB1	6	12/9/2007	18:57	0:45	134.7	180	5,448	149,096
TB1	7	12/9/2007	19:42	0:45	112.2	120	3,026	152,274
TB1	8	12/9/2007	20:27	0:45	98.5	97	2,147	154,214
TB1	9	12/9/2007	21:12	0:45	96.6	69	1,498	155,581
TB1	10	12/9/2007	21:57	0:45	95.1	56	1,196	156,591
TB1	11	12/9/2007	22:42	0:45	96.1	43	929	157,388
TB1	12	12/9/2007	23:27	0:45	95.0	40	854	158,056
TB1	13	12/10/2007	0:12	0:45	94.6	38	808	158,680
TB1	14	12/10/2007	0:57	0:45	90.2	34	689	159,241
TB1	15	12/10/2007	1:42	0:45	83.8	30	565	159,711
TB1	16	12/10/2007	2:27	0:45	79.7	29	519	160,118
TB1	17	12/10/2007	3:12	0:45	74.3	23	384	160,457
TB1	18	12/10/2007	3:57	0:45	70.1	26	410	160,755
TB1	19	12/10/2007	4:42	0:45	65.4	22	323	161,030
TB1	20	12/10/2007	5:27	0:45	62.1	21	293	161,261
TB1	21	12/10/2007	6:12	0:45	56.6	20	254	161,466
TB1	22	12/10/2007	6:57	0:45	53.5	18	217	161,643
TB1	23	12/10/2007	7:42	0:45	51.8	18	209	161,802
TB1	24	12/10/2007	8:27	0:45	48.7	17	186	161,951
Max					**365**	**1,100**	**83,034**	
Min					**49**	**17**	**186**	
Average					**120**	**166**	**9,311**	
Median					**95**	**39**	**831**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
TB1	1	2/5/2008	10:49	0:00	140.3	940	29,643	0
TB1	2	2/5/2008	10:59	0:10	149.8	850	28,618	4,855
TB1	3	2/5/2008	11:09	0:10	159.7	980	35,170	10,171
TB1	4	2/5/2008	11:19	0:10	170.5	1,200	45,990	16,934
TB1	5	2/5/2008	11:29	0:10	182.8	1,300	53,397	25,216
TB1	6	2/5/2008	11:39	0:10	182.6	1,300	53,348	34,112
TB1	7	2/5/2008	11:49	0:10	184.0	1,200	49,628	42,693
TB1	8	2/5/2008	11:59	0:10	189.9	1,000	42,678	50,385
TB1	9	2/5/2008	12:09	0:10	194.2	900	39,288	57,216
TB1	10	2/5/2008	12:19	0:10	196.5	840	37,101	63,582
TB1	11	2/5/2008	12:29	0:10	196.0	780	34,358	69,537
TB1	12	2/5/2008	12:39	0:10	190.7	740	31,719	75,043
TB1	13	2/5/2008	12:49	0:10	186.5	720	30,185	80,202
TB1	14	2/5/2008	12:59	0:10	184.8	710	29,487	85,174
TB1	15	2/5/2008	13:09	0:10	196.9	730	32,306	90,324
TB1	16	2/5/2008	13:19	0:10	203.2	740	33,797	95,832
TB1	17	2/5/2008	13:29	0:10	198.5	710	31,674	101,288
TB1	18	2/5/2008	13:39	0:10	192.7	740	32,050	106,598
TB1	19	2/5/2008	13:49	0:10	189.6	720	30,672	111,825
TB1	20	2/5/2008	13:59	0:10	190.5	650	27,830	116,700
TB1	21	2/5/2008	14:09	0:10	190.2	600	25,652	121,157
TB1	22	2/5/2008	14:19	0:10	187.1	560	23,543	125,257
TB1	23	2/5/2008	14:29	0:10	179.8	520	21,006	128,969
TB1	24	2/5/2008	14:39	0:10	174.8	510	20,041	132,390
Max					**203**	**1,300**	**53,397**	
Min					**140**	**510**	**20,041**	
Average					**184**	**831**	**34,133**	
Median					**188**	**740**	**31,884**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
TB1	1	3/4/2008	1:21	0:00	150.0	1,600	53,929	0
TB1	2	3/4/2008	1:31	0:10	169.8	1,100	41,966	7,991
TB1	3	3/4/2008	1:41	0:10	188.3	1,400	59,255	16,426
TB1	4	3/4/2008	1:51	0:10	202.1	1,200	54,492	25,905
TB1	5	3/4/2008	2:01	0:10	213.5	1,300	62,375	35,644
TB1	6	3/4/2008	2:11	0:10	233.4	1,200	62,956	46,088
TB1	7	3/4/2008	2:21	0:10	255.5	840	48,237	55,354
TB1	8	3/4/2008	2:31	0:10	277.0	1,200	74,697	65,599
TB1	9	3/4/2008	2:41	0:10	280.0	1,000	62,935	77,068
TB1	10	3/4/2008	2:51	0:10	293.2	1,200	79,083	88,903
TB1	11	3/4/2008	3:01	0:10	311.9	1,200	84,121	102,503
TB1	12	3/4/2008	3:11	0:10	319.0	1,200	86,037	116,683
TB1	13	3/4/2008	3:21	0:10	328.8	1,100	81,296	130,628
TB1	14	3/4/2008	3:31	0:10	340.1	1,100	84,081	144,409
TB1	15	3/4/2008	3:41	0:10	348.1	1,000	78,224	157,934
TB1	16	3/4/2008	3:51	0:10	355.9	1,100	87,974	171,784
TB1	17	3/4/2008	4:01	0:10	362.2	1,100	89,553	186,578
TB1	18	3/4/2008	4:11	0:10	356.8	1,000	80,196	200,724
TB1	19	3/4/2008	4:21	0:10	357.4	960	77,104	213,832
TB1	20	3/4/2008	4:31	0:10	362.5	1,000	81,474	227,047
TB1	21	3/4/2008	4:41	0:10	373.6	850	71,367	239,784
TB1	22	3/4/2008	4:51	0:10	380.3	920	78,640	252,284
TB1	23	3/4/2008	5:01	0:10	383.8	860	74,181	265,019
TB1	24	3/4/2008	5:11	0:10	383.6	860	74,142	277,380
Max					**384**	**1,600**	**89,553**	
Min					**150**	**840**	**41,966**	
Average					**301**	**1,095**	**72,013**	
Median					**324**	**1,100**	**75,900**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
TB1	1	3/18/2008	10:43	0:00	173.1	750	29,172	0
TB1	2	3/18/2008	10:53	0:10	183.2	870	35,820	5,416
TB1	3	3/18/2008	11:03	0:10	190.4	880	37,662	11,540
TB1	4	3/18/2008	11:13	0:10	194.1	800	34,900	17,586
TB1	5	3/18/2008	11:23	0:10	196.5	720	31,796	23,144
TB1	6	3/18/2008	11:33	0:10	199.5	680	30,492	28,335
TB1	7	3/18/2008	11:43	0:10	204.8	650	29,919	33,369
TB1	8	3/18/2008	11:53	0:10	219.8	670	33,096	38,621
TB1	9	3/18/2008	12:03	0:10	235.2	630	33,301	44,154
TB1	10	3/18/2008	12:13	0:10	245.9	590	32,608	49,646
TB1	11	3/18/2008	12:23	0:10	257.5	620	35,875	55,353
TB1	12	3/18/2008	12:33	0:10	270.5	770	46,803	62,243
TB1	13	3/18/2008	12:43	0:10	286.3	710	45,689	69,950
TB1	14	3/18/2008	12:53	0:10	303.8	680	46,425	77,627
TB1	15	3/18/2008	13:03	0:10	322.3	300	21,733	83,307
TB1	16	3/18/2008	13:13	0:10	342.6	670	51,581	89,416
TB1	17	3/18/2008	13:23	0:10	357.8	640	51,468	98,003
TB1	18	3/18/2008	13:33	0:10	371.7	850	71,009	108,210
TB1	19	3/18/2008	13:43	0:10	385.3	830	71,862	120,116
TB1	20	3/18/2008	13:53	0:10	381.8	810	69,504	131,896
TB1	21	3/18/2008	14:03	0:10	378.5	860	73,164	143,785
TB1	22	3/18/2008	14:13	0:10	385.6	820	71,062	155,804
TB1	23	3/18/2008	14:23	0:10	387.5	790	68,798	167,459
TB1	24	3/18/2008	14:33	0:10	387.9	1,400	122,031	183,362
Max					**388**	**1,400**	**122,031**	
Min					**173**	**300**	**21,733**	
Average					**286**	**750**	**48,990**	
Median					**278**	**735**	**41,676**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
TB1	1	3/27/2008	13:06	0:00	113.0	550	13,973	0
TB1	2	3/27/2008	13:16	0:10	111.7	540	13,556	2,294
TB1	3	3/27/2008	13:26	0:10	111.7	590	14,815	4,658
TB1	4	3/27/2008	13:36	0:10	112.3	630	15,906	7,218
TB1	5	3/27/2008	13:46	0:10	113.0	640	16,255	9,899
TB1	6	3/27/2008	13:56	0:10	110.7	620	15,421	12,538
TB1	7	3/27/2008	14:06	0:10	108.6	620	15,139	15,085
TB1	8	3/27/2008	14:16	0:10	106.8	670	16,084	17,687
TB1	9	3/27/2008	14:26	0:10	104.9	640	15,091	20,285
TB1	10	3/27/2008	14:36	0:10	102.2	620	14,244	22,729
TB1	11	3/27/2008	14:46	0:10	99.1	640	14,249	25,104
TB1	12	3/27/2008	14:56	0:10	96.4	590	12,785	27,357
TB1	13	3/27/2008	15:06	0:10	94.2	550	11,642	29,392
TB1	14	3/27/2008	15:16	0:10	92.5	470	9,767	31,176
TB1	15	3/27/2008	15:26	0:10	92.9	410	8,558	32,703
TB1	16	3/27/2008	15:36	0:10	93.0	370	7,729	34,061
TB1	17	3/27/2008	15:46	0:10	92.8	330	6,883	35,278
TB1	18	3/27/2008	15:56	0:10	92.7	300	6,247	36,372
TB1	19	3/27/2008	16:06	0:10	91.5	280	5,759	37,373
TB1	20	3/27/2008	16:16	0:10	89.9	260	5,253	38,291
TB1	21	3/27/2008	16:26	0:10	89.7	240	4,838	39,131
TB1	22	3/27/2008	16:36	0:10	89.2	260	5,212	39,969
TB1	23	3/27/2008	16:46	0:10	88.5	220	4,376	40,768
TB1	24	3/27/2008	16:56	0:10	87.8	220	4,343	41,495
Max					**113**	**670**	**16,255**	
Min					**88**	**220**	**4,343**	
Average					**99**	**469**	**10,755**	
Median					**95**	**545**	**12,213**	

ISCO Wet Weather Event Data

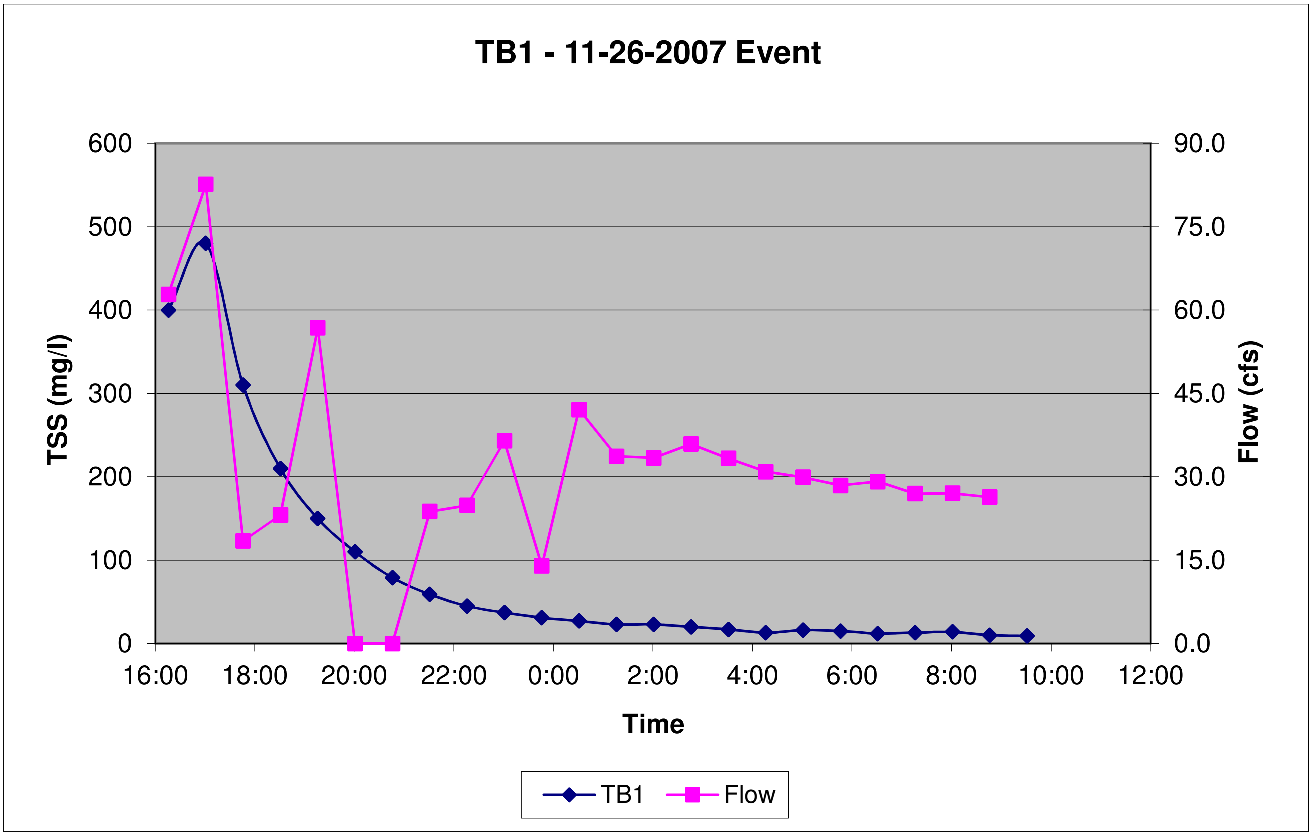
Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
TB1	1	5/15/2008	18:48	0:00	162.2	520	18,956	0
TB1	2	5/15/2008	19:03	0:15	173.8	510	19,920	4,860
TB1	3	5/15/2008	19:18	0:15	187.3	570	23,991	10,349
TB1	4	5/15/2008	19:33	0:15	195.5	590	25,917	16,587
TB1	5	5/15/2008	19:48	0:15	200.4	600	27,026	23,205
TB1	6	5/15/2008	20:03	0:15	222.6	780	39,028	31,462
TB1	7	5/15/2008	20:18	0:15	274.1	940	57,908	43,579
TB1	8	5/15/2008	20:33	0:15	329.1	880	65,092	58,954
TB1	9	5/15/2008	20:48	0:15	372.8	970	81,276	77,250
TB1	10	5/15/2008	21:03	0:15	404.1	1,100	99,888	99,895
TB1	11	5/15/2008	21:18	0:15	416.4	1,400	131,009	128,757
TB1	12	5/15/2008	21:33	0:15	427.4	1,200	115,276	159,543
TB1	13	5/15/2008	21:48	0:15	427.6	1,100	105,699	187,165
TB1	14	5/15/2008	22:03	0:15	433.9	820	79,966	210,373
TB1	15	5/15/2008	22:18	0:15	450.7	720	72,929	229,485
TB1	16	5/15/2008	22:33	0:15	426.5	550	52,714	245,190
TB1	17	5/15/2008	22:48	0:15	385.8	500	43,347	257,198
TB1	18	5/15/2008	23:03	0:15	342.3	430	33,075	266,750
TB1	19	5/15/2008	23:18	0:15	289.2	440	28,595	274,459
TB1	20	5/15/2008	23:33	0:15	211.8	360	17,132	280,175
TB1	21	5/15/2008	23:48	0:15	0.0	320	0	282,316
TB1	22	5/16/2008	0:03	0:15	0.0	270	0	282,316
TB1	23	5/16/2008	0:18	0:15	0.0	270	0	282,316
TB1	24	5/16/2008	0:33	0:15	0.0	240	0	282,316
Max					**451**	**1,400**	**131,009**	
Min					**0**	**240**	**0**	
Average					**264**	**670**	**47,448**	
Median					**282**	**580**	**36,051**	

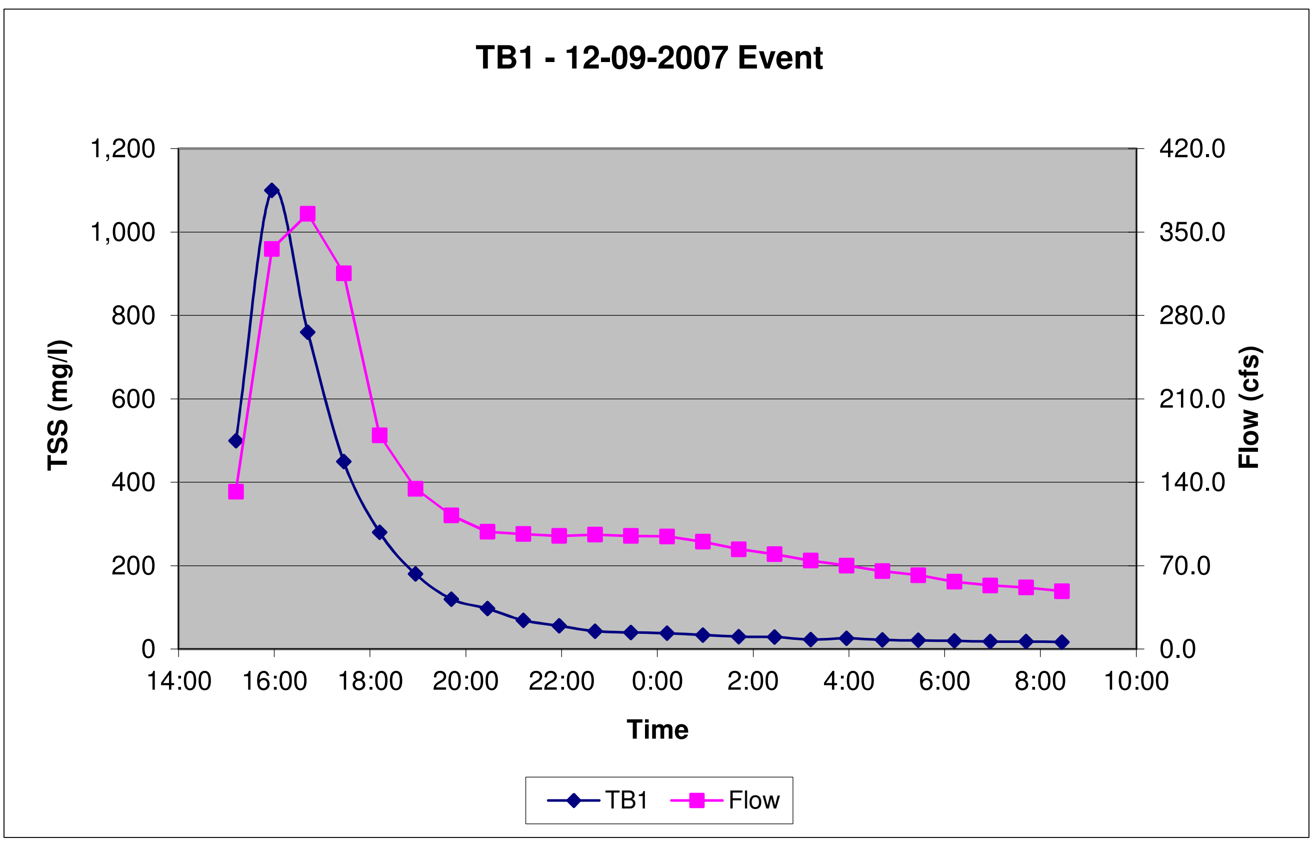
ISCO Wet Weather Event Data

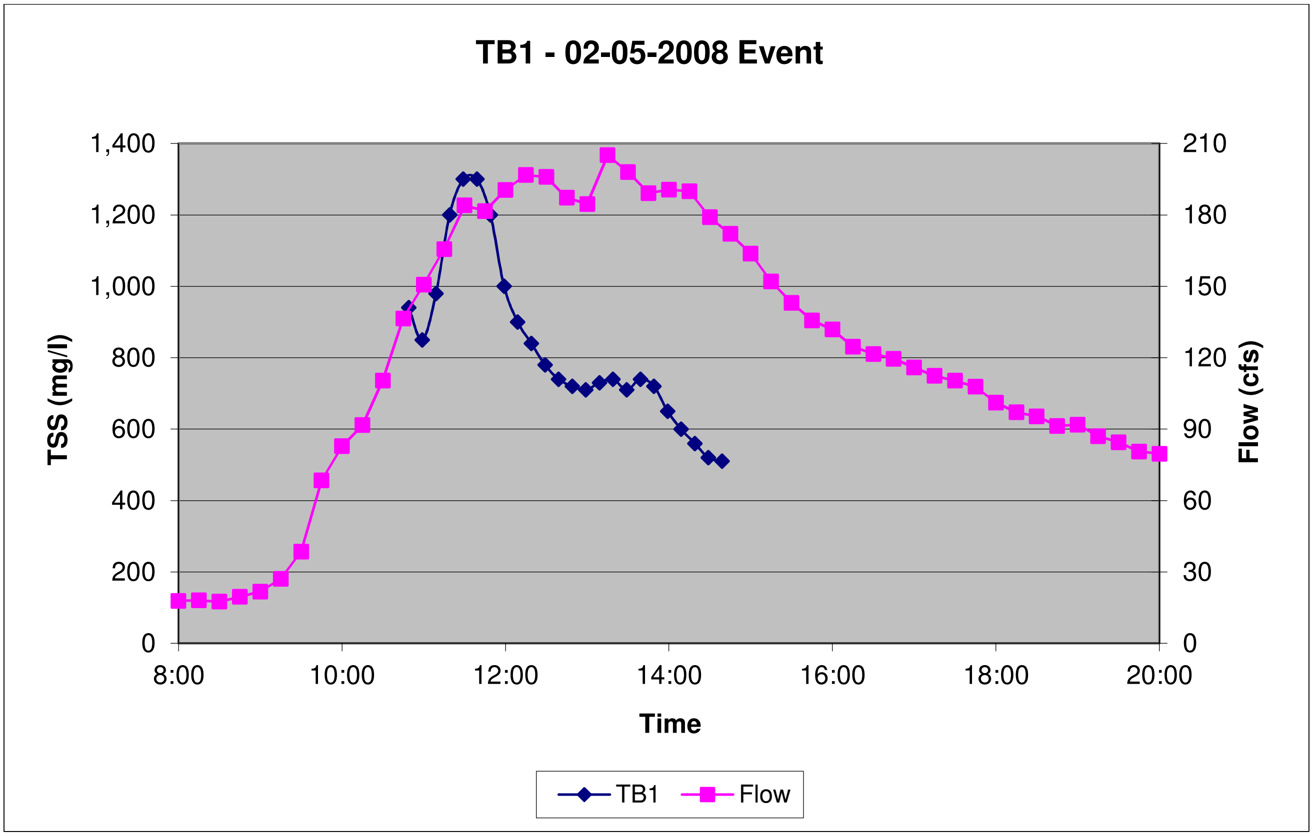
Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
TB1	1	6/3/2008	9:58	0:00	2.1	960	450	0
TB1	2	6/3/2008	10:13	0:15	0.0	1,500	0	56
TB1	3	6/3/2008	10:28	0:15	0.0	1,700	0	56
TB1	4	6/3/2008	10:43	0:15	0.0	1,400	0	56
TB1	5	6/3/2008	10:58	0:15	0.0	1,100	0	56
TB1	6	6/3/2008	11:13	0:15	0.0	820	0	56
TB1	7	6/3/2008	11:28	0:15	0.0	700	0	56
TB1	8	6/3/2008	11:43	0:15	0.0	590	0	56
TB1	9	6/3/2008	11:58	0:15	0.0	540	0	56
TB1	10	6/3/2008	12:13	0:15	0.0	470	0	56
TB1	11	6/3/2008	12:28	0:15	0.0	420	0	56
TB1	12	6/3/2008	12:43	0:15	0.0	380	0	56
TB1	13	6/3/2008	12:58	0:15	0.0	350	0	56
TB1	14	6/3/2008	13:13	0:15	0.0	290	0	56
TB1	15	6/3/2008	13:28	0:15	0.0	280	0	56
TB1	16	6/3/2008	13:43	0:15	0.0	260	0	56
TB1	17	6/3/2008	13:58	0:15	0.0	230	0	56
TB1	18	6/3/2008	14:13	0:15	0.0	230	0	56
TB1	19	6/3/2008	14:28	0:15	0.0	210	0	56
TB1	20	6/3/2008	14:43	0:15	0.0	200	0	56
TB1	21	6/3/2008	14:58	0:15	0.0	160	0	56
TB1	22	6/3/2008	15:13	0:15	0.0	170	0	56
TB1	23	6/3/2008	15:28	0:15	0.0	150	0	56
TB1	24	6/3/2008	15:43	0:15	0.0	130	0	56
Max					**2**	**1,700**	**450**	
Min					**0**	**130**	**0**	
Average					**0**	**552**	**19**	
Median					**0**	**365**	**0**	

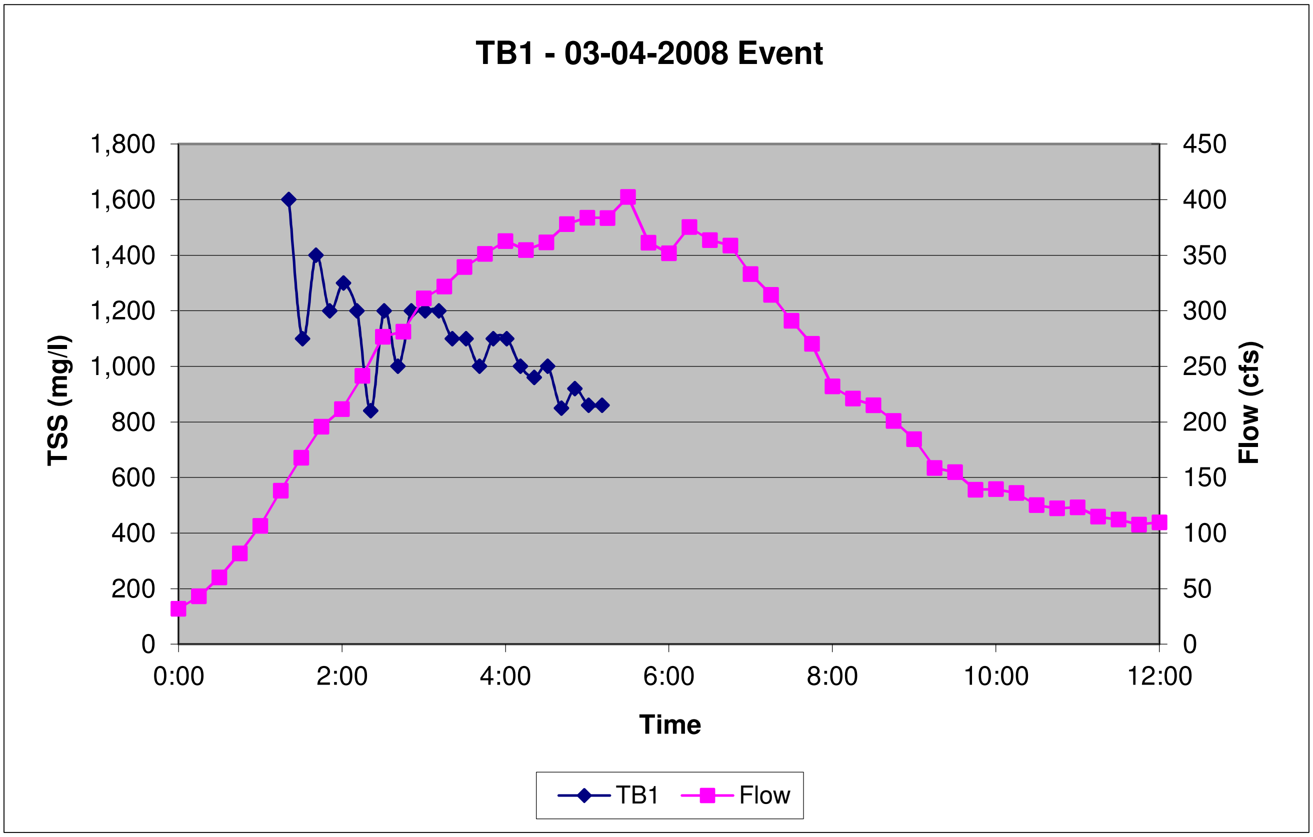
ISCO Wet Weather Event Data

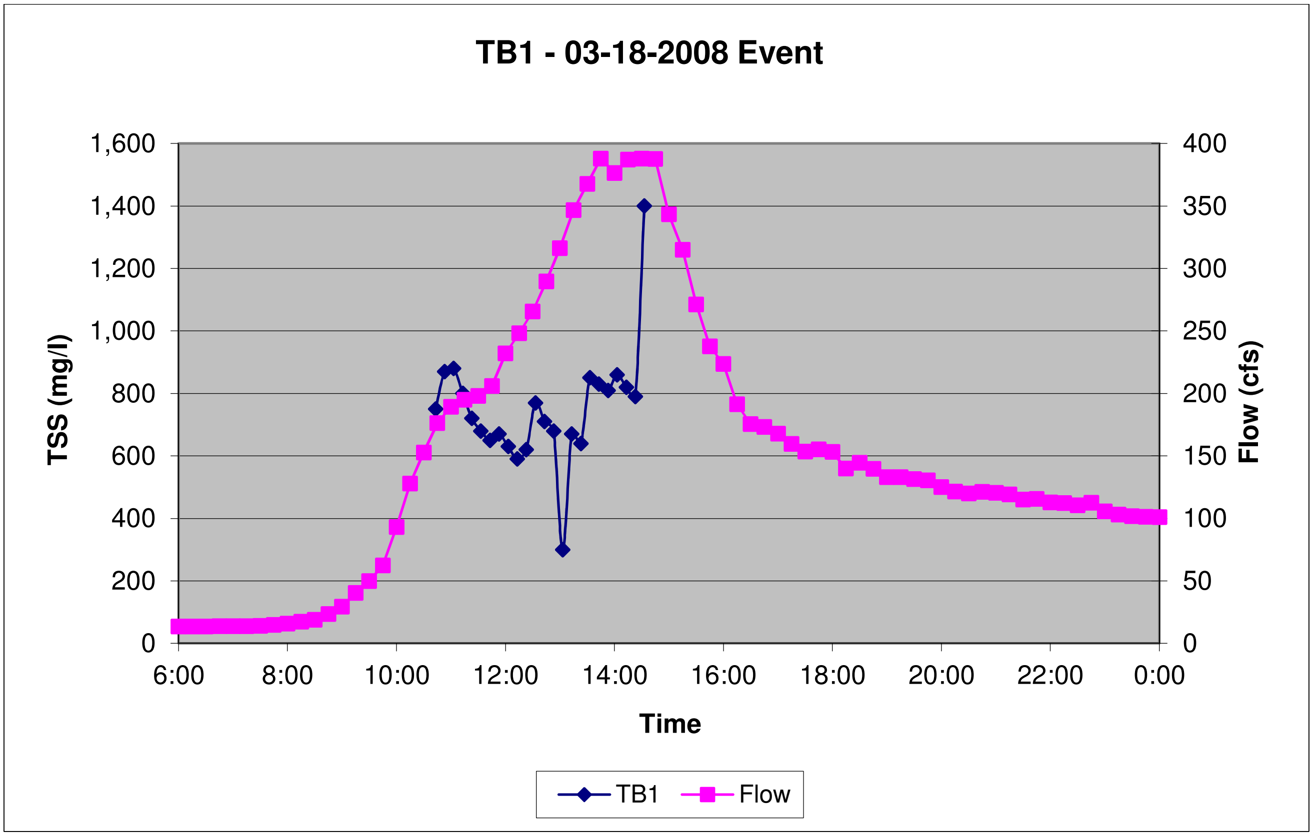
Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
TB1	1	7/31/2008	9:58	0:00	9.1	1,400	2,877	0
TB1	2	7/31/2008	10:13	0:15	1.4	1,800	569	431
TB1	3	7/31/2008	10:28	0:15	0.0	1,200	0	502
TB1	4	7/31/2008	10:43	0:15	5.4	1,600	1,946	745
TB1	5	7/31/2008	10:58	0:15	6.1	1,400	1,904	1,226
TB1	6	7/31/2008	11:13	0:15	5.3	1,400	1,656	1,671
TB1	7	7/31/2008	11:28	0:15	1.6	1,200	444	1,934
TB1	8	7/31/2008	11:43	0:15	4.5	880	888	2,100
TB1	9	7/31/2008	11:58	0:15	5.0	650	734	2,303
TB1	10	7/31/2008	12:13	0:15	4.5	610	617	2,472
TB1	11	7/31/2008	12:28	0:15	4.4	760	749	2,643
TB1	12	7/31/2008	12:43	0:15	3.3	1,200	881	2,847
TB1	13	7/31/2008	12:58	0:15	3.7	540	449	3,013
TB1	14	7/31/2008	13:13	0:15	3.6	380	306	3,107
TB1	15	7/31/2008	13:28	0:15	1.9	340	147	3,164
TB1	16	7/31/2008	13:43	0:15	4.5	350	355	3,227
TB1	17	7/31/2008	13:58	0:15	3.1	290	199	3,296
TB1	18	7/31/2008	14:13	0:15	2.5	26	14	3,323
TB1	19	7/31/2008	14:28	0:15	2.3	26	14	3,326
TB1	20	7/31/2008	14:43	0:15	2.5	240	134	3,345
TB1	21	7/31/2008	14:58	0:15	2.4	180	97	3,374
TB1	22	7/31/2008	15:13	0:15	1.9	200	84	3,396
TB1	23	7/31/2008	15:28	0:15	1.8	170	68	3,415
TB1	24	7/31/2008	15:43	0:15	1.7	160	61	3,431
Max					**9**	**1,800**	**2,877**	
Min					**0**	**26**	**0**	
Average					**3**	**708**	**633**	
Median					**3**	**575**	**400**	

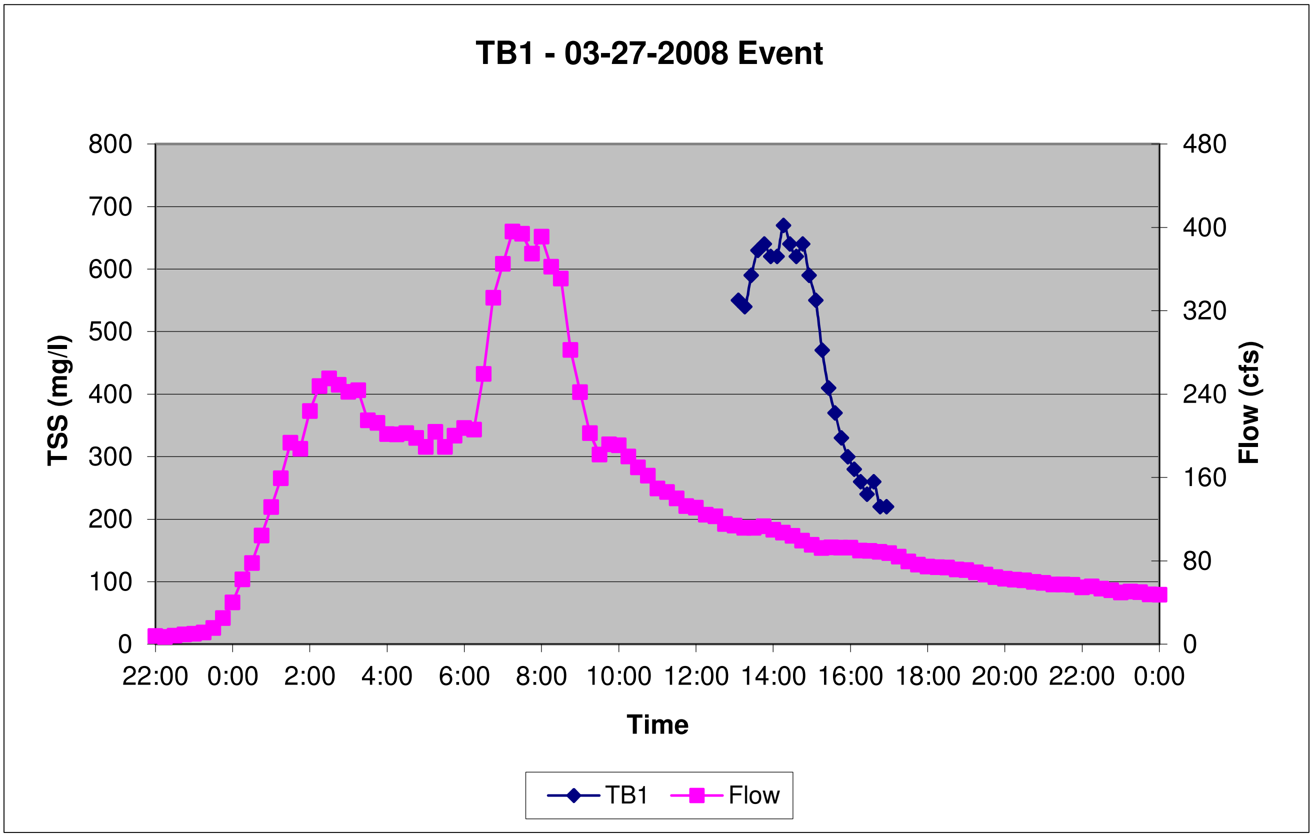

TB1 - 11-26-2007 Event
600
500
400
300
200
100
0
90.0
75.0
60.0
45.0
30.0
15.0
0.0
TSS (mg/l)
Flow (cfs)
16:00
18:00
20:00
22:00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
Time
TB1
Flow

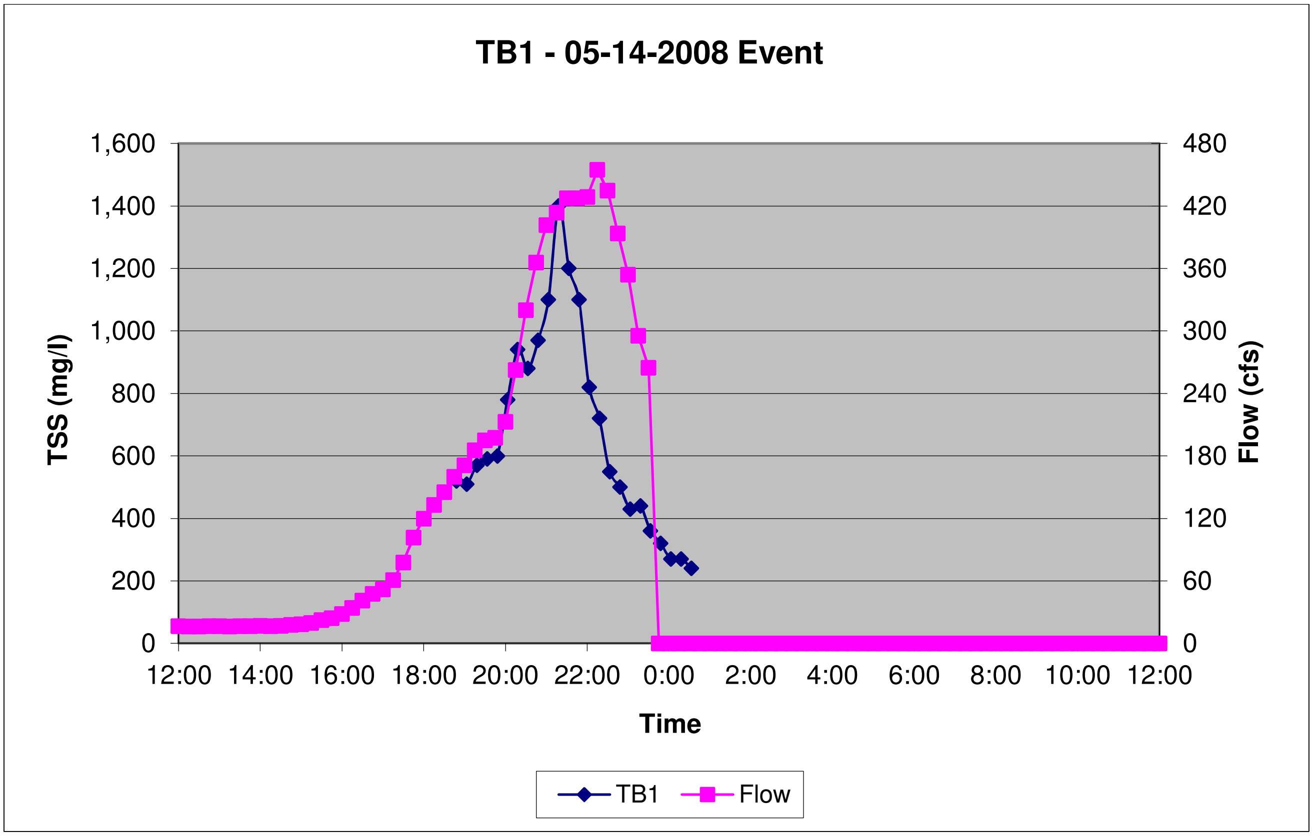

TB1 - 12-09-2007 Event
1,200
1,000
800
600
400
200
0
420.0
350.0
280.0
210.0
140.0
70.0
0.0
TSS (mg/l)
Flow (cfs)
14:00
16:00
18:00
20:00
22:00
0:00
2:00
4:00
6:00
8:00
10:00
Time
TB1
Flow

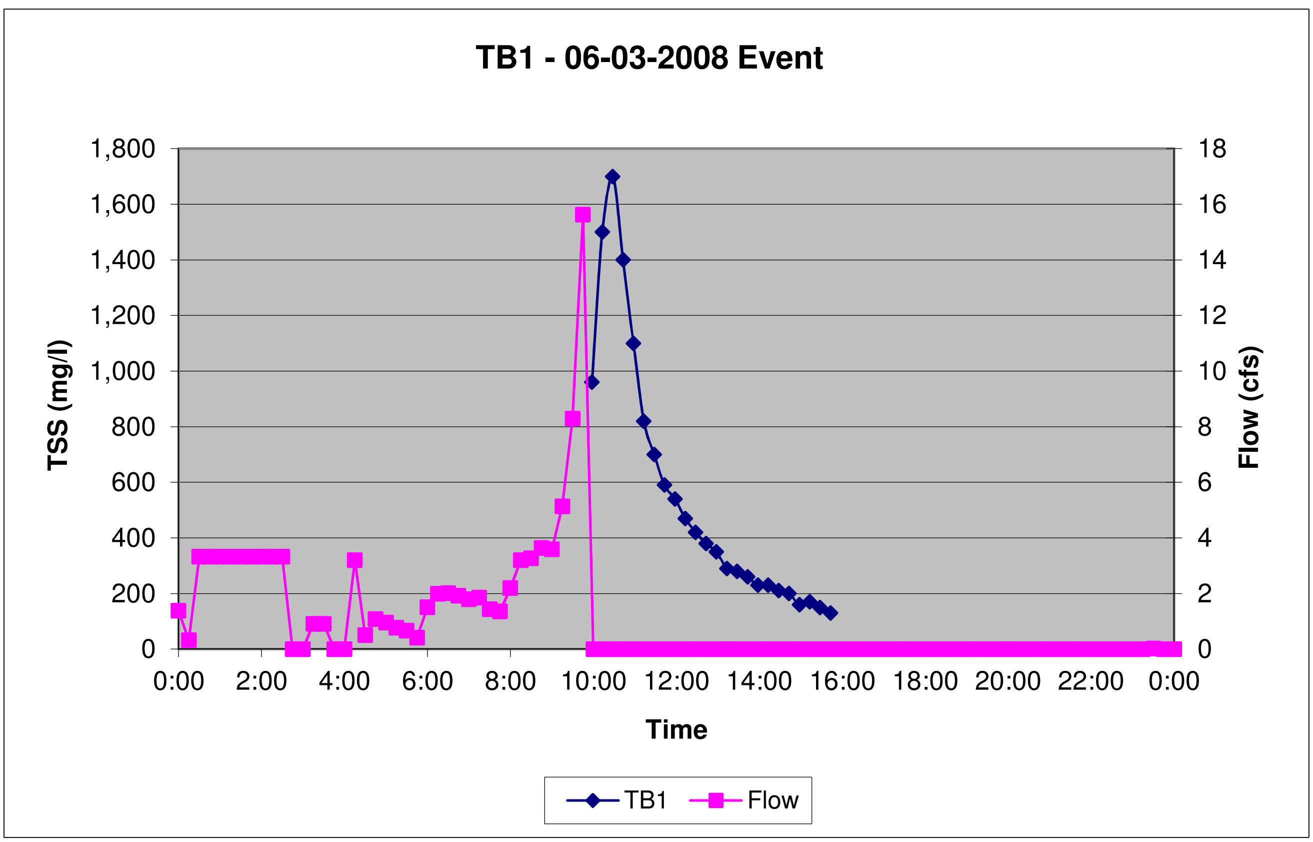

TB1 - 02-05-2008 Event
TSS (mg/l)
Flow (cfs)
Time
1,400
1,200
1,000
800
600
400
200
0
210
180
150
120
90
60
30
0
8:00
10:00
12:00
14:00
16:00
18:00
20:00
TB1
Flow


TB1 - 03-04-2008 Event
TSS (mg/l)
Flow (cfs)
Time
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
450
400
350
300
250
200
150
100
50
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
TB1
Flow

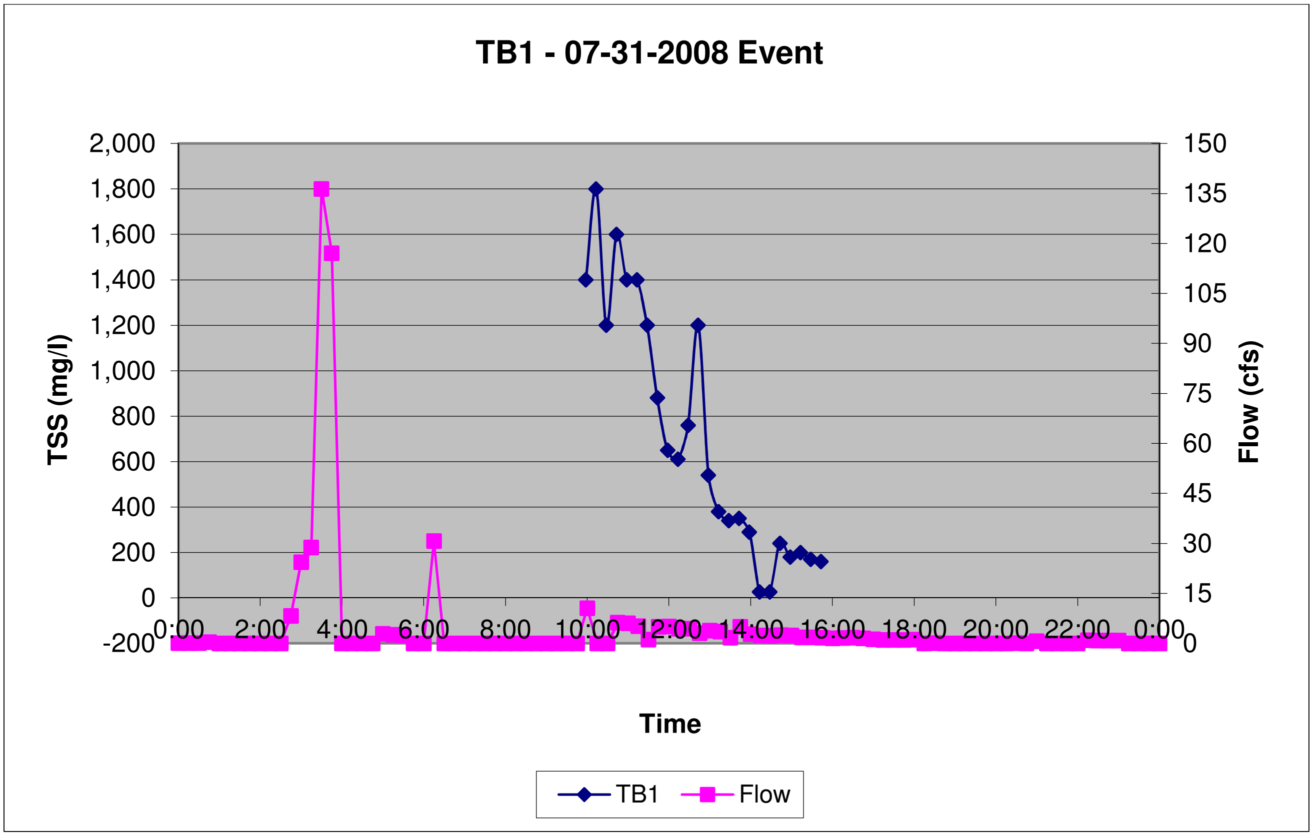

TB1 - 03-18-2008 Event
TSS (mg/l)
1,600
1,400
1,200
1,000
800
600
400
200
0
Flow (cfs)
400
350
300
250
200
150
100
50
0
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time
TB1
Flow


TB1 - 03-27-2008 Event
TSS (mg/l)
800
700
600
500
400
300
200
100
0
Flow (cfs)
480
400
320
240
160
80
0
22:00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time
TB1
Flow


TB1 - 05-14-2008 Event
TSS (mg/l)
Flow (cfs)
Time
1,600
1,400
1,200
1,000
800
600
400
200
0
480
420
360
300
240
180
120
60
0
12:00
14:00
16:00
18:00
20:00
22:00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
TB1
Flow


TB1 - 06-03-2008 Event
TSS (mg/l)
Flow (cfs)
Time
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
18
16
14
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
TB1
Flow

ISCO Wet Weather Event Data



ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
CF2	1	11/22/2007	3:01	0:00	198.7	120	5,358	0
CF2	2	11/22/2007	3:45	0:44	335.4	170	12,815	6,663
CF2	3	11/22/2007	4:31	0:46	281.9	120	7,603	14,490
CF2	4	11/22/2007	5:17	0:46	250.9	100	5,639	19,566
CF2	5	11/22/2007	6:01	0:44	250.8	90	5,073	23,494
CF2	6	11/22/2007	6:46	0:45	244.2	87	4,775	27,187
CF2	7	11/22/2007	7:31	0:45	215.2	81	3,918	30,447
CF2	8	11/22/2007	8:16	0:45	193.1	68	2,951	33,023
CF2	9	11/22/2007	9:01	0:45	178.7	60	2,410	35,034
CF2	10	11/22/2007	9:46	0:45	162.9	48	1,757	36,596
CF2	11	11/22/2007	10:31	0:45	153.3	46	1,585	37,850
CF2	12	11/22/2007	11:16	0:45	136.0	43	1,315	38,937
CF2	13	11/22/2007	12:01	0:45	127.0	40	1,142	39,858
CF2	14	11/22/2007	12:46	0:45	123.8	34	946	40,641
CF2	15	11/22/2007	13:31	0:45	113.1	32	814	41,301
CF2	16	11/22/2007	14:16	0:45	105.1	30	708	41,872
CF2	17	11/22/2007	15:01	0:45	102.5	29	668	42,388
CF2	18	11/22/2007	15:46	0:45	97.1	42	917	42,982
CF2	19	11/22/2007	16:31	0:45	93.7	26	547	43,531
CF2	20	11/22/2007	17:16	0:45	88.5	24	477	43,916
CF2	21	11/22/2007	18:01	0:45	88.2	22	436	44,258
CF2	22	11/22/2007	18:46	0:45	83.4	18	337	44,548
CF2	23	11/22/2007	19:31	0:45	80.3	18	325	44,796
CF2	24	11/22/2007	20:16	0:45	76.7	17	293	45,028
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
CF2	1	12/9/2007	11:28	0:00	200.4	59	2,657	0
CF2	2	12/9/2007	12:13	0:45	848.5	320	61,020	23,879
CF2	3	12/9/2007	12:58	0:45	1026.8	680	156,917	105,605
CF2	4	12/9/2007	13:43	0:45	849.3	650	124,068	210,975
CF2	5	12/9/2007	14:28	0:45	746.8	480	80,557	287,709
CF2	6	12/9/2007	15:13	0:45	1197.8	650	174,973	383,533
CF2	7	12/9/2007	15:58	0:45	1756.0	760	299,934	561,623
CF2	8	12/9/2007	16:43	0:45	2235.8	950	477,353	853,105
CF2	9	12/9/2007	17:28	0:45	2381.8	1,000	535,282	1,232,843
CF2	10	12/9/2007	18:13	0:45	2151.5	830	401,326	1,584,071
CF2	11	12/9/2007	18:58	0:45	1653.2	570	211,771	1,813,982
CF2	12	12/9/2007	19:43	0:45	1245.3	340	95,157	1,929,080
CF2	13	12/9/2007	20:28	0:45	1026.3	230	53,049	1,984,657
CF2	14	12/9/2007	21:13	0:45	873.7	170	33,379	2,017,067
CF2	15	12/9/2007	21:58	0:45	797.0	140	25,075	2,038,987
CF2	16	12/9/2007	22:43	0:45	720.3	120	19,426	2,055,675
CF2	17	12/9/2007	23:28	0:45	698.3	90	14,124	2,068,256
CF2	18	12/10/2007	0:13	0:45	662.1	82	12,202	2,078,129
CF2	19	12/10/2007	0:58	0:45	634.4	72	10,266	2,086,554
CF2	20	12/10/2007	1:43	0:45	585.4	63	8,288	2,093,512
CF2	21	12/10/2007	2:28	0:45	566.5	64	8,148	2,099,675
CF2	22	12/10/2007	3:13	0:45	516.2	59	6,845	2,105,298
CF2	23	12/10/2007	3:58	0:45	505.5	53	6,021	2,110,122
CF2	24	12/10/2007	4:43	0:45	468.6	51	5,371	2,114,394
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
CF2	1	2/5/2008	10:54	0:00	532.6	1,200	143,622	0
CF2	2	2/5/2008	11:04	0:10	693.4	1,300	202,573	28,850
CF2	3	2/5/2008	11:14	0:10	878.1	1,100	217,076	63,820
CF2	4	2/5/2008	11:24	0:10	1050.0	1,100	259,575	103,541
CF2	5	2/5/2008	11:34	0:10	1212.8	1,400	381,590	156,972
CF2	6	2/5/2008	11:44	0:10	1364.1	1,800	551,808	234,755
CF2	7	2/5/2008	11:54	0:10	1443.8	1,900	616,516	332,115
CF2	8	2/5/2008	12:04	0:10	1508.0	1,900	643,907	437,150
CF2	9	2/5/2008	12:14	0:10	1560.6	1,600	561,175	537,574
CF2	10	2/5/2008	12:24	0:10	1625.7	1,700	621,092	636,096
CF2	11	2/5/2008	12:34	0:10	1668.8	1,700	637,587	740,986
CF2	12	2/5/2008	12:44	0:10	1677.2	1,600	603,078	844,375
CF2	13	2/5/2008	12:54	0:10	1629.3	1,600	585,859	943,453
CF2	14	2/5/2008	13:04	0:10	1615.4	1,500	544,559	1,037,655
CF2	15	2/5/2008	13:14	0:10	1661.9	1,500	560,224	1,129,720
CF2	16	2/5/2008	13:24	0:10	1689.8	1,400	531,681	1,220,712
CF2	17	2/5/2008	13:34	0:10	1692.8	1,300	494,580	1,306,234
CF2	18	2/5/2008	13:44	0:10	1661.4	1,300	485,406	1,387,899
CF2	19	2/5/2008	13:54	0:10	1703.1	1,200	459,292	1,466,624
CF2	20	2/5/2008	14:04	0:10	1722.3	1,200	464,477	1,543,605
CF2	21	2/5/2008	14:14	0:10	1695.8	1,100	419,211	1,617,246
CF2	22	2/5/2008	14:24	0:10	1720.1	1,000	386,573	1,684,394
CF2	23	2/5/2008	14:34	0:10	1702.5	970	371,133	1,747,536
CF2	24	2/5/2008	14:44	0:10	1613.4	860	311,831	1,804,450
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

ISCO Wet Weather Event Data

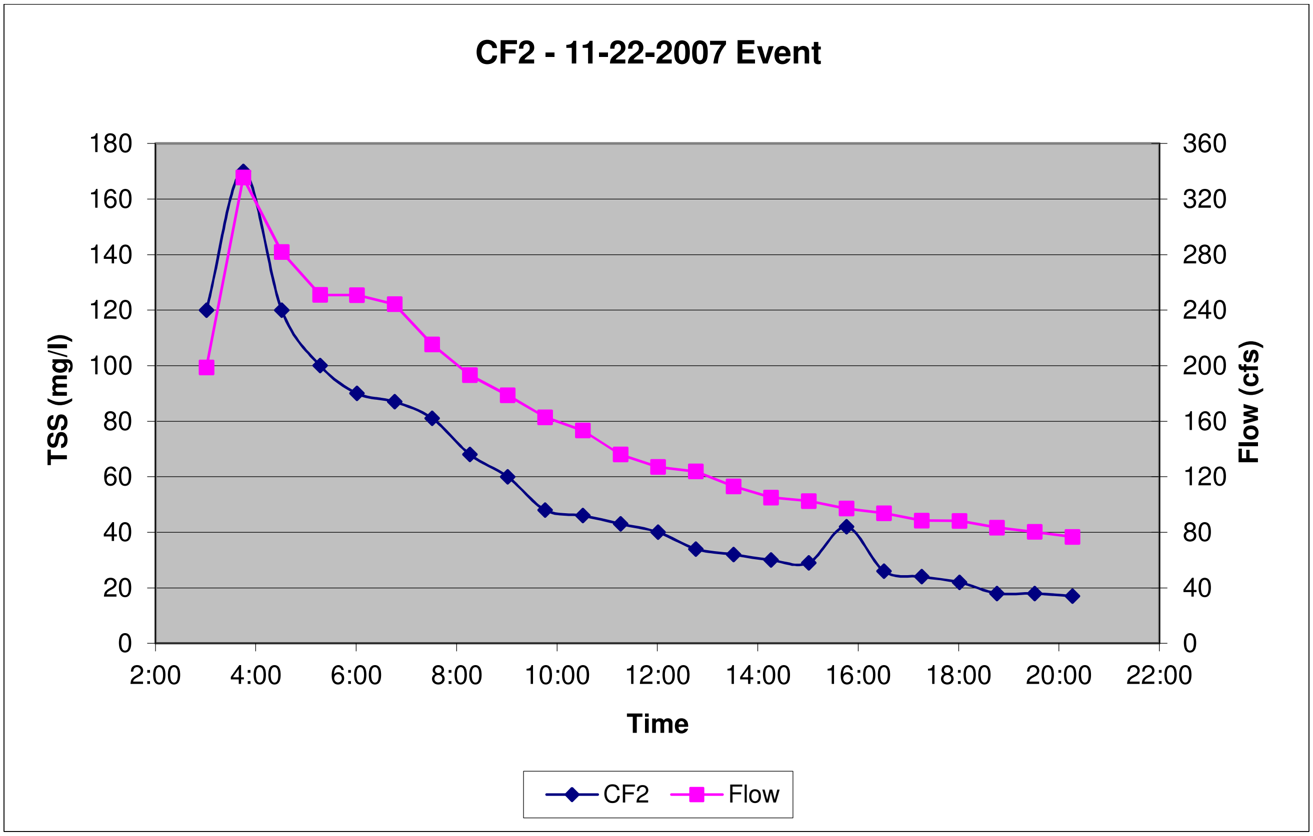
Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
CF2	1	3/18/2008	10:14	0:00	506.1	530	60,282	0
CF2	2	3/18/2008	10:24	0:10	685.1	380	58,505	9,899
CF2	3	3/18/2008	10:34	0:10	883.7	420	83,415	21,726
CF2	4	3/18/2008	10:44	0:10	1103.3	480	119,022	38,595
CF2	5	3/18/2008	10:54	0:10	1232.0	630	174,430	63,050
CF2	6	3/18/2008	11:04	0:10	1352.5	830	252,293	98,610
CF2	7	3/18/2008	11:14	0:10	1476.1	930	308,523	145,345
CF2	8	3/18/2008	11:24	0:10	1586.8	1,000	356,624	200,774
CF2	9	3/18/2008	11:34	0:10	1700.6	1,000	382,193	262,342
CF2	10	3/18/2008	11:44	0:10	1821.1	920	376,539	325,570
CF2	11	3/18/2008	11:54	0:10	1832.3	820	337,667	385,087
CF2	12	3/18/2008	12:04	0:10	1872.9	900	378,827	444,794
CF2	13	3/18/2008	12:14	0:10	1976.0	900	399,674	509,670
CF2	14	3/18/2008	12:24	0:10	2101.3	810	382,521	574,852
CF2	15	3/18/2008	12:34	0:10	2222.1	590	294,635	631,282
CF2	16	3/18/2008	12:44	0:10	2332.2	700	366,893	686,409
CF2	17	3/18/2008	12:54	0:10	2380.6	750	401,266	750,423
CF2	18	3/18/2008	13:04	0:10	2452.9	740	407,934	817,856
CF2	19	3/18/2008	13:14	0:10	2571.2	770	444,938	888,929
CF2	20	3/18/2008	13:24	0:10	2660.1	810	484,240	966,360
CF2	21	3/18/2008	13:34	0:10	2719.7	840	513,418	1,049,498
CF2	22	3/18/2008	13:44	0:10	2740.1	790	486,480	1,132,823
CF2	23	3/18/2008	13:54	0:10	2782.4	830	519,002	1,216,613
CF2	24	3/18/2008	14:04	0:10	2796.1	900	565,543	1,306,992
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

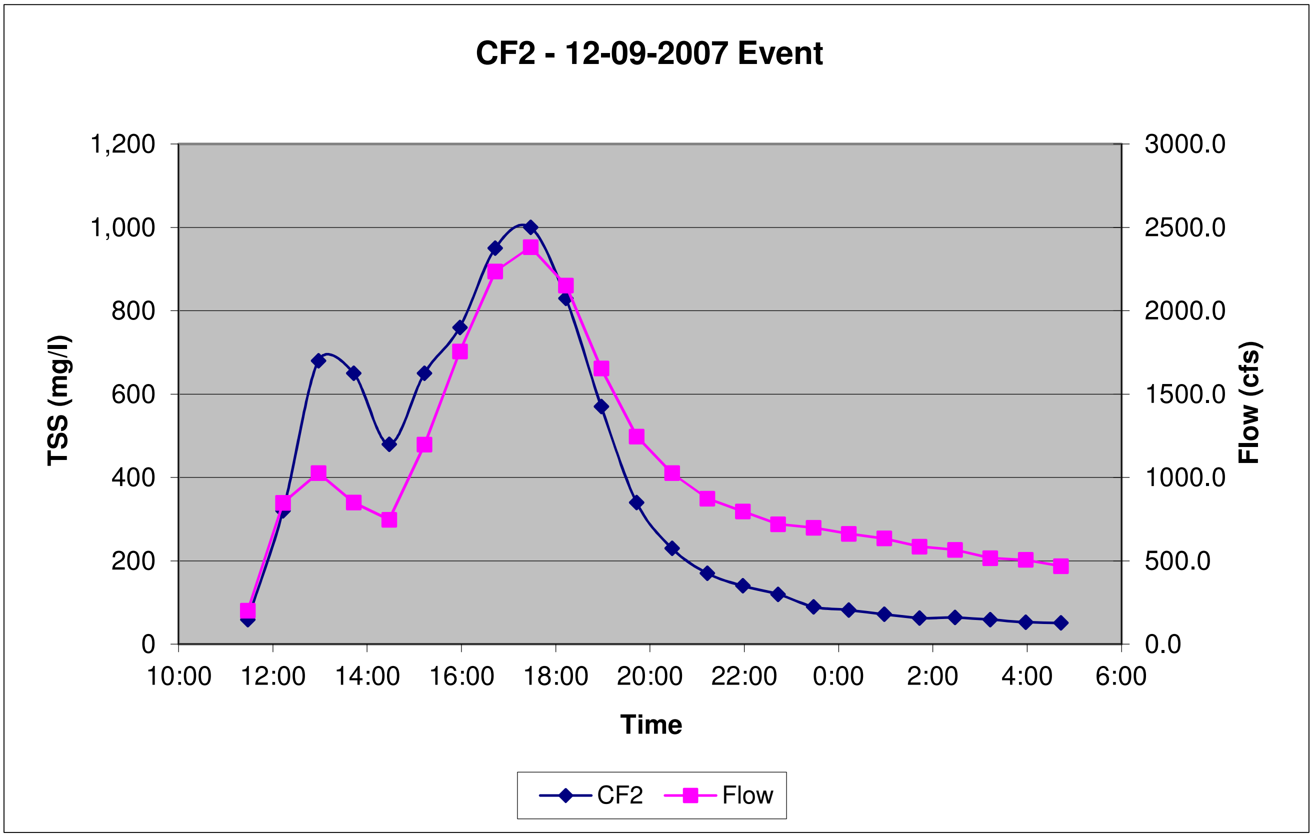
ISCO Wet Weather Event Data

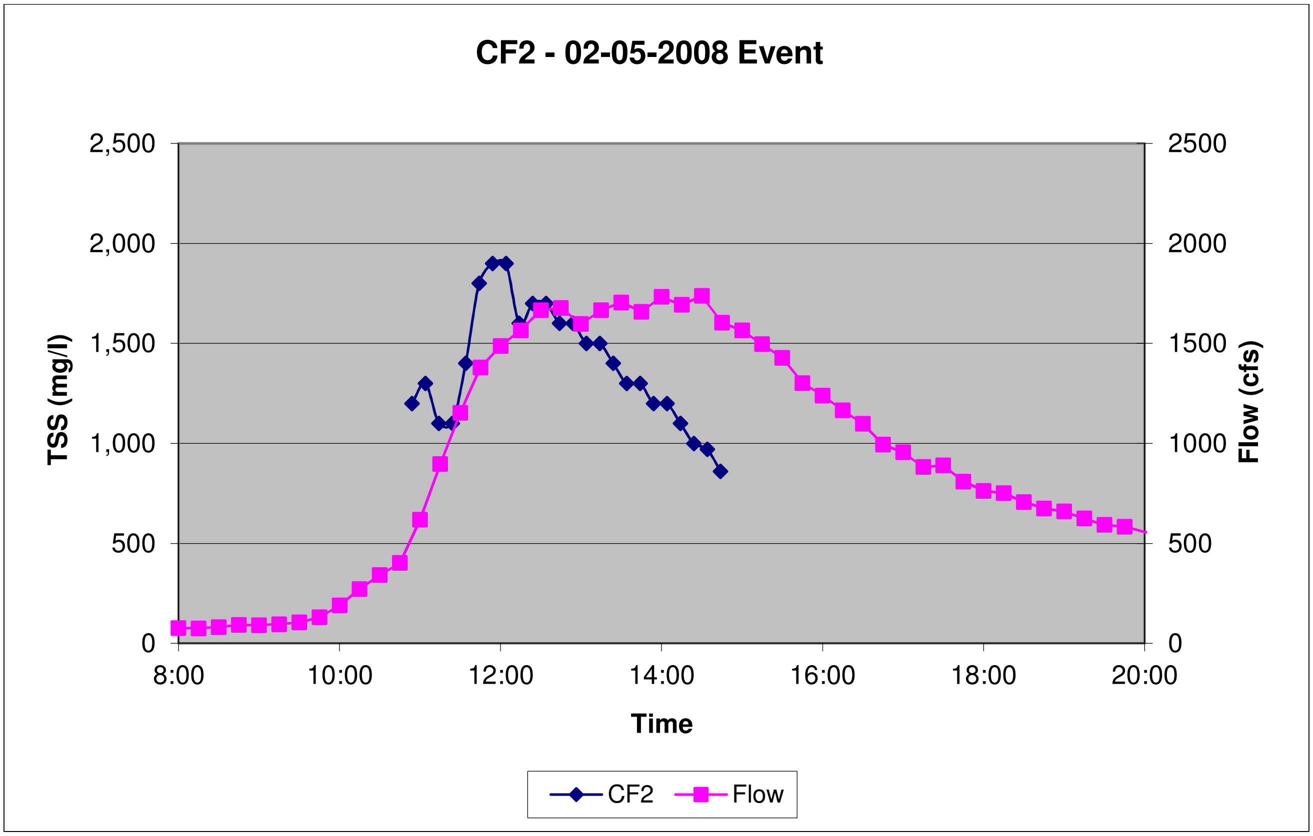
Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
CF2	1	3/27/2008	1:32	0:00	508.9	360	41,175	0
CF2	2	3/27/2008	1:42	0:10	686.2	480	74,025	9,600
CF2	3	3/27/2008	1:52	0:10	853.9	480	92,113	23,445
CF2	4	3/27/2008	2:02	0:10	1009.9	490	111,216	40,389
CF2	5	3/27/2008	2:12	0:10	1136.0	500	127,650	60,294
CF2	6	3/27/2008	2:22	0:10	1276.4	500	143,425	82,884
CF2	7	3/27/2008	2:32	0:10	1422.6	520	166,246	108,690
CF2	8	3/27/2008	2:42	0:10	1567.4	520	183,168	137,808
CF2	9	3/27/2008	2:52	0:10	1677.6	530	199,825	169,724
CF2	10	3/27/2008	3:02	0:10	1758.6	530	209,474	203,832
CF2	11	3/27/2008	3:12	0:10	1781.8	520	208,233	238,641
CF2	12	3/27/2008	3:22	0:10	1823.4	530	217,185	274,093
CF2	13	3/27/2008	3:32	0:10	1872.4	560	235,652	311,829
CF2	14	3/27/2008	3:42	0:10	1920.1	520	224,391	350,166
CF2	15	3/27/2008	3:52	0:10	1965.0	540	238,466	388,737
CF2	16	3/27/2008	4:02	0:10	1991.8	500	223,818	427,261
CF2	17	3/27/2008	4:12	0:10	1951.3	500	219,271	464,185
CF2	18	3/27/2008	4:22	0:10	1907.3	460	197,174	498,889
CF2	19	3/27/2008	4:32	0:10	1880.8	450	190,210	531,171
CF2	20	3/27/2008	4:42	0:10	1930.8	430	186,588	562,571
CF2	21	3/27/2008	4:52	0:10	1925.8	410	177,451	592,907
CF2	22	3/27/2008	5:02	0:10	1902.6	400	171,036	621,948
CF2	23	3/27/2008	5:12	0:10	1900.7	380	162,319	649,727
CF2	24	3/27/2008	5:22	0:10	1893.2	360	153,174	676,018
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

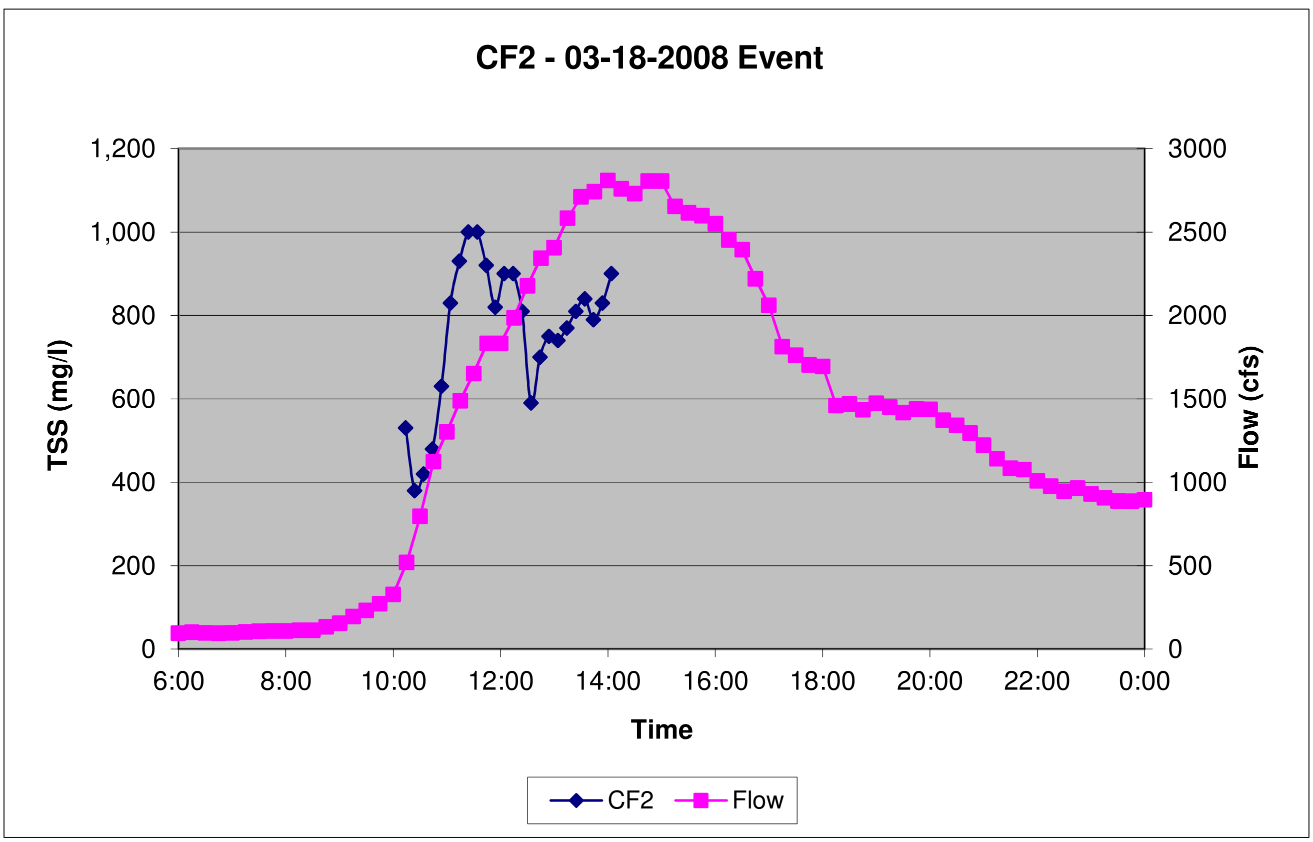
ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
CF2	1	4/11/2008	14:33	0:00	585.0	250	32,870	0
CF2	2	4/11/2008	14:48	0:15	649.1	320	46,678	9,944
CF2	3	4/11/2008	15:03	0:15	693.3	320	49,858	22,011
CF2	4	4/11/2008	15:18	0:15	753.2	230	38,931	33,109
CF2	5	4/11/2008	15:33	0:15	789.3	400	70,958	46,845
CF2	6	4/11/2008	15:48	0:15	828.7	360	67,045	64,096
CF2	7	4/11/2008	16:03	0:15	806.3	370	67,045	80,857
CF2	8	4/11/2008	16:18	0:15	857.8	490	94,460	101,045
CF2	9	4/11/2008	16:33	0:15	839.0	460	86,740	123,695
CF2	10	4/11/2008	16:48	0:15	800.5	430	77,363	144,208
CF2	11	4/11/2008	17:03	0:15	743.2	400	66,808	162,230
CF2	12	4/11/2008	17:18	0:15	721.1	400	64,820	178,683
CF2	13	4/11/2008	17:33	0:15	671.3	300	45,258	192,443
CF2	14	4/11/2008	17:48	0:15	639.1	320	45,963	203,846
CF2	15	4/11/2008	18:03	0:15	602.6	340	46,047	215,347
CF2	16	4/11/2008	18:18	0:15	569.6	300	38,401	225,903
CF2	17	4/11/2008	18:33	0:15	522.8	260	30,547	234,522
CF2	18	4/11/2008	18:48	0:15	497.5	260	29,070	241,974
CF2	19	4/11/2008	19:03	0:15	478.6	240	25,813	248,834
CF2	20	4/11/2008	19:18	0:15	453.8	230	23,458	254,993
CF2	21	4/11/2008	19:33	0:15	435.3	160	15,654	259,882
CF2	22	4/11/2008	19:48	0:15	413.5	210	19,517	264,278
CF2	23	4/11/2008	20:03	0:15	390.8	210	18,442	269,023
CF2	24	4/11/2008	20:18	0:15	373.5	200	16,788	273,427
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

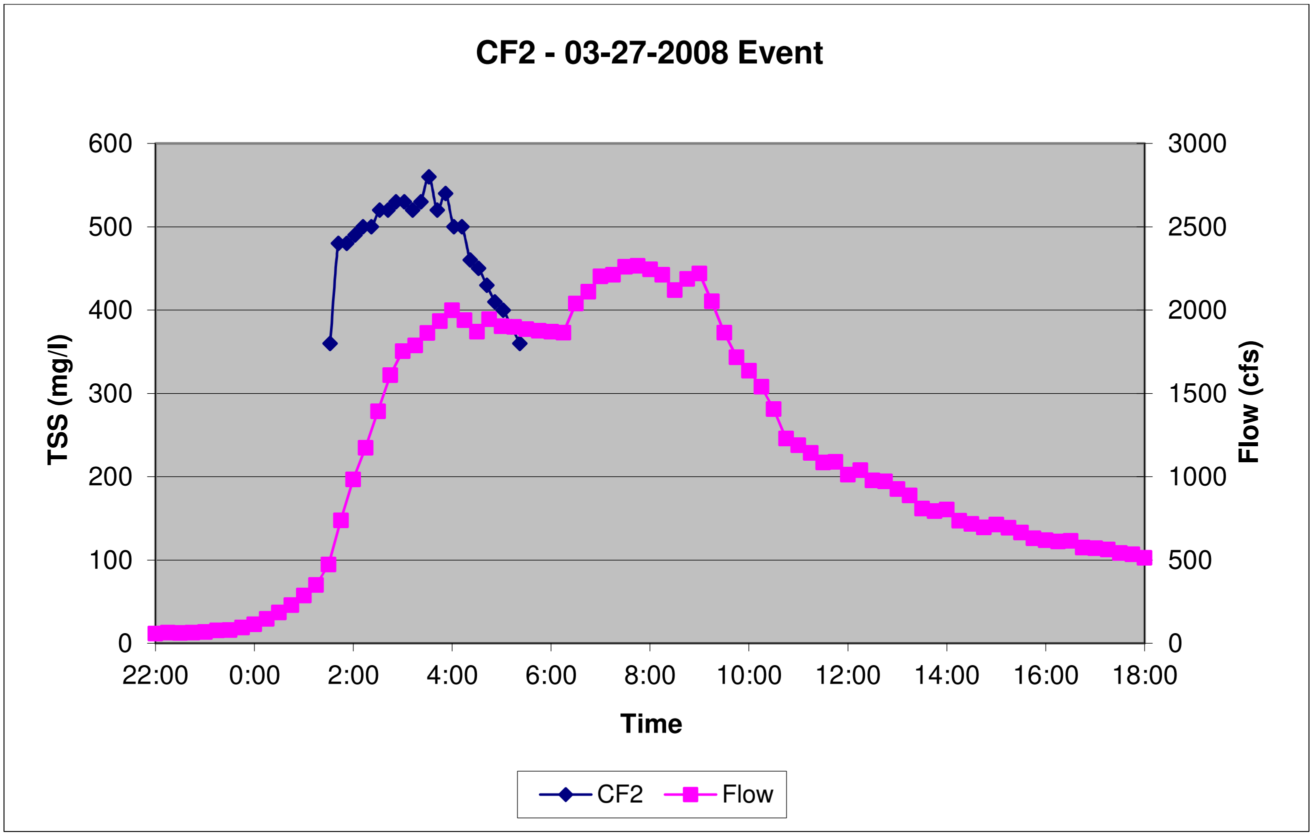

CF2 - 11-22-2007 Event
TSS (mg/l)
180
160
140
120
100
80
60
40
20
0
Flow (cfs)
360
320
280
240
200
160
120
80
40
0
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Time
CF2
Flow

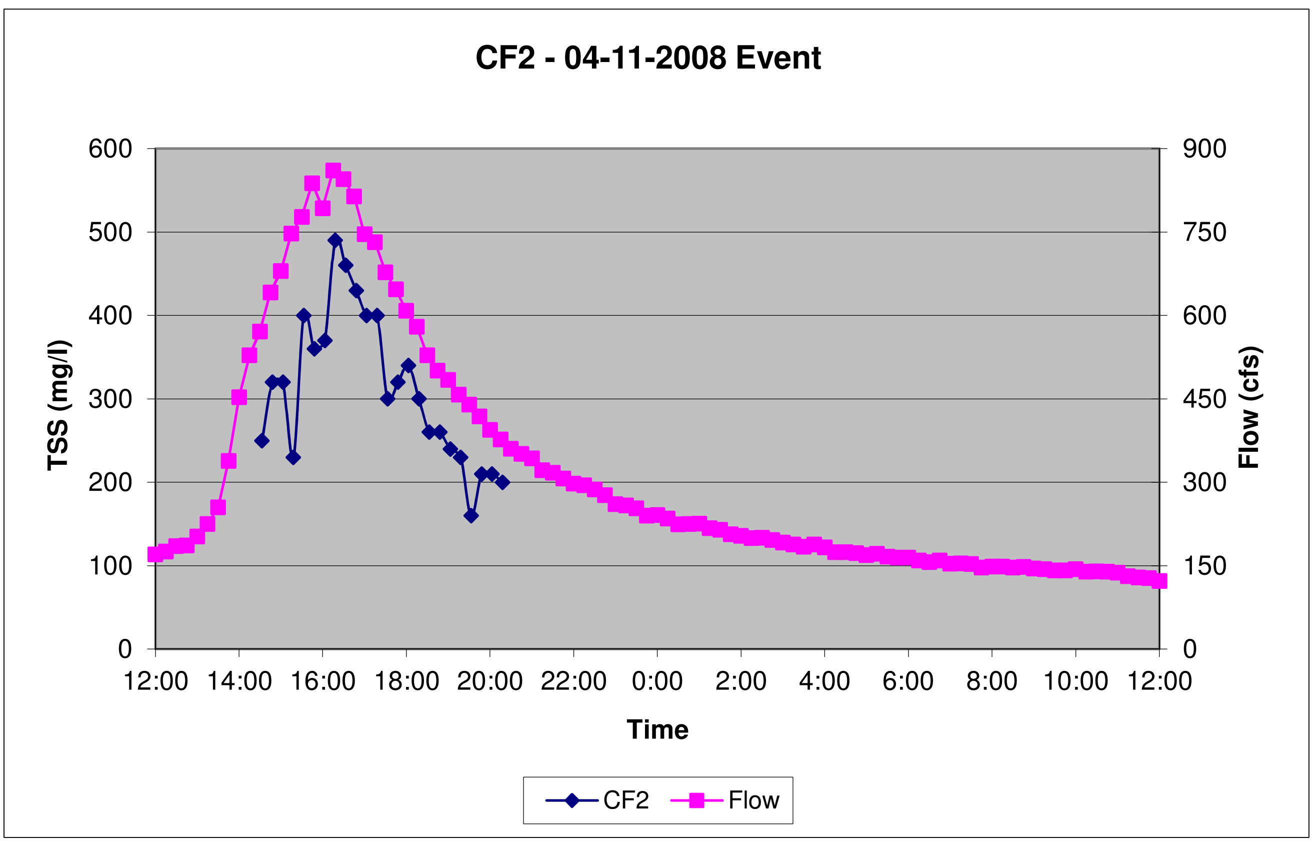

CF2 - 12-09-2007 Event
TSS (mg/l)
1,200
1,000
800
600
400
200
0
Flow (cfs)
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
2:00
4:00
6:00
Time
CF2
Flow


CF2 - 02-05-2008 Event
TSS (mg/l)
Flow (cfs)
2,500
2,000
1,500
1,000
500
0
2500
2000
1500
1000
500
0
8:00
10:00
12:00
14:00
16:00
18:00
20:00
Time
CF2
Flow


CF2 - 03-18-2008 Event
TSS (mg/l)
Flow (cfs)
1,200
1,000
800
600
400
200
0
3000
2500
2000
1500
1000
500
0
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time
CF2
Flow

ISCO Wet Weather Event Data





ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
SC1	1	3/4/2008	1:01	0:00	256.5	660	38,053	0
SC1	2	3/4/2008	1:11	0:10	297.4	570	38,098	6,346
SC1	3	3/4/2008	1:21	0:10	353.4	570	45,276	13,294
SC1	4	3/4/2008	1:31	0:10	417.8	460	43,191	20,666
SC1	5	1/0/1900	1:41	0:00	465.8	0	0	20,666
SC1	6	1/0/1900	1:51	0:00	517.7	0	0	20,666
SC1	7	1/0/1900	2:01	0:00	569.8	0	0	20,666
SC1	8	3/4/2008	2:11	0:40	602.7	760	102,937	54,978
SC1	9	3/4/2008	2:21	0:10	664.6	610	91,109	71,149
SC1	10	3/4/2008	2:31	0:10	740.0	740	123,064	88,997
SC1	11	3/4/2008	2:41	0:10	762.2	770	131,899	110,244
SC1	12	3/4/2008	2:51	0:10	789.5	720	127,743	131,881
SC1	13	3/4/2008	3:01	0:10	821.9	760	140,377	154,224
SC1	14	3/4/2008	3:11	0:10	870.7	740	144,801	177,989
SC1	15	3/4/2008	3:21	0:10	892.5	700	140,398	201,755
SC1	16	3/4/2008	3:31	0:10	902.2	720	145,981	225,620
SC1	17	3/4/2008	3:41	0:10	965.7	860	186,637	253,338
SC1	18	1/0/1900	3:51	0:00	999.0	0	0	253,338
SC1	19	3/4/2008	4:01	0:20	1013.5	650	148,056	278,014
SC1	20	3/4/2008	4:11	0:10	1038.8	640	149,412	302,803
SC1	21	3/4/2008	4:21	0:10	1127.1	570	144,383	327,286
SC1	22	3/4/2008	4:31	0:10	1252.1	1,000	281,401	362,768
SC1	23	3/4/2008	4:41	0:10	1329.4	850	253,951	407,381
SC1	24	3/4/2008	4:51	0:10	1371.8	550	169,561	442,674
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
SC1	1	3/18/2008	9:53	0:00	210.8	450	21,314	0
SC1	2	3/18/2008	10:03	0:10	252.1	460	26,063	3,948
SC1	3	3/18/2008	10:13	0:10	284.2	290	18,520	7,663
SC1	4	3/18/2008	10:23	0:10	325.5	280	20,482	10,914
SC1	5	3/18/2008	10:33	0:10	373.3	720	60,412	17,655
SC1	6	3/18/2008	10:43	0:10	431.0	420	40,687	26,080
SC1	7	3/18/2008	10:53	0:10	494.8	490	54,492	34,011
SC1	8	3/18/2008	11:03	0:10	528.2	0	0	38,552
SC1	9	3/18/2008	11:13	0:10	487.1	0	0	38,552
SC1	10	3/18/2008	11:23	0:10	555.9	0	0	38,552
SC1	11	3/18/2008	11:33	0:10	631.3	0	0	38,552
SC1	12	3/18/2008	11:43	0:10	657.9	0	0	38,552
SC1	13	3/18/2008	11:53	0:10	679.9	0	0	38,552
SC1	14	3/18/2008	12:03	0:10	713.9	0	0	38,552
SC1	15	3/18/2008	12:13	0:10	778.2	0	0	38,552
SC1	16	3/18/2008	12:23	0:10	842.1	0	0	38,552
SC1	17	3/18/2008	12:33	0:10	903.9	0	0	38,552
SC1	18	3/18/2008	12:43	0:10	960.8	0	0	38,552
SC1	19	3/18/2008	12:53	0:10	990.3	0	0	38,552
SC1	20	3/18/2008	13:03	0:10	1024.6	0	0	38,552
SC1	21	3/18/2008	13:13	0:10	1086.0	0	0	38,552
SC1	22	3/18/2008	13:23	0:10	1143.4	0	0	38,552
SC1	23	3/18/2008	13:33	0:10	1203.3	0	0	38,552
SC1	24	3/18/2008	13:43	0:10	1271.2	0	0	38,552
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

ISCO Wet Weather Event Data

Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
SC1	1	3/27/2008	1:07	0:00	295.6	350	23,253	0
SC1	2	3/27/2008	1:17	0:10	363.6	260	21,247	3,708
SC1	3	3/27/2008	1:27	0:10	417.2	380	35,626	8,448
SC1	4	3/27/2008	1:37	0:10	468.7	460	48,454	15,454
SC1	5	3/27/2008	1:47	0:10	518.0	390	45,402	23,276
SC1	6	3/27/2008	1:57	0:10	561.9	500	63,140	32,321
SC1	7	3/27/2008	2:07	0:10	601.0	430	58,078	42,422
SC1	8	3/27/2008	2:17	0:10	641.8	450	64,907	52,671
SC1	9	3/27/2008	2:27	0:10	697.6	480	75,258	64,351
SC1	10	3/27/2008	2:37	0:10	678.9	400	61,026	75,708
SC1	11	3/27/2008	2:47	0:10	649.9	460	67,186	86,393
SC1	12	3/27/2008	2:57	0:10	708.2	500	79,585	98,624
SC1	13	3/27/2008	3:07	0:10	704.0	500	79,107	111,848
SC1	14	3/27/2008	3:17	0:10	691.3	470	73,021	124,525
SC1	15	3/27/2008	3:27	0:10	752.3	480	81,149	137,373
SC1	16	1/0/1900	3:37	0:00	750.1	0	0	137,373
SC1	17	1/0/1900	3:47	0:00	729.0	0	0	137,373
SC1	18	1/0/1900	3:57	0:00	740.6	0	0	137,373
SC1	19	1/0/1900	4:07	0:00	686.7	0	0	137,373
SC1	20	1/0/1900	4:17	0:00	619.2	0	0	137,373
SC1	21	1/0/1900	4:27	0:00	609.2	0	0	137,373
SC1	22	1/0/1900	4:37	0:00	588.3	0	0	137,373
SC1	23	1/0/1900	4:47	0:00	562.3	0	0	137,373
SC1	24	1/0/1900	4:57	0:00	534.9	0	0	137,373
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

ISCO Wet Weather Event Data

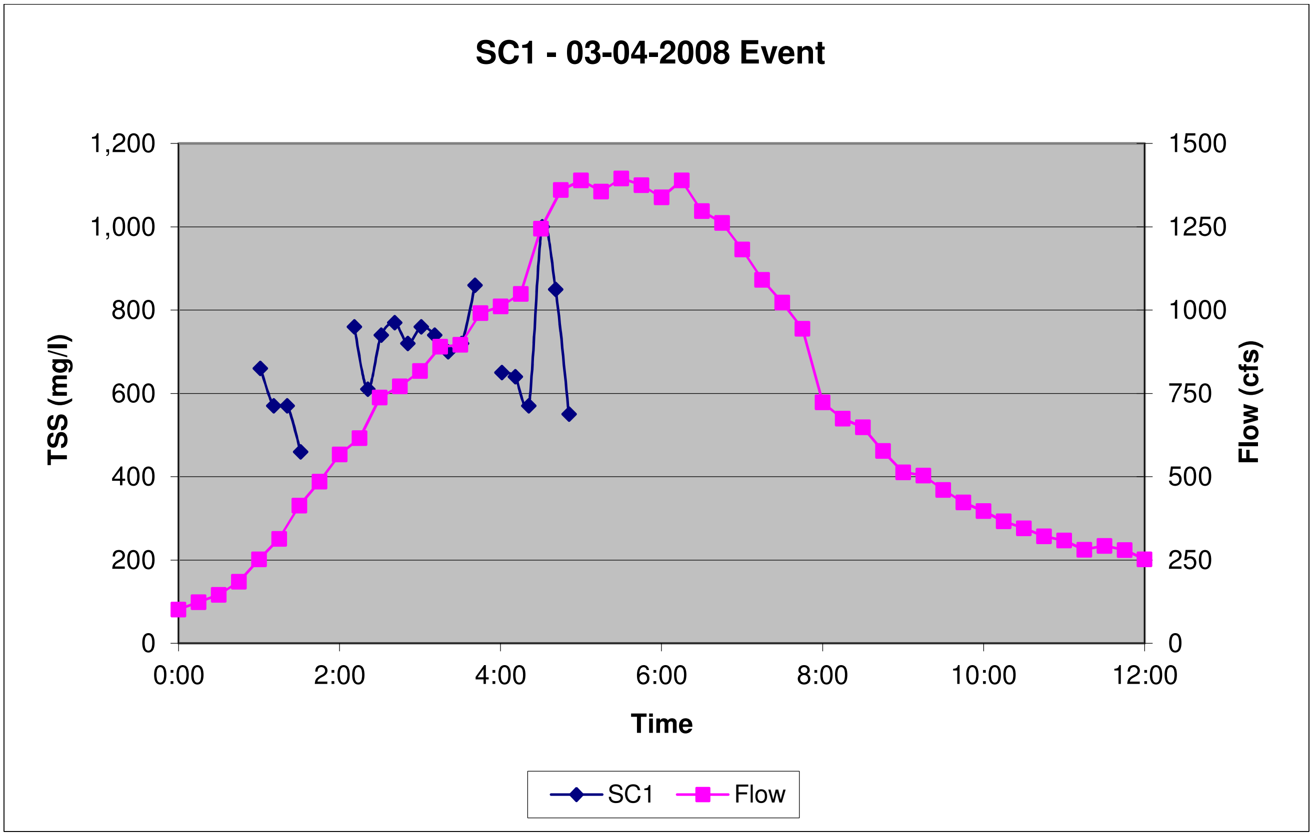
Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
SC1	1	4/3/2008	22:41	0:00	180.1	810	32,778	0
SC1	2	4/3/2008	22:56	0:15	495.1	1,800	200,294	29,134
SC1	3	4/3/2008	23:11	0:15	961.9	2,300	497,184	116,319
SC1	4	4/3/2008	23:26	0:15	1388.5	2,400	748,912	272,081
SC1	5	4/3/2008	23:41	0:15	1591.7	2,300	822,734	468,536
SC1	6	4/3/2008	23:56	0:15	1673.0	2,200	827,169	674,774
SC1	7	4/4/2008	0:11	0:15	1758.1	1,700	671,692	862,132
SC1	8	4/4/2008	0:26	0:15	1796.2	1,600	645,871	1,026,827
SC1	9	4/4/2008	0:41	0:15	1718.9	1,500	579,443	1,179,992
SC1	10	4/4/2008	0:56	0:15	1671.5	1,500	563,491	1,322,858
SC1	11	4/4/2008	1:11	0:15	1701.1	1,300	496,982	1,455,418
SC1	12	4/4/2008	1:26	0:15	1710.9	1,100	422,967	1,570,411
SC1	13	4/4/2008	1:41	0:15	1722.6	940	363,898	1,668,769
SC1	14	4/4/2008	1:56	0:15	1746.5	710	278,677	1,749,091
SC1	15	4/4/2008	2:11	0:15	1701.7	640	244,764	1,814,521
SC1	16	4/4/2008	2:26	0:15	1692.7	530	201,614	1,870,319
SC1	17	4/4/2008	2:41	0:15	1690.4	470	178,553	1,917,840
SC1	18	4/4/2008	2:56	0:15	1638.8	480	176,785	1,962,257
SC1	19	4/4/2008	3:11	0:15	1636.9	430	158,189	2,004,129
SC1	20	4/4/2008	3:26	0:15	1607.7	410	148,136	2,042,419
SC1	21	4/4/2008	3:41	0:15	1688.6	410	155,594	2,080,385
SC1	22	4/4/2008	3:56	0:15	1682.7	380	143,700	2,117,797
SC1	23	4/4/2008	4:11	0:15	1722.2	390	150,949	2,154,628
SC1	24	4/4/2008	4:26	0:15	1640.3	430	158,511	2,193,311
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

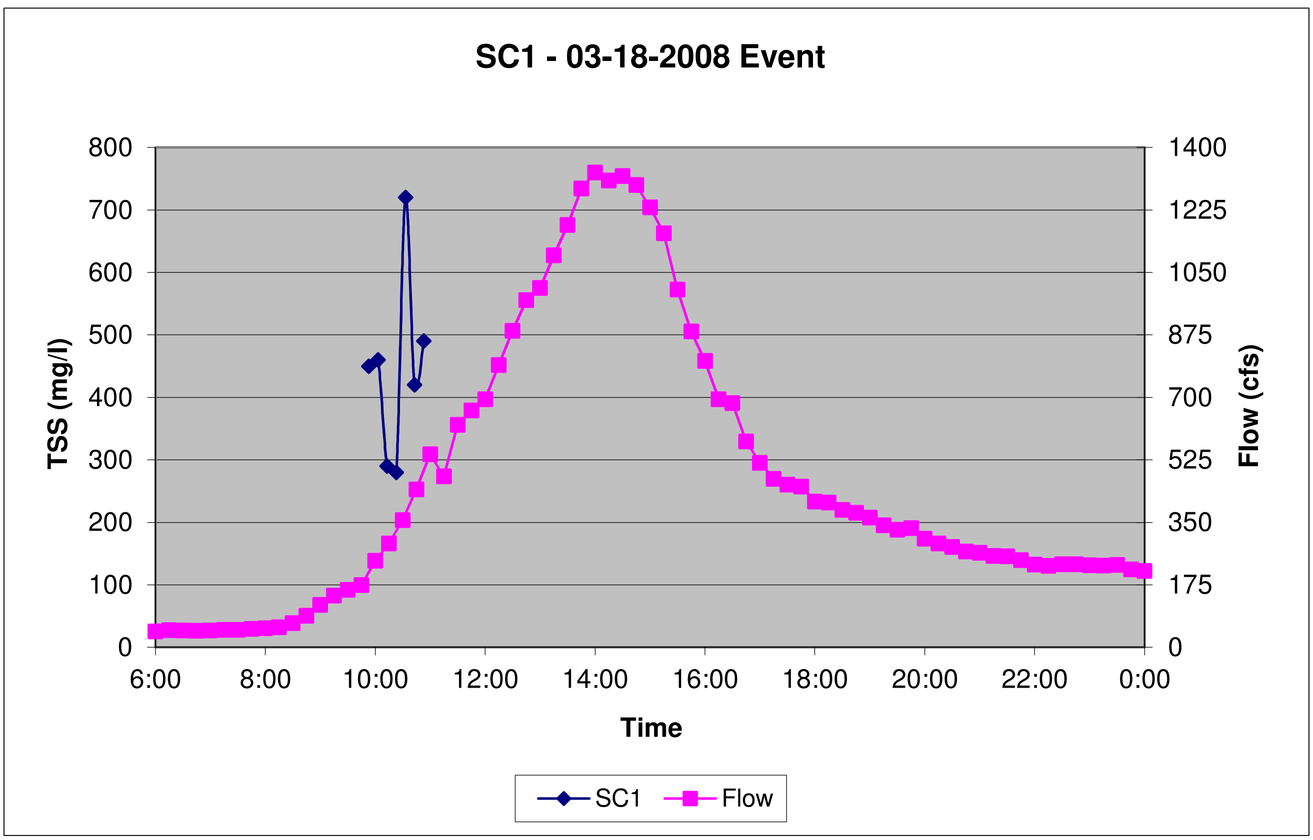
ISCO Wet Weather Event Data

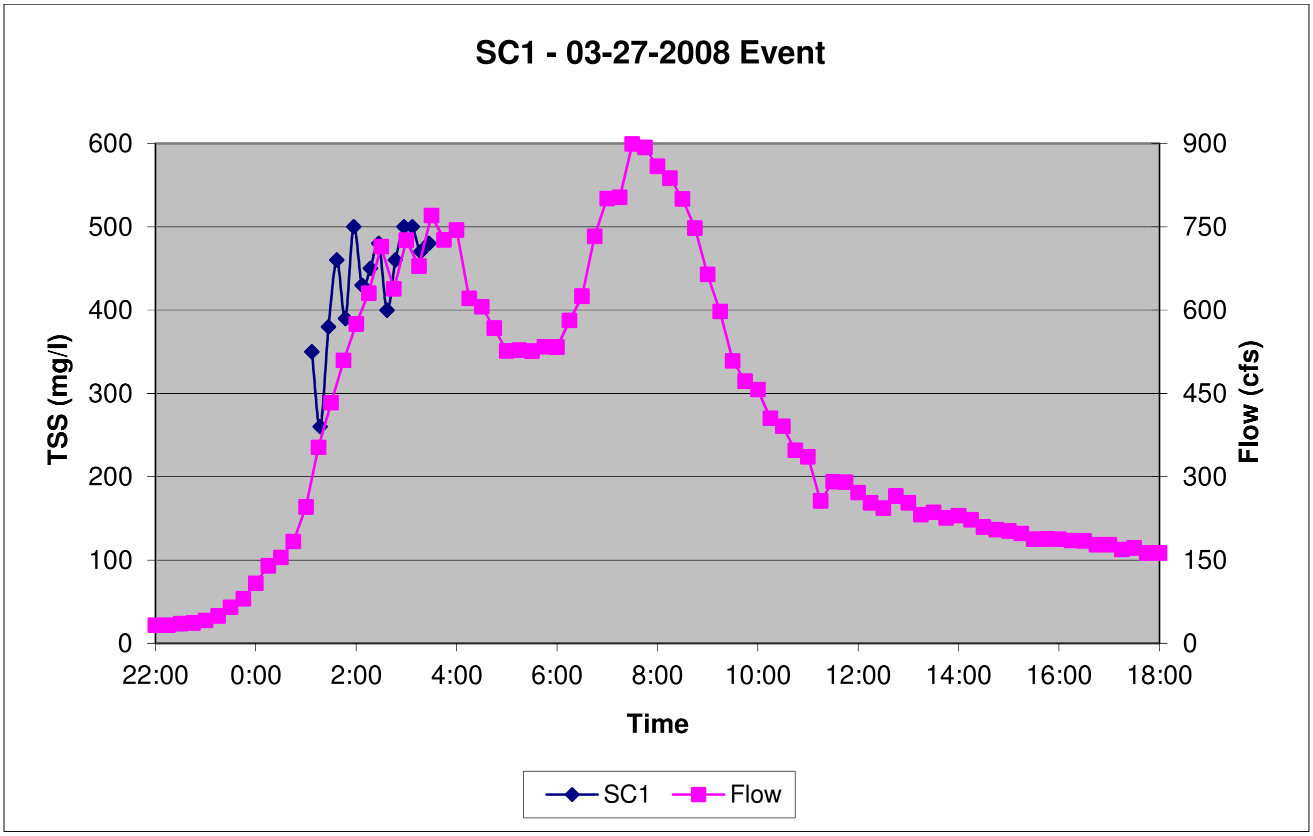
Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
SC1	1	5/11/2008	16:26	0:00	290.6	330	21,555	0
SC1	2	5/11/2008	16:41	0:15	308.2	350	24,245	5,725
SC1	3	5/11/2008	16:56	0:15	308.6	400	27,738	12,223
SC1	4	5/11/2008	17:11	0:15	304.3	370	25,307	18,854
SC1	5	5/11/2008	17:26	0:15	302.7	330	22,451	24,823
SC1	6	5/11/2008	17:41	0:15	306.5	310	21,350	30,298
SC1	7	5/11/2008	17:56	0:15	301.8	290	19,667	35,426
SC1	8	5/11/2008	18:11	0:15	294.6	260	17,212	40,035
SC1	9	5/11/2008	18:26	0:15	285.9	230	14,776	44,034
SC1	10	5/11/2008	18:41	0:15	278.6	220	13,773	47,603
SC1	11	5/11/2008	18:56	0:15	274.7	200	12,348	50,868
SC1	12	5/11/2008	19:11	0:15	270.7	180	10,951	53,780
SC1	13	5/11/2008	19:26	0:15	266.7	170	10,188	56,422
SC1	14	5/11/2008	19:41	0:15	261.6	150	8,818	58,798
SC1	15	5/11/2008	19:56	0:15	266.4	150	8,982	61,023
SC1	16	5/11/2008	20:11	0:15	264.6	130	7,732	63,112
SC1	17	5/11/2008	20:26	0:15	259.2	130	7,573	65,025
SC1	18	5/11/2008	20:41	0:15	252.9	130	7,390	66,896
SC1	19	5/11/2008	20:56	0:15	243.5	140	7,663	68,777
SC1	20	5/11/2008	21:11	0:15	238.3	120	6,427	70,538
SC1	21	5/11/2008	21:26	0:15	226.0	110	5,588	72,040
SC1	22	5/11/2008	21:41	0:15	212.1	110	5,245	73,394
SC1	23	5/11/2008	21:56	0:15	201.3	110	4,976	74,672
SC1	24	5/11/2008	22:11	0:15	201.7	100	4,533	75,860
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

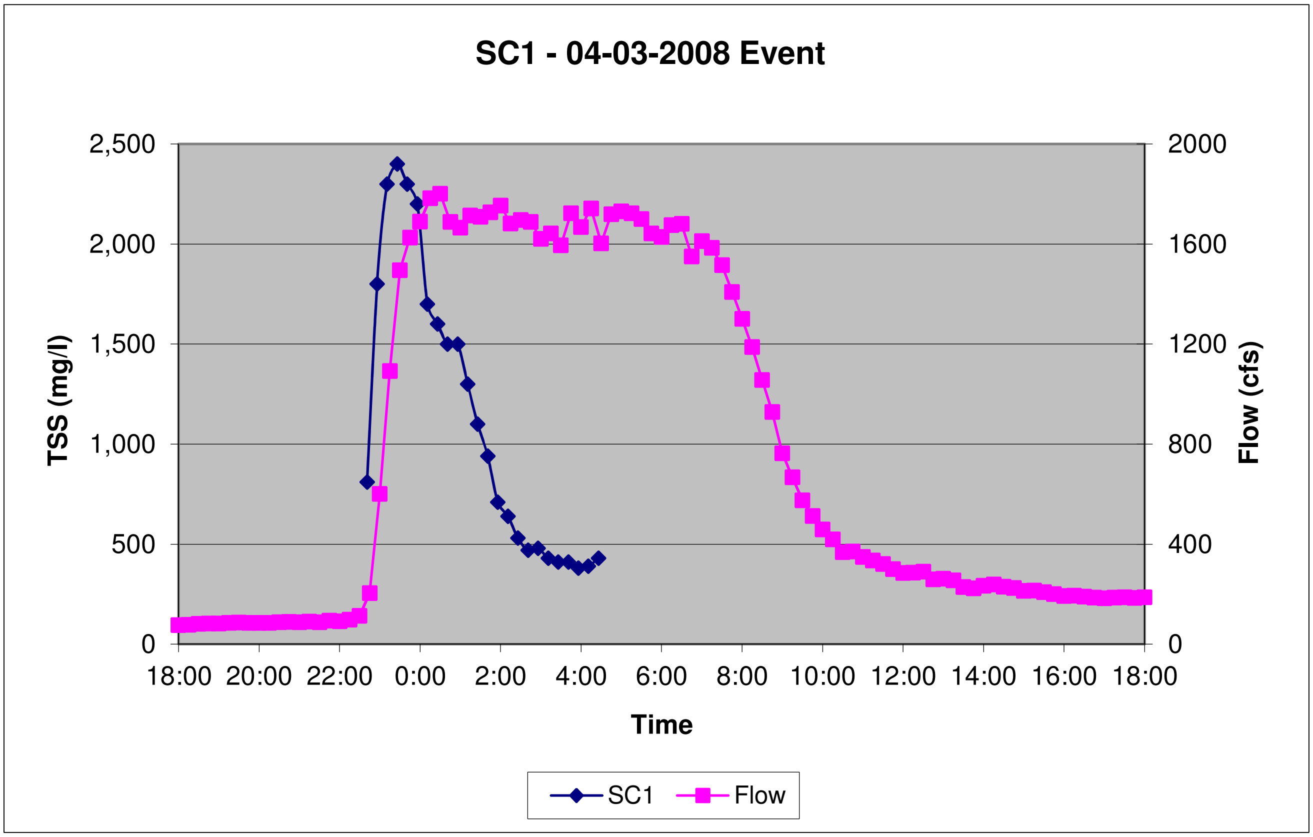
ISCO Wet Weather Event Data

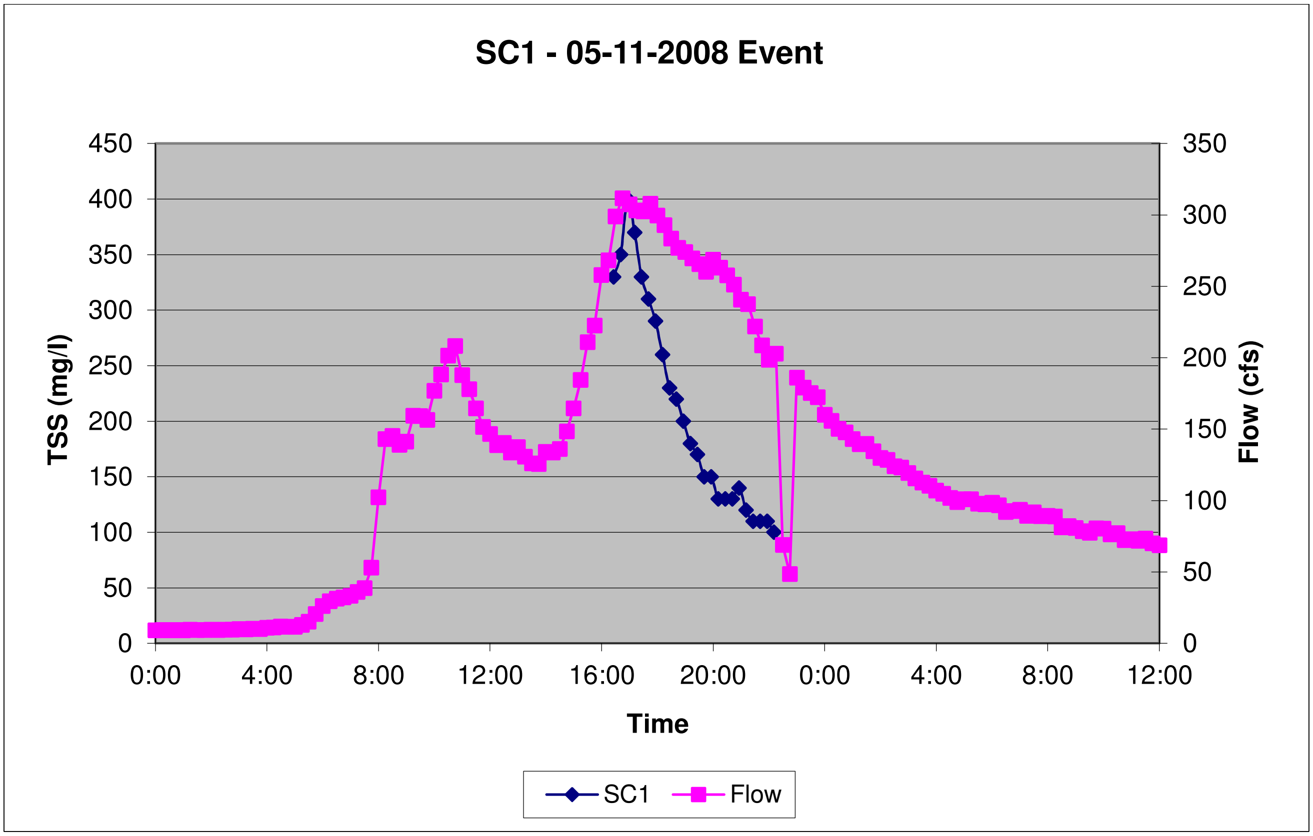
Sample ID	Sample No.	Date	Time	Sample Time Interval	Stream Flow (cfs)	TSS (mg/l)	Instantaneous Sediment Load (lbs/hour)	Cumulative Load (lbs)
SC1	1	5/15/2008	18:57	0:00	267.9	330	19,867	0
SC1	2	5/15/2008	19:12	0:15	290.7	380	24,822	5,586
SC1	3	5/15/2008	19:27	0:15	329.7	450	33,339	12,856
SC1	4	5/15/2008	19:42	0:15	414.4	500	46,562	22,844
SC1	5	5/15/2008	19:57	0:15	516.9	810	94,086	40,425
SC1	6	5/15/2008	20:12	0:15	626.7	1,100	154,927	71,552
SC1	7	5/15/2008	20:27	0:15	772.4	1,100	190,940	114,785
SC1	8	5/15/2008	20:42	0:15	880.8	1,100	217,738	165,870
SC1	9	5/15/2008	20:57	0:15	974.1	980	214,535	219,904
SC1	10	5/15/2008	21:12	0:15	1070.2	1,100	264,565	279,791
SC1	11	5/15/2008	21:27	0:15	1155.9	970	251,986	344,360
SC1	12	5/15/2008	21:42	0:15	1182.7	970	257,816	408,086
SC1	13	5/15/2008	21:57	0:15	1147.8	860	221,849	468,044
SC1	14	5/15/2008	22:12	0:15	1188.7	870	232,425	524,828
SC1	15	5/15/2008	22:27	0:15	1212.4	760	207,083	579,766
SC1	16	5/15/2008	22:42	0:15	1158.6	620	161,431	625,831
SC1	17	5/15/2008	22:57	0:15	1085.0	550	134,108	662,773
SC1	18	5/15/2008	23:12	0:15	996.1	480	107,456	692,969
SC1	19	5/15/2008	23:27	0:15	899.4	400	80,856	716,508
SC1	20	5/15/2008	23:42	0:15	786.0	360	63,594	734,564
SC1	21	5/15/2008	23:57	0:15	628.8	330	46,638	748,343
SC1	22	5/16/2008	0:12	0:15	515.4	310	35,907	758,661
SC1	23	5/16/2008	0:27	0:15	456.1	280	28,698	766,736
SC1	24	5/16/2008	0:42	0:15	417.8	240	22,533	773,140
Max					**335**	**170**	**12,815**	
Min					**77**	**17**	**293**	
Average					**158**	**57**	**2,617**	
Median					**132**	**43**	**1,228**	

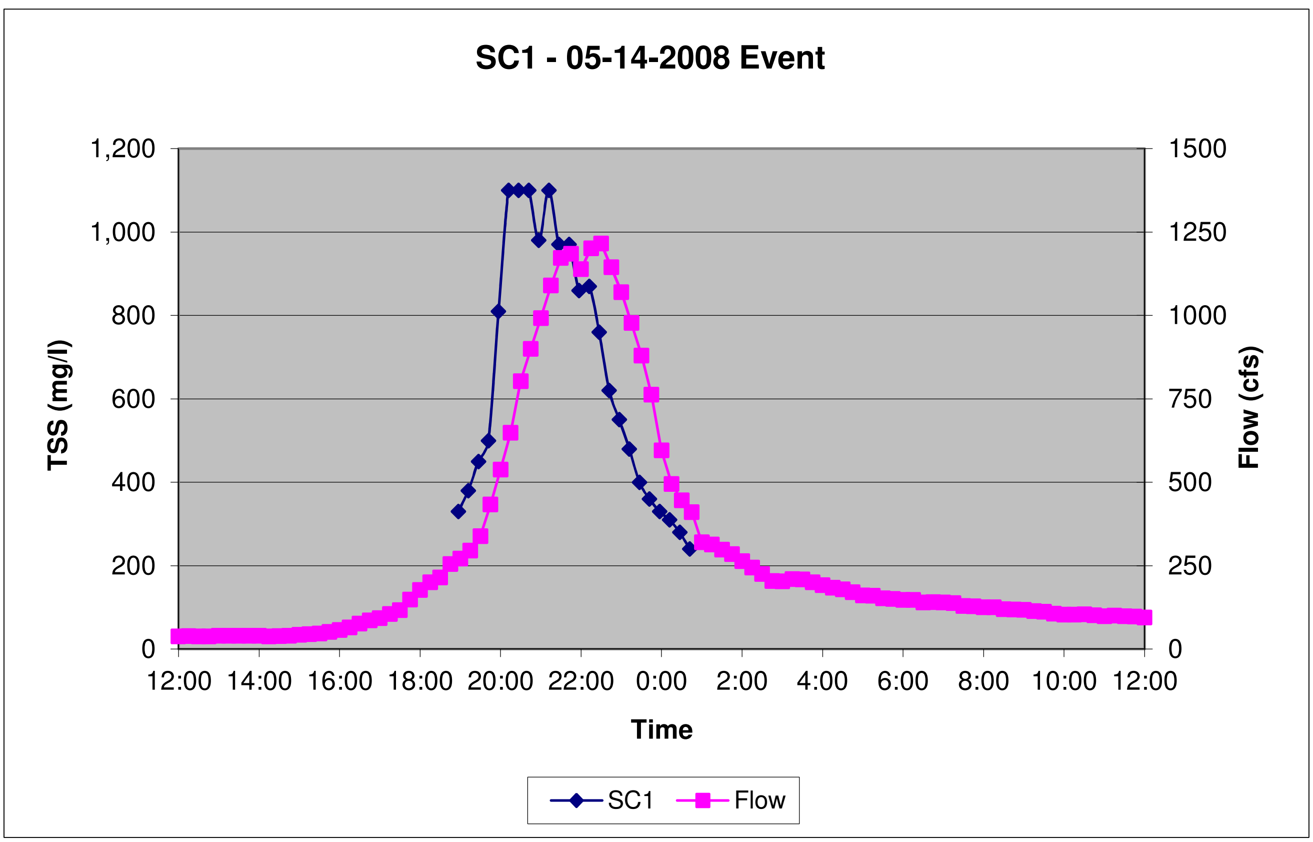

SC1 - 03-04-2008 Event
TSS (mg/l)
Flow (cfs)
Time
1,200
1,000
800
600
400
200
0
1500
1250
1000
750
500
250
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
SC1
Flow


SC1 - 03-18-2008 Event
TSS (mg/l)
Flow (cfs)
Time
800
700
600
500
400
300
200
100
0
1400
1225
1050
875
700
525
350
175
0
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
SC1
Flow


SC1 - 03-27-2008 Event
TSS (mg/l)
Flow (cfs)
600
500
400
300
200
100
0
900
750
600
450
300
150
0
22:00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
Time
SC1
Flow


SC1 - 04-03-2008 Event
TSS (mg/l)
Flow (cfs)
2,500
2,000
1,500
1,000
500
0
2000
1600
1200
800
400
0
18:00
20:00
22:00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
Time
SC1
Flow


SC1 - 05-11-2008 Event
TSS (mg/l)
450
400
350
300
250
200
150
100
50
0
Flow (cfs)
350
300
250
200
150
100
50
0
0:00
4:00
8:00
12:00
16:00
20:00
0:00
4:00
8:00
12:00
Time
SC1
Flow


SC1 - 05-14-2008 Event
TSS (mg/l)
1,200
1,000
800
600
400
200
0
Flow (cfs)
1500
1250
1000
750
500
250
0
12:00
14:00
16:00
18:00
20:00
22:00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
Time
SC1
Flow

APPENDIX J
SECONDARY KDOW BIOLOGICAL AND HABITAT ASSESSMENTS

Secondary KDOW Biological and Habitat Data

SiteID	12028002	12028003
Agency	DOW	DOW
Stations.Program	INT	INT
StationID	DOW12028002	DOW12028003
Location	KY HIGHWAY 1408 (TODDS POINT ROAD) BRIDGE	KY HIGHWAY 393 BRIDGE
River Mile	0.40	6.70
UT		
Basin	SALT	SALT
Strm_Order	4	3
Physiographic Region	OB	OB
Ecoregion	INTERIOR PLATEAU	INTERIOR PLATEAU
Sub-Ecoregion Number	71d	71d
FRepNum	1	1
FishSamps.Program	INT	INT
County	OLDHAM	OLDHAM
Lat_Dec	38.3075	38.3772
Long_Dec	-85.4508	-85.4275
CollDate	11/11/81	11/17/81
CollMeth	BACKPACK ELECTROFISHER, SEINE	BACKPACK ELECTROFISHER, SEINE
Collector	MILLS, PORTER, SCHNIEDER, HOUP	CALL, PORTER, SCHNIEDER, SOLE, HOUP
ID by	M. R. MILLS	M. R. MILLS
Shocking Seconds		
Seine Minutes		
Catchment Area	28.4	8
StreamName	CURRYS FORK	NORTH FORK CURRYS FORK
TNI	195	257
NAT	19	19
DMS	5	5
INT	1	0
SL	6	7
%INSCT	60.00	26.46
%TOL	34.35897436	43.19066148
%FHW	73.33	74.32
NAT	72.16	91.92
DMS	58.00	75.56
INT	17.56	23.64
SL	52.71	80.15
%INSCT	65.75	40.50
%TOL	66.61	67.95
%FHW	36.47	0.67
KIBI_Wadeable	55	63
Classification	Excellent	Excellent
Ambloplites rupestris		
Ameiurus natalis		
Campostoma anomalum	2	60
Carpiodes cyprinus		
Catostomus commersonii		3
Cottus carolinae		

Cyprinella spiloptera		
Cyprinella whipplei		
Esox americanus vermiculatus		
Etheostoma blennioides	6	3
Etheostoma caeruleum	24	11
Etheostoma flabellare	16	20
Etheostoma nigrum	7	6
Etheostoma zonale		
Fundulus notatus	1	2
Hypentelium nigricans		1
Labidesthes sicculus	6	
Lepomis cyanellus		
Lepomis cyanellus X L_ macrochirus		
Lepomis macrochirus	2	6
Lepomis megalotis	1	9
Lepomis microlophus		3
Luxilus chrysocephalus	16	9
Lythrurus fasciolaris	47	10
Micropterus dolomieu		
Micropterus punctulatus		
Micropterus salmoides		1
Minytrema melanops		2
Moxostoma breviceps		
Moxostoma duquesnei		
Moxostoma erythrurum	1	
Notropis boops	2	
Notropis buccatus	4	18
Notropis rubellus		
Notropis stramineus	5	
Notropis volucellus		
Noturus flavus		
Noturus miurus		
Percina caprodes	1	
Percina maculata		1
Percopsis omiscomaycus	5	
Phenacobius mirabilis		
Pimephales notatus	47	61
Pomoxis nigromaculatus		
Semotilus atromaculatus	2	31

Secondary KDOW Biological and Habitat Data

StationID	DOW12028002	DOW12028002	DOW12028003
Program	INT	WBM	INT
StreamName	CURRYS FORK	CURRYS FORK	NORTH FORK CURRYS FORK
Location	KY HIGHWAY 1408 (TODDS POINT ROAD) BRIDGE	KY HIGHWAY 1408 (TODDS POINT ROAD) BRIDGE	KY HIGHWAY 393 BRIDGE
Strm_Order	4	4	3
Catchment Area	28.4	28.4	8
Ecoregion	INTERIOR PLATEAU	INTERIOR PLATEAU	INTERIOR PLATEAU
Sub-Ecoregion Number	71d	71d	71d
Basin	SALT	SALT	SALT
CollDate	11/11/81	07/27/99	11/17/81
CollMeth	MULTI-HABITAT	MULTI-HABITAT	MULTI-HABITAT
G-TR	38	42	31
G-EPT	9	13	9
HBI2	5.60	5.57	5.21
m%EPT	16.54636313	17.23636364	13.47387718
%-Chiro+Olig	24.15324783	1.090909123	4.032997131
%ClngP	60.63	72.15	65.72
TotInd	1801	1375	1091
G-TR	51.35	56.76	41.89
G-EPT	30.00	43.33	30.00
HBI2	63.92	64.32	69.49
m%EPT	22.67	23.61	18.46
%-Chiro+Olig	76.61	99.91	96.94
%ClngP	81.94	97.49	88.81
MBI	54.4	64.2	57.6
Classification	Fair	Good	Fair
BankSta-LB		2	
BankSta-RB		3	
BankVegP-LB		4	
BankVegP-RB		5	
ChaFlowS		13	
ChanAlter		15	
Embeddedness		10	
EpiFauSub		12	
FreqOfRiffles		16	
RipVegZW-LB		2	
RipVegZW-RB		2	
SedDep		10	
Vel/Dep Regime		11	

Secondary KDOW Biological and Habitat Data

StationID	DOW12028002
StreamName	CURRYS FORK
Location	KY HIGHWAY 1408 (TODDS POINT ROAD) BRIDGE
River Mile	0.40
Basin	SALT
Strm_Order	4
Catchment Area	28.4
Ecoregion	INTERIOR PLATEAU
County	OLDHAM
Lat_Dec	38.3075
Long_Dec	-85.4508
Map_Name	CRESTWOOD
CollDate	27-Jul-99
DRepNum	1
Substrate	N
Program	WBM
Collector	L. METZMEIER
ID By	L. METZMEIER
Algae_Type	DIATOM
TNI	501
TR	52
Diversity	0.989
PTI	1.748
%Nav+Nit+Sur	86.22754491
Cym Gp Richness	4
FGR	0
TR	50.00
Diversity	69.16
PTI	50.52
%Nav+Nit+Sur	14.14
Cym Gp Richness	30.77
FGR	0.00
DBI	35.8
Classification	Poor
Achnanthes deflexa	9
Achnanthes pinnata	2
Achnanthidium minutissimum	
Amphora bullatoides	0
Amphora ovalis var_ pediculus	
Amphora perpusilla	26
Bacillaria paradoxa	
Caloneis bacillum	0
Cocconeis pediculus	4
Cocconeis placentula var_ euglypta	4
Cyclotella atomus	0
Cyclotella striata var_ ambigua	0
Cymbella affinis	1
Cymbella tumida	5
Cymbella turgidula	3
Diadesmis confervacea	
Diatoma vulgare	1

Diploneis puella	0
Encyonema prostrata var_ auerswaldii	
Gomphonema affine	1
Gomphonema angustatum	
Gomphonema clavatum var_ mexicanum	0
Gomphonema parvulum	3
Gomphonema truncatum var_ capitatum	0
Gyrosigma acuminatum	0
Gyrosigma scalproides	0
Gyrosigma spencerii var_ curvula	
Hippodonta capitata	
Melosira varians	1
Navicula accomoda	
Navicula agrestis	
Navicula arvensis	
Navicula capitatoradiata	0
Navicula cryptocephala	
Navicula cryptocephala var_ veneta	0
Navicula elginensis	
Navicula lanceolata	0
Navicula menisculus var_ upsaliensis	0
Navicula minima	130
Navicula radiosa var_ tenella	7
Navicula rhynchocephala	
Navicula rhynchocephala var_ germanii	11
Navicula schroeteri var_ escambia	11
Navicula secreta var_ apiculata	0
Navicula spp_	
Navicula subminuscula	25
Navicula tenelloides	
Navicula tripunctata var_ schizonemoides	4
Navicula viridula var_ rostellata	1
Nitzschia amphibia	51
Nitzschia angustatula	1
Nitzschia constricta	0
Nitzschia dissipata	8
Nitzschia filiformis	
Nitzschia gracilis	0
Nitzschia hungarica	0
Nitzschia inconspicua	146
Nitzschia intermedia	
Nitzschia linearis	0
Nitzschia palea	9
Nitzschia perminuta	24
Nitzschia sinuata var_ tabellaria	0
Nitzschia sp_1	3
Planothidium lanceolata	
Pleurosigma delicatulum	
Pleurosira laevis	
Reimeria sinuata	0
Rhoicosphenia curvata	6
Sellophora pupula f_ rostrata	

Stauroneis smithii	
Stephanocyclus meneghiniana	1
Surirella ovata	1
Synedra ulna	
Thalassiosira weissflogii	2
Tryblionella levidensis	0
Tryblionella victoriae	

Secondary KDOW Biological and Habitat Data

StationID	DOW12028002
SiteID	12028002
StreamName	CURRYS FORK
CollDate	07/27/99
Program	WBM
TotHabSc	105
BankSta-LB	2
BankSta-RB	3
BankVegP-LB	4
BankVegP-RB	5
ChaFlowS	13
ChanAlter	15
Embeddedness	10
EpiFauSub	12
FreqOfRiffles	16
RipVegZW-LB	2
RipVegZW-RB	2
SedDep	10
Vel/Dep Regime	11