United States Environmental Protection Agency
Region 7
Total Maximum Daily Load
For Nutrients

West Fork Black River (MO_2755)
Reynolds County, Missouri

for Karen A. Flournoy
William A. Spratlin
Director
Water, Wetlands and Pesticides Division

12-23-10
Date

(This page intentionally left blank.)

Total Maximum Daily Load (TMDL)
For West Fork Black River
Pollutants: Nutrients

Name: West Fork Black River

Location: Near the City of Centerville in Reynolds County, Missouri

Hydrologic Unit Code (HUC): 1101000701

Water Body Identification (WBID): 2755

Missouri Stream Class: P[1]

Designated Beneficial Uses:

- Livestock and Wildlife Watering
- Protection of Warm-Water Aquatic Life
- Human Health Protection (Fish Consumption)
- Protection of Cool-Water Fishery
- Whole Body Contact Recreation – Category A

Location of Impaired Segment: Mouth to Section 25, T33N, R03W

Length of Impaired Segment: 31.7 miles[2]

Pollutants: Nutrients

Uses that are impaired: General Criteria

TMDL Priority Ranking: Medium

[1] Class P streams maintain permanent flow even during drought conditions. See the Missouri Water Quality Standards (WQS) at 10 CSR 20-7.031(1)(F)4. The WQS can be found at: http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7.pdf

[2] The stream length listed corresponds to the EPA approved Missouri WQS Table H and the 2008 303(d) list; however, due to the increased accuracy of GIS data the stream length used in the TMDL analysis may not correspond exactly to Table H. The descriptive start and end point of each segment remains the same and this TMDL addresses the impaired segment in its entirety.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

LIST OF ACRONYMS and ABBREVIATIONS

Σ	Sum of
AFO	Animal Feeding Operation
AML	Abandoned Mine Lands
BOD	Biochemical Oxygen Demand
CAFO	Concentrated Animal Feeding Operation
CFR	Code of Federal Regulation
cfs	Cubic Feet per Second
Chl-a	Chlorophyll-a
CSR	Code of State Regulation
CWA	Clean Water Act
Deg	Degrees
DO	Dissolved Oxygen
e.g.	For Example
EDU	Ecological Drainage Unit
EPA	United States Environmental Protection Agency
FDC	Flow Duration Curve
GIS	Geographic Information System
HUC	Hydrologic Unit Code
L	Liter
LA	Load Allocation
lbs	Pounds
lbs/day	Pounds per Day
LC	Loading Capacity
LDC	Load Duration Curve
MDNR	Missouri Department of Natural Resources
Mg	Milligram
MGD	Million Gallons per Day
mi	Mile
MO	Missouri
MOG	Missouri General Permits
MOR	Missouri Storm Water Permits
MoRAP	Missouri Resource Assessment Partnership
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
MSOP	Missouri State Operating Permit System
NA	Not Applicable
NESC	National Environmental Service Center
NH_3-N	Ammonium as Nitrogen
NHD	National Hydrography Dataset
NO_2-N	Nitrite Nitrogen
NO_3-N	Nitrate Nitrogen
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System

LIST OF ACRONYMS and ABBREVIATIONS (CONTINUED)

NRCS	Natural Resources Conservation Service
PCS	Permit Compliance System
RTI	Research Triangle Institute, International
TKN	Total kjeldahl nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TR	Total Recoverable
URS	URS Group
U.S.	United States
USDI	United States Department of the Interior
USGS	United States Geological Survey
WBID	Water Body Identification
WET	Whole Effluent Toxicity
WLA	Wasteload Allocation
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plant

1 INTRODUCTION

The West Fork Black River Total Maximum Daily Load (TMDL) is being established in accordance with Section 303(d) of the Clean Water Act (CWA). The water quality-limited segment is included on the United States (U.S.) Environmental Protection Agency (EPA) - approved 2008 Missouri 303(d) List and is identified as impaired due to nutrients. Although no source is identified for nutrients on the 2008 Missouri 303(d) List, the source had been identified on previous 303(d) lists (up through the 2004/2006 Missouri 303(d) List) as the Doe Run, West Fork Mine. The goal of this TMDL is to reduce nutrients in the water column of West Fork Black River and restore the impaired beneficial uses. This report addresses the West Fork Black River impairment by establishing total nitrogen (TN) and total phosphorus (TP) TMDLs in accordance with Section 303(d) of the CWA. EPA is establishing this TMDL to meet the milestones of the 2001 Consent Decree, *American Canoe Association, et al. v. EPA*, No. 98-1195-CV-W in consolidation with No. 98-4282-CV-W, February 27, 2001. West Fork Black River is also currently on the EPA-approved 2008 Missouri § 303(d) List for lead and nickel in sediment. These pollutants are not part of the consent decree and a TMDL will be developed to address impairments associated with these pollutants at a later date.

Section 303(d) of the CWA and Federal Chapter 40 of the Code of Federal Regulations (CFR) Part 130 requires states to develop TMDLs for waters not meeting designated beneficial uses. The TMDL process quantitatively assesses the impairment factors so that states can establish water-quality based controls to reduce pollutants and restore and protect the quality of their water resources. The purpose of a TMDL is to determine the maximum amount of a pollutant (the load) that a water body can assimilate without exceeding the water quality standards (WQS) for that pollutant. WQS are benchmarks used to assess the quality of rivers and lakes. The TMDL also establishes the pollutant loading capacity (LC) necessary to meet the Missouri WQS established for each water body based on the relationship between pollutant sources and instream water quality conditions. The TMDL consists of a wasteload allocation (WLA), load allocation (LA) and a margin of safety (MOS). The WLA is the portion of the allowable load that is allocated to point sources. The LA is the portion of the allowable load that is allocated to nonpoint sources. The MOS accounts for the uncertainty associated with linking pollutant loads to receiving water impacts. This is often associated with model assumptions and data limitations.

The goal of the TMDL program is to restore designated beneficial uses that are impaired by point and nonpoint sources of pollutants. This TMDL report provides a summary of the pollutants of concern and management target recommendations related to the impairment based on a broad analysis of watershed information and detailed analysis of water quality, flow data and comparison to a reference stream condition in the same ecoregion and ecological drainage unit (EDU) in which West Fork Black River is located.

Section 2 of this report provides background information on the West Fork Black River watershed and Section 3 describes potential sources of concern. Section 4 presents the applicable WQS and Section 5 describes the water quality problems. Section 6 describes the technical approach used to develop the TMDL. Sections 7 to 11 present the required TMDL elements (LC, WLA, LA, MOS and seasonal variation). Sections 12 to 14 summarize the follow-up monitoring plan, reasonable assurances and public participation. A summary of the administrative record is presented in Section 15. A summary of available water quality and sediment data is presented in Appendix A.

2 BACKGROUND

This section of the report provides background information on West Fork Black River and its watershed, including location, geology, soils, rainfall, climate and land use.

2.1 THE SETTING

The West Fork Black River is located in the Black River watershed in southeast Missouri. The West Fork Black River watershed is within the confines of Missouri's only national forest, the Mark Twain National Forest. This forest encompasses approximately 1.5 million acres, mostly within the Ozark Highlands. The Ozark Highlands are a landscape characterized by large permanent springs, over 5,000 caves, rocky barren glades, old volcanic mountains and nationally recognized streams. The West Fork Black River flows east through the town of Centerville into the Black River in Reynolds County. The Black River flows south through Wayne and Butler counties and into Arkansas. The study watershed is rural with few residents. The Doe Run mining company and logging activities account for the majority of the commerce in the watershed.

The West Fork Black River impaired segment has a watershed area of approximately 163 square miles with a river distance of approximately 31.7 miles. The elevation of the impaired segment ranges from approximately 1,055 to 660 feet above mean sea level (USDI, 1997). The channel averages 40 feet wide and has an average stream gradient of 0.0023 feet/feet or 0.23 percent, based on measurements at six monitoring locations (Appendix A). The portion of the impaired segment that was sampled can generally be characterized as having shallow banks common to recreational streams in the Ozarks region. Sand beaches and smaller depositional areas are common along the river, although rock outcroppings form the banks of some sections. True to streams of the Ozarks region, the West Fork Black River is dominated by riffle/pool complexes. The water is clear with noticeable periphyton occurring throughout the sampled reaches.

The stream length listed on page iii corresponds to the EPA-approved Missouri WQS Table H. Due to the increased accuracy of Geographic Information System (GIS) data layers over previous methods of stream length measurement, the stream length used in the TMDL may not correspond exactly to Table H. However, the descriptive start and end point of each segment remains the same and this TMDL addresses the impaired segment in its entirety.

2.2 PHYSIOGRAPHIC LOCATION, GEOLOGY AND SOILS

The West Fork Black River watershed is located within the upper subbasin of the Black River in the Salem Plateau of the Ozark Highlands physiographic province. Geology of the West Fork Black River watershed consists of Early Ordovician-lbexian Series and Late Cambrian-Croixian Series. Sandstone, dolostone (dolomite) and chert are the dominant rock types in the West Fork Black River watershed (Stoeser *et. al.,* 2005). Groundwater in the Salem Plateau Groundwater Province has historically been high-quality. The water is typically a moderately mineralized calcium-magnesium-bicarbonate type due to the abundance of dolomitic bedrock in the area (MDNR, 2009).

2.3 SOIL TYPES

Table 1 and Figure 2-1 provides a summary of soil types in the impaired West Fork Black River watershed. The dominant soil types include Clarksville-Scholten complex (26.5 percent), Alred-Rueter complex (16.5 percent), Poynor-Clarksville-Scholten complex (10.2 percent), Scholten-Bendavis-Poymor complex (10.9 percent) and Coulstone-Bender complex (9.2 percent). Both the Poynor-Clarksville-Scholten complex and Scholten-Bendavis-Poynor complex have slopes of 8 to 15 percent and are moderately well drained. The Clarksville-Scholten complex has slopes of 15 to 45 percent, is very stony and is moderately well drained. The Alred-Rueter complex has slopes of 15 to 35 percent and is very stony. The Coulstone-Bender complex has slopes of 15 to 50 percent, is very stony and is somewhat excessively drained (NRCS, 2009).

The soils hydrologic group relates to the rate at which surface water enters the soil profile, which in turn affects the amount of water that enters the stream as direct runoff. The dominant soil groups are C and B, covering approximately 45.4 and 44.8 percent of the watershed, respectively. Group C includes sandy clay loam soils that have a moderately fine to fine structure. These soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water. Group B includes silt loam and loam which have moderate infiltration rates. These soils consist of well drained soils with moderately fine to moderately coarse textures. Approximately 5.3 percent of soils in the impaired watershed are categorized as Group A. Group A includes sandy loam soils that have low runoff potential and high infiltration rates, even when thoroughly wetted. Group A soils include predominantly well to excessively drained sands or gravels and have a high rate of water transmission (Purdue Research Foundation, 2009).

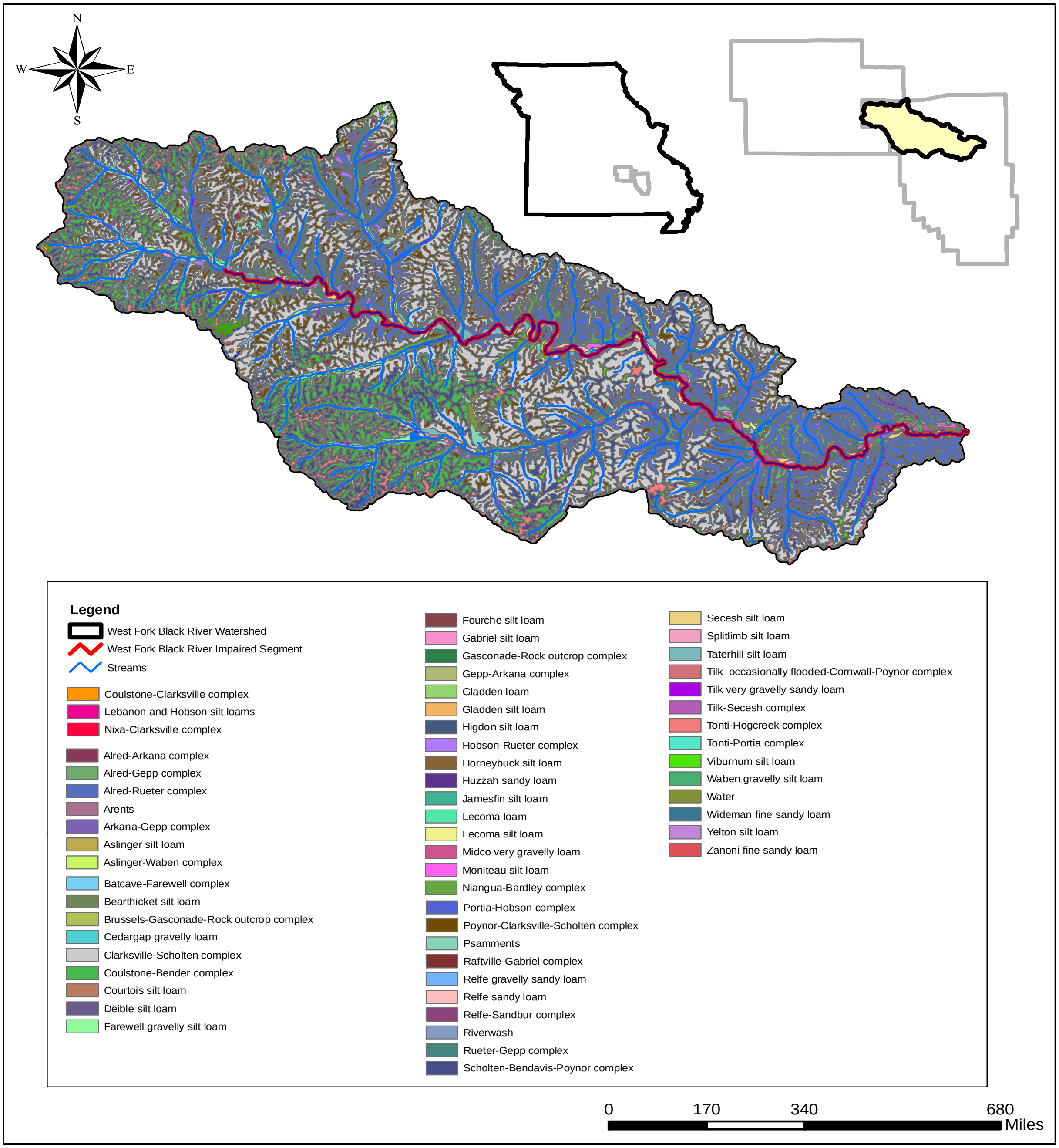

Figure 2-1. Soil Distribution of West Fork Black River Watershed

Table 1. West Fork Black River Watershed Soils Summary

Soil Type	Hydrologic Soil Group	Acres	Percent
Relfe-Sandbur complex	A	1,793	1.7
Relfe gravelly sandy loam	A	1,574	1.5
Relfe sandy loam	A	1,201	1.1
Riverwash	A	1,084	1.0
(Subtotal Soil Group A)	**A**	**5,653**	**5.3**
Clarksville-Scholten complex	B	27,721	26.5
Coulstone-Bender complex	B	9,571	9.2
Rueter-Gepp complex	B	3,507	3.4
Tilk very gravelly sandy loam	B	1,446	1.4
Midco very gravelly loam	B	995	1.0
Taterhill silt loam	B	866	0.8
Tilk-Secesh complex	B	709	0.7
Waben gravelly silt loam	B	738	0.7
Lecoma loam	B	629	0.6
Secesh silt loam	B	540	0.5
(Subtotal Soil Group B)	**B**	**46,722**	**44.8**
Alred-Rueter complex	C	17,272	16.5
Scholten-Bendavis-Poynor complex	C	11,406	10.9
Poynor-Clarksville-Scholten complex	C	10,647	10.2
Niangua-Bardley complex	C	2,604	2.5
Tonti-Hogcreek complex	C	2,413	2.3
Alred-Gepp complex	C	1,082	1.0
Alred-Arkana complex	C	976	0.9
Viburnum silt loam	C	587	0.6
Batcave-Farewell complex	C	562	0.5
(Subtotal Soil Group C)	**C**	**47,549**	**45.4**
Other[3]	A/B/C/D	4,629	4.4

[3] Other soil types that are less than or equal to 0.5 percent of the total watershed area include: Arents (D), Arkana-Geep complex (C), Aslinger silt loam (C), Aslinger-Waben complex (C), Bearthicket silt loam (B), Brussels-Gasconade-Rock outcrop complex (C), Cedargap gravelly loam (unknown), Coulstone-Clarksville complex (B), Courtois silt loam (C), Deible silt loam (D), Farewell gravelly silt loam (C), Fourche silt loam (C), Gabriel silt loam (B/D), Gasconade-Rock outcrop complex (D), Gepp-Arkana complex (C), Gladden loam (B), Gladden silt loam (B), Higdon silt loam (C), Hobson-Rueter complex (C), Homeybuck silt loam (C), Huzzah sandy loam (B), Jamesfin silt loam (B), Lebanon and Hobson silt loams (C), Lecoma silt loam (B), Moniteau silt loam (C/D), Nixa-Clarksville complex (C), Portia-Hobson complex (B), Psamments (A), Raftvillle-Gabriel complex (C), Relfe gravelly sandy loam (A), Slitlimb silt loam (C), Tilk Cornwall Poynor complex (B), Tonti-Portia complex (C), Water (no classification), Wideman fine sandy loam (A), Yelton silt loam (C) and Zanoni fine sandy loam (B).

2.4 RAINFALL AND CLIMATE

Three weather stations are within or close to the West Fork Black River watershed (Figure 2-2). All three stations record daily precipitation, maximum and minimum temperature, snowfall and snow depth. Figure 2-2 provides a summary of rainfall and climate data for Station 231101 (Bunker 4 N, Missouri) based on a 30-year record from 1971 to 2000 (NOAA, 2009). The annual average precipitation and temperature over the 30 year period is 41.2 inches and 54.2 degrees Fahrenheit, respectively.

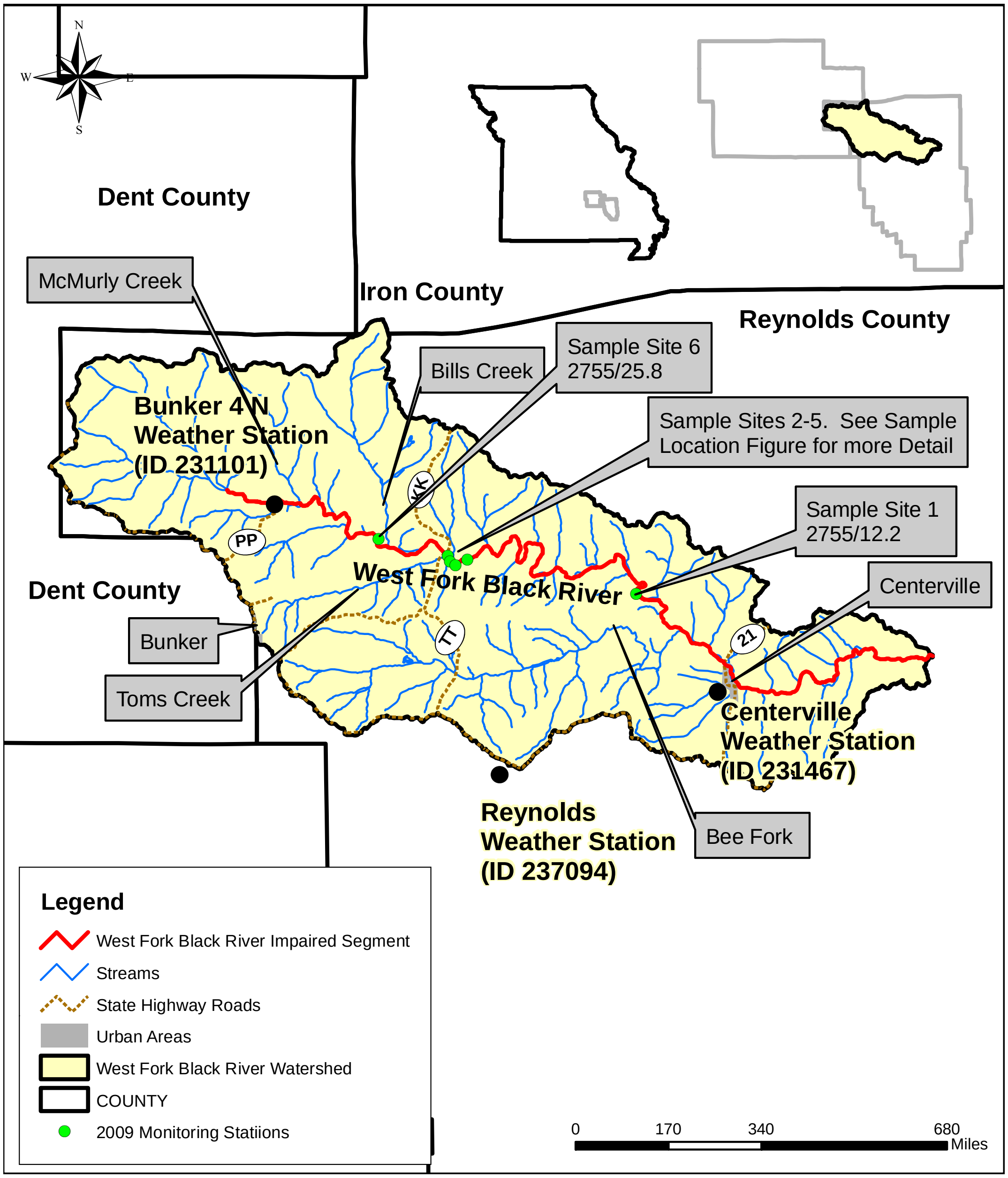

Figure 2-2. Location of West Fork Black River Watershed and Its Associated Distribution of Weather and Sampling Stations

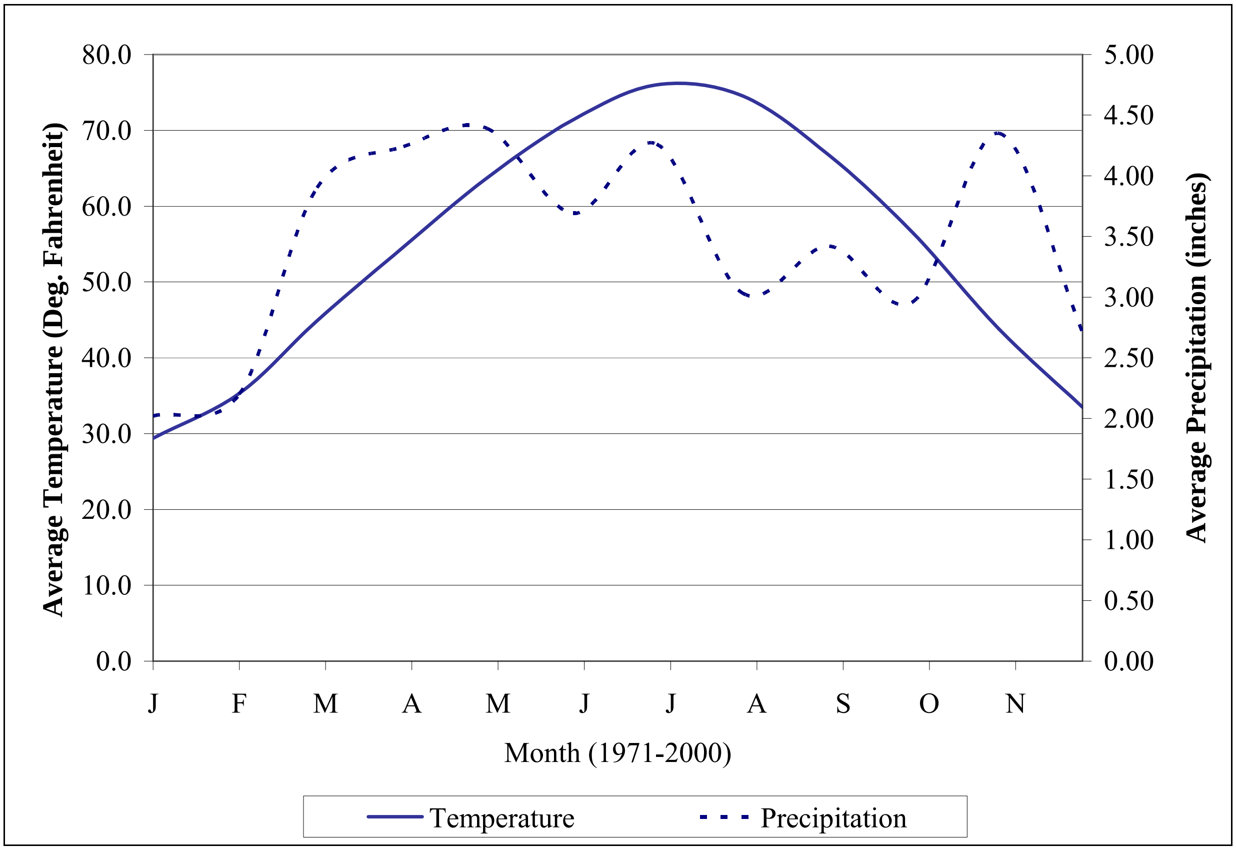

Figure 2-3. Monthly Temperature and Precipitation Averages for Station 231101 (Bunker 4 N, Missouri) during the period from 1971 to 2000

2.5 POPULATION

According to the U.S. Census Bureau, the 2000 population for Centerville and Bunker was 171 and 427, respectively (U.S. Census Bureau, 2000). The city of Centerville is located in Reynolds County, Missouri, while the city of Bunker is located in both Reynolds and Dent Counties. For the purpose of population estimates, the population of the city of Bunker will be equally distributed to both counties. The urban population of the watershed can be estimated by multiplying the percent of urban area that is within the watershed by the population of the urban area. The urban population of the West Fork Black River watershed is approximately 207 because all of Centerville and only a small portion of Bunker are within the watershed boundary.

The rural population of the watershed can be estimated based on the proportion of the watershed compared to Reynolds and Dent Counties. Reynolds County covers an area of 814.2 square miles and has a population of 6,689. Dent County covers an area of 754.3 square miles and has a population of 14,927.

The rural population in Reynolds County is approximately 6,322 (total county population minus population of Centerville and Bunker) and the rural county area is 812.2 square miles (total county area minus 2.0 square miles county urban area). The rural population in the Reynolds County portion of the watershed was estimated to be 1,252 persons. This estimate was calculated by dividing the rural area of the West Fork Black River watershed in Reynolds County (160.9 square miles) by the rural Reynolds County area (812.2 square miles) and the product was multiplied by the rural population in Reynolds County (6,322 persons).

The rural population in Dent County is approximately 9,878 (total county population minus population of Salem at 4,854 persons and Bunker) and the rural county area is 750.5 square miles (total county area minus 3.8 square miles county urban area). The rural population in the Dent County portion of the watershed was estimated to be 28 persons. This estimate was calculated by dividing the rural area of the West Fork Black River watershed in Dent County (2.1 square miles) by the rural Dent County Area (750.5 square miles) and the product was multiplied by the rural population in Dent County (9,878). The total (includes both urban and rural population) estimated population of the West Fork Black River watershed is approximately 1,487 persons. An overall population density for the West Fork Black River watershed was calculated to be about 9 persons per square mile (1,487 persons divided by 163 square miles).

2.6 LAND USE AND LAND COVER

The land use and land cover of the West Fork Black River watershed is summarized in Table 2 and shown in Figure 2-4 (MoRAP, 2005). The dominant land use/land cover is forest (84.8 percent) while grassland and herbaceous cover occupy 8.3 percent and 3.9 percent of the watershed area, respectively. The remaining categories comprise approximately 3 percent of the watershed area.

Table 2. Land Use/Land Cover in the West Fork Black River Impaired Watershed

Land Use/Land Cover	Watershed Area		Percent (%)
	Acres	Square Miles	
Impervious[4]	509	0.8	0.5
Low Intensity Urban[5]	83	0.1	0.1
Barren or Sparsely Vegetated	1,095	1.7	1.0
Cropland	231	0.4	0.2
Grassland	8,672	13.5	8.3
Forest	88,714	138.6	84.8
Herbaceous[5]	4,036	6.3	3.9
Wetland	710	1.1	0.7
Open Water	506	0.8	0.5
Total	**104,556**	**163.3**	**100**

[4] Impervious land use includes non-vegetated, impervious surfaces including areas dominated by streets, parking lots and buildings while herbaceous land use includes shrub lands, young woodlots and open woodlands.
[5] Low intensity urban land use includes vegetated urban environments with a low density of buildings.

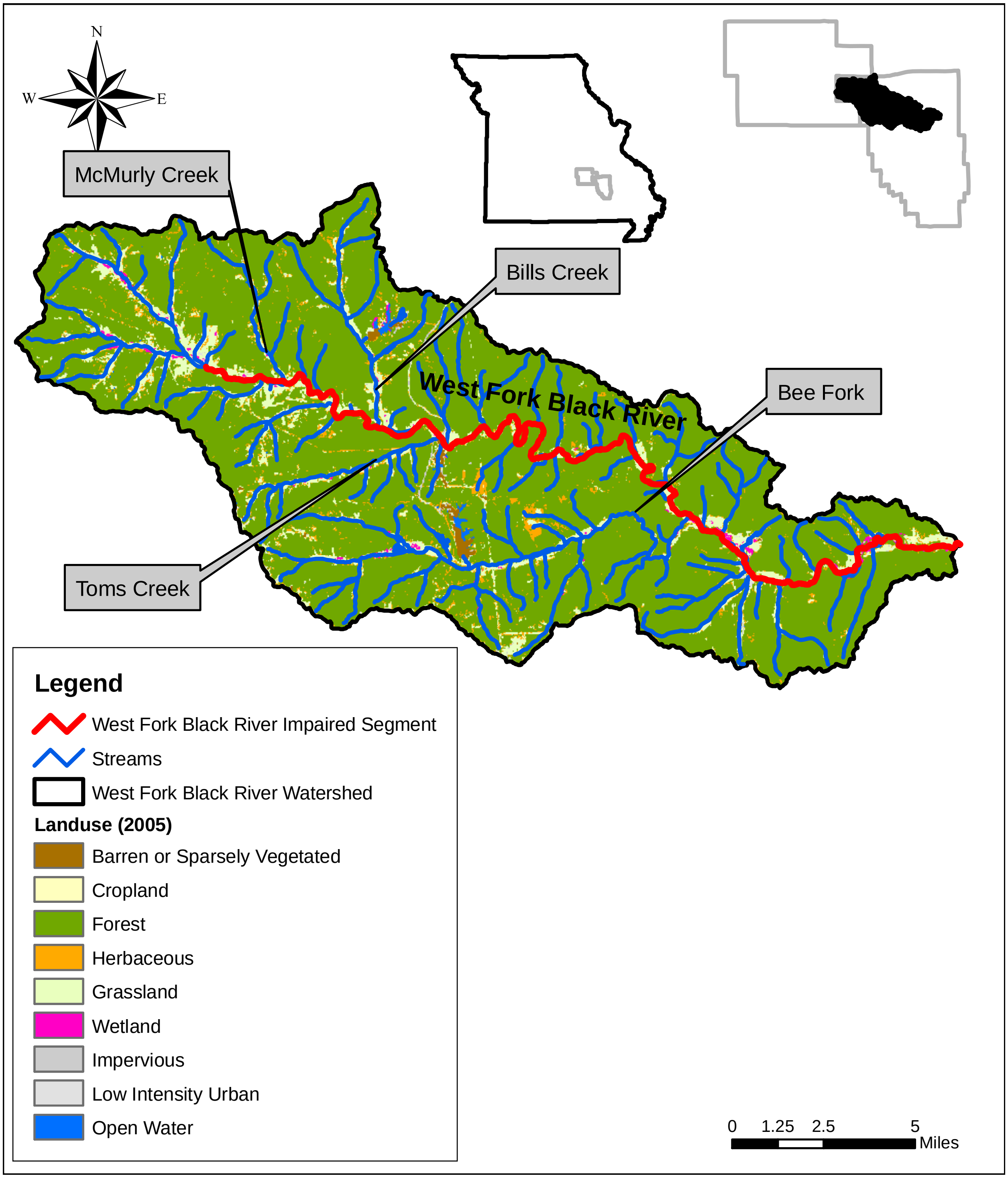

Figure 2-4. Land Use/Land Cover in the Impaired West Fork Black River Watershed

3 DEFINING THE PROBLEM

The Missouri Department of Natural Resources (MDNR) has received several complaints regarding unsightly algal growth in West Fork Black River (MDNR, 2004). Through monitoring, excess nutrients have been identified as causing or contributing to the undesirable algal condition. MDNR identified the Doe Run West Fork Mine discharge as a source of nutrients and a cause of nuisance algal growth in the river because underground water pumped from the West Fork Mine contains elevated levels of nutrients. This mine water, when discharged to the river, has the potential to cause excessive algae growth on the river bottom.

Water quality measurements for TN, TP and flow values collected from 2001 to 2009 in the West Fork Black River watershed are presented in Appendix A. As part of a study conducted by EPA in July and August 2009 (EPA, 2009a), water column and sediment chemistry parameters, in-situ water quality parameters, stream physical characters, algal biomass and chlorophyll-a (phytoplankton and periphyton) were collected to address the elevated nutrient levels which are creating algal blooms in the West Fork Black River. During the 2009 field study, sampling took place both upstream and downstream of the Doe Run West Fork River mine discharge (Figure 3-1). Laboratory results of TN and TP analysis from the 2009 sampling events are summarized in Table 3. Results of algal biomass and chlorophyll-a are summarized in Table 4.

Ammonia was not detected at any of the six sample locations for the 2009 sampling events. Nitrate+nitrite-N concentrations were consistently lower in July than August and showed a greater variability across locations in August. Peak nitrate+nitrite-N concentrations were observed at locations 2755/23.1 and 2755/22.3 in August. Total kjeldahl nitrogen (TKN) concentrations were typically higher in August than July, with most of the concentrations occurring below the laboratory reporting limit (0.3 milligrams per liter [mg/L]) in July. Because TN was calculated by summing the nitrate nitrite-N and TKN concentrations, the TN values in July were reflective of the TKN concentrations while in August they were reflective of the nitrate+nitrite-N concentrations. All TP results were below the laboratory reporting limit (0.003 mg/L), with the exceptions of locations 2755/12.2 and 2755/25.8 in August. TP concentrations were typically lower in July than in August.

Table 3. Nutrient Concentrations in the Water Column Based on Monitoring Conducted at Six Locations in the West Fork Black River Watershed During July and August 2009

Date and Sample Location (mile marker)[1]	Ammonia (mg/L)	Nitrate+ Nitrite-N (mg/L)	TKN (mg/L)	Total Nitrogen (mg/L)[2]	Total Phosphorus (mg/L)
7/9 – 10/2009					
2755/25.8	<0.5	0.005	0.128	0.133	0.0028
2755/23.1	<0.5	0.083	0.219	0.302	0.0024
2755/22.8	<0.5	0.079	0.294	0.372	0.0022
2755/22.7	<0.5	0.055	0.100	0.155	0.0021
2755/22.3	<0.5	0.050	0.068	0.118	0.002
2755/12.2	<0.5	0.013	0.567	0.580	0.0019

Table 3 (continued)

Date and Sample Location (mile marker)[1]	Ammonia (mg/L)	Nitrate+ Nitrite-N (mg/L)	TKN (mg/L)	Total Nitrogen (mg/L)[2]	Total Phosphorus (mg/L)
8/14 – 15/2009					
2755/25.8	<0.5	0.370	0.479	0.849	0.003
2755/23.1	<0.5	0.920	0.287	1.207	0.003
2755/22.8	<0.5	0.515	0.351	0.866	0.002
2755/22.7	<0.5	0.380	0.485	0.865	0.003
2755/22.3	<0.5	0.550	0.572	1.122	0.001
2755/12.2	<0.5	0.040	0.305	0.343	0.005

[1] Mile marker descriptions are as follows:
2755/25.8: West Fork Black River above Bills Creek
2755/23.1: West Fork Black River 0.2 miles above the West Fork Mine
2755/22.8: July 9-10, 2009 monitoring at West Fork Black River directly upstream of the West Fork mine outfall 001
2755/22.8: August 14-15, 2009 monitoring at West Fork Black River 0.1 miles below the West Fork mine outfall 001
2755/22.7: West Fork Black River 0.2 miles below the West Fork mine outfall
2755/22.3: West Fork Black River 0.6 miles below the West Fork mine outfall
2755/12.2: West Fork Black River @ Sutton Bluff campground
[2] Total Nitrogen calculated as the sum of Nitrate+Nitrite-N value and TKN value.

Phytoplankton (suspended algae) biomass values were consistently higher in July than August. In July, variation in the algal biomass was observed with the three upstream locations (2755/25.8 through 2755/22.8) having higher concentrations than the three downstream locations (2755/22.7 through 2755/12.2). In August, the phytoplankton biomass values were consistent across all six locations. Phytoplankton chlorophyll-a values were detected at estimated concentrations below the laboratory reporting limit (0.0005 mg/L) for all samples in both July and August, with the exception of the sample collected at location 2755/22.8 in July.

Periphyton (benthic algae) biomass values were generally higher in August than in July. The highest values occurred at location 2755/23.1 for both sampling events. These data are consistent with the field observation that benthic algae were most prevalent at location 2755/23.1. Periphyton chlorophyll-a concentrations were generally higher in August than in July. A peak concentration occurred at location 2755/23.1 during the August sampling event. This was consistent with the periphyton biomass results and field observations of periphyton. For the samples collected in July, periphyton chlorophyll-a concentrations gradually decreased from upstream to downstream.

Nutrient related water quality issues include the following:

- Proliferation of nuisance algae and resultant unsightly, harmful blooms and deposits
- Elevated turbidity due to suspended algae
- High organic nutrient levels as a result of algae die off
- Low DO resulting from the decomposition of algae and other organic materials

Table 4. Concentrations of Phytoplankton Biomass, Phytoplankton Chl-a and Periphyton Chl-a, Based on Monitoring Conducted at Six Locations in the West Fork Black River Watershed During July and August 2009

Date and Sample Location (mile marker)[1]	Phytoplankton Biomass (g/L)	Phytoplankton Chl-a (mg/L)	Periphyton Biomass (g/cm^2)	Periphyton Chl-a (mg/cm^2) Rep1	Periphyton Chl-a (mg/cm^2) Rep2
7/9 – 10/2009					
2755/25.8	21.5740	0.00013	0.3217	0.07421	0.06514
2755/23.1	21.7940	0.00039	0.3232	0.03669	0.05030
2755/22.8	21.8600	0.00142	0.1681	0.03979	0.03264
2755/22.7	20.0880	0.00013	0.1514	0.01635	0.01773
2755/22.3	20.6440	0.00039	0.1593	0.01992	0.01670
2755/12.2	20.1120	0.00026	0.0755	0.00557	0.00886
8/14 – 15/2009					
2755/25.8	19.572	0.00013	0.2546	0.04331	0.03073
2755/23.1	19.478	0.00039	0.5145	0.16452	0.10597
2755/22.8	19.386	0.00013	0.2553	0.05347	0.04090
2755/22.7	19.418	0.00013	0.2591	0.07645	0.04041
2755/22.3	19.368	0.00039	0.2576	0.04428	0.07767
2755/12.2	19.192	0.00013	0.2577	0.03919	0.04960

[1] Mile marker descriptions are as follows:
2755/25.8: West Fork Black River above Bills Creek
2755/23.1: West Fork Black River 0.2 miles above the West Fork Mine
2755/22.8: July 9-10, 2009, monitoring at West Fork Black River directly upstream of the West Fork mine outfall 001
2755/22.8: August 14-15, 2009, monitoring at West Fork Black River 0.1 miles below the West Fork mine outfall 001
2755/22.7: West Fork Black River 0.2 miles below the West Fork mine outfall
2755/22.3: West Fork Black River 0.6 miles below the West Fork mine outfall
2755/12.2: West Fork Black River @ Sutton Bluff campground

"Chl-a" = Chlorophyll-a
g/L = grams per liter
g/ cm^2 = grams per centimeters squared
mg/ cm^2 = milligrams per centimeters squared

An overabundance of nutrients, in particular nitrogen and phosphorus, is a serious threat to aquatic ecosystems. Excess nutrients support rapid algal growth, which will cause significant changes to the water body. This phenomenon is called eutrophication. Eutrophication is the natural aging process of aquatic systems caused by the enrichment of nutrients. Cultural eutrophication is the accelerated aging of the natural condition caused by human activities.

Algal blooms at the surface of the water may block light penetration and reduce nutrient availability to other plant species and cause a reduction in the plant diversity. When algae die, they can become a source of nutrients that can use up the available DO in the water during decomposition. Decomposition in return may release nutrients back to the water to support algal growth. Algal blooms may also degrade recreational uses and cause taste and odor problems in drinking water systems.

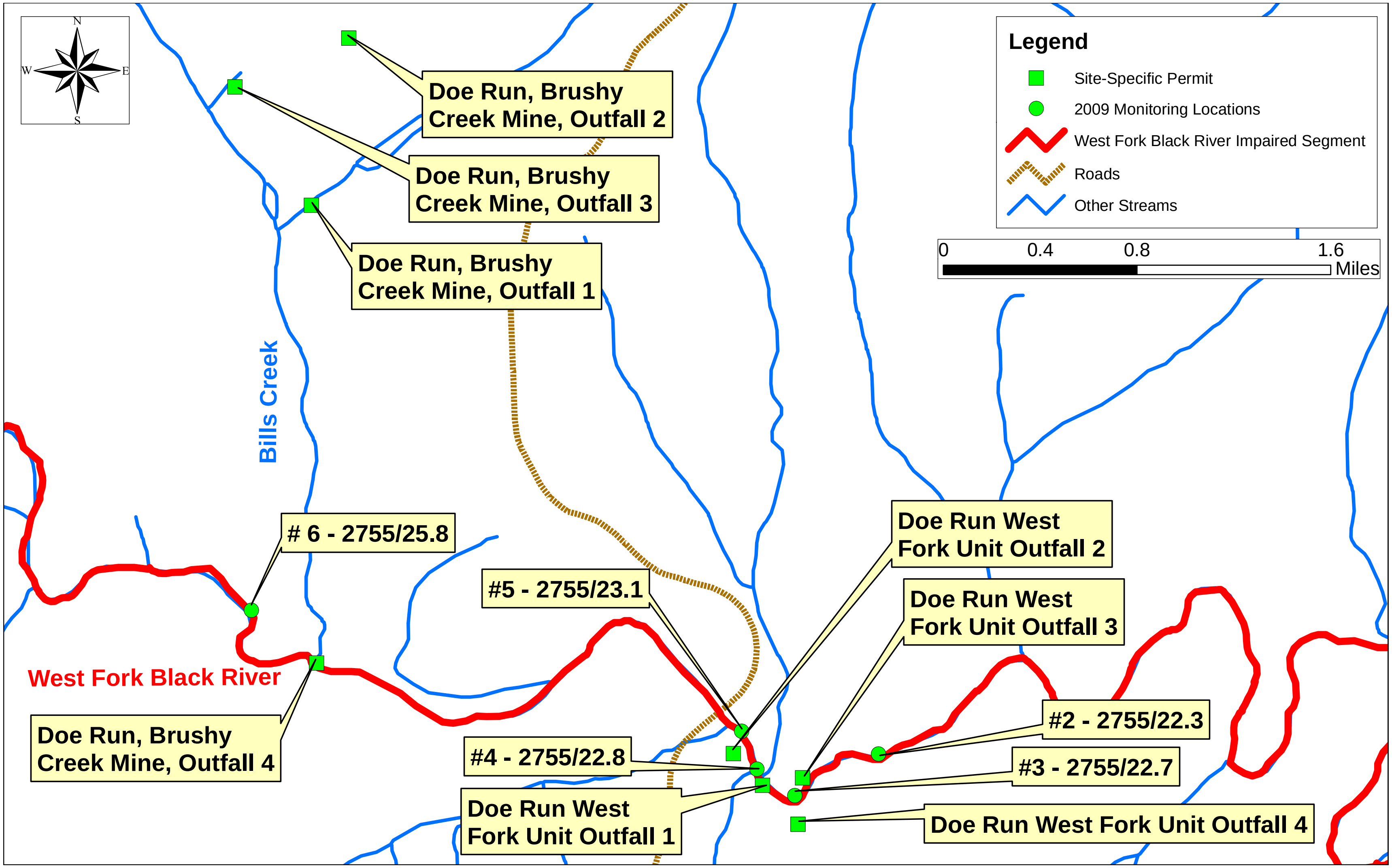

Figure 3-1. Sample Locations and NPDES Discharges in the West Fork Black River

4 SOURCE INVENTORY

A source assessment is used to identify and characterize the known and potential pollutant sources that contribute to the nutrient impairment in West Fork Black River. For the purpose of this report, the contributing sources are divided into two categories, point sources and nonpoint sources. Point sources are defined as the sources, either constant or time transient, which occur at a fixed location in the watershed. Nonpoint sources are generally the diffuse sources that do not enter a water body at a specific location. These two categories of pollutant sources are described in detail in the following sections.

4.1 POINT SOURCES

The term "point source" refers to any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel or conduit, by which pollutants are transported to a water body. For the purposes of TMDL development, point sources are defined as sources regulated through the National Pollutant Discharge and Elimination System (NPDES) program. Missouri has its own program for administering the NPDES program, referred to as the Missouri State Operating Permit (MSOP) system. The NPDES and MSOP programs are the same and for the purposes of this document the term "NPDES" will be used. The following regulated entities are included in this source category:

- Municipal and industrial wastewater treatment plants (WWTPs);
- Concentrated animal feeding operations (CAFOs);
- Active, permitted or abandoned mining operations;
- Storm water runoff from Municipal Separate Storm Sewer Systems (MS4s) and
- General permitted facilities (e.g. including storm water runoff from construction and industrial sites).

General permits (as opposed to site specific permits) are issued to activities that are similar enough to be covered by a single set of requirements. Storm water permits are issued to activities that discharge only in response to precipitation events. Point sources in the West Fork Black River watershed were identified by consulting EPA's Permit Compliance System (PCS) website[6] and the MDNR's GIS inventory[7] of NPDES permitted facilities covered under storm water or general permits.

Point sources in the West Fork Black River watershed are listed in Table 5 and shown in Figure 4-1. In total, there are eight permits issued in the watershed; five are site specific permits, one is a general permit and the remaining two are storm water permits. As indicated in Table 2, approximately 1,095 acres (or about 1 percent of the watershed) is classified as "Barren or Sparsely Vegetated" lands. Although no information was available from which to estimate the

[6] www.epa.gov/enviro/html/pcs/index.html
[7] http://msdis.missouri.edu/datasearch/ThemeList.jsp; GIS layers updated May 2009 and June 2009 (Missouri Spatial Data Information Service [MSDIS], 2009)

amount of barren land that contains mining areas or mine tailings, it is conservatively estimated that all or nearly all of this area contains mine tailings based on historical records and field surveys of the extensive mining activities in the area.

4.1.1 Permitted Point Sources

Two permittees in the West Fork Black River watershed are required to directly monitor and report effluent concentrations of nutrients. The Doe Run Company, West Fork Unit (MO0100218) is required to meet effluent limits for nitrate+nitrite-N and TP. The Doe Run Company, Brushy Creek Mine (MO0001848) is also required to monitor and report effluent concentrations for nitrate, TN and TP. The Bunker WWTP (MO0117951) is required to monitor and report effluent concentrations of ammonia.

The Doe Run Company, West Fork Unit (MO0100218) is located six miles east of Bunker, Missouri, on Highway KK. The current NPDES permit for this facility was issued in March 2010. The first record of this permit was issued in October 1991. The current permit covers four outfalls. Discharge from outfall 001 includes flow from mine dewatering activities that are processed through Doe Run's onsite treatment before being discharged into West Fork Black River. Outfall 002 includes domestic waste and outfalls 003 and 004 include storm water runoff from mining and milling areas. The design flow for outfall 001 is an average of 1.44 million gallons per day (MGD) and the design flow for outfall 002 is 6,000 gallons per day. Design flows are not included in the permit for outfalls 003 and 004 which do not discharge during normal operation. All four outfalls are potential sources of nutrients, as reflected in the monitoring and effluent limit requirements found in the facility operating permit. Previous versions of the Missouri 303(d) List of impaired waters (i.e., 1998, 2002 and 2004/2006) have identified the Doe Run, West Fork Mine as the source of the nutrient impairment of West Fork Black River. Currently, no reclamation plans are on file with the state of Missouri for these operations.

The Doe Run Company, Brushy Creek Mine (MO0001848) is located on Highway KK in Bunker, Missouri. The current NPDES permit for this facility was issued in February 2010. The first permit for this site was issued prior to 1976. The facility maintains three outfalls that discharge to Bills Creek. Outfall 001 includes flows from mine dewatering and storm water runoff from mining and milling activities. Water discharged at outfall 001 is processed through Doe Run's onsite treatment before it is discharged into Bills Creek. The design flow at outfall 001 is 2.93 MGD. Outfalls 002 and 003 include storm water flows from mining activities and a design flow is not included in the permit. All three outfalls may be potential sources of nutrients.

The Doe Run Company, Fletcher Mine Mill (MO0001856) is located on Highway TT in Bunker, Missouri. The current permit for this facility was issued November 2009 and revised July 2010. The first permit for this site was issued prior to 1976. The facility maintains three outfalls that discharge into an unnamed tributary of Bee Fork. Outfall 001 has a design flow of an average of 3.27 MGD and includes flows from mine dewatering and storm water runoff. Outfalls 002 and 003 include storm water flows from mining activities and a design flow is not included in the permit. All three outfalls may be potential sources of nutrients.

As of April 2010, the Brushy Creek and Fletcher mine sites are currently engaged in active underground mining and surface milling. Tailings from the Fletcher Mine site are being disposed of in the Fletcher impoundment. There is no mining or milling taking place at West Fork Mine, although water is still being pumped from underground and treated at the West Fork Mine treatment system. The Doe Run Company has dismantled the mill at West Fork Mine and has no plans at this time to reactivate it. The Fletcher Mine site now encompasses the historic operations at the West Fork Mine site.

The operating permit for the Centerville WWTP (MO0127940), located in Centerville, Missouri, was issued November 2008 and expires November 2013. This permit was first issued in July 2003. The facility was designed to accommodate a population of 308 people with a design flow of 23,100 gallons per day and sludge production of 5.54 dry tons per year. Actual flow for the facility is 10,600 gallons per day and actual sludge production is 2.77 dry tons per year. The facility maintains one outfall that discharges a small volume, compared to the base flow in the river, directly into West Fork Black River. This discharge is not considered to be a significant source of nutrients to West Fork Black River.

The Bunker WWTP permit (MO0117951) was issued June 2008 and expires June 2013. The permit was first issued in June 1998. The facility was designed to accommodate 500 people with a design flow of 45,000 gallons per day and sludge production of 10.5 dry tons per year. Actual flow at the facility is 20,300 gallons per day to an irrigation system. The facility operates as a no discharge system. This discharge is not considered to be a significant source of nutrients to West Fork Black River.

The general permit for Ray Johnson (MOG500158), Centerville, Missouri, became effective on July 2, 2010, and expires on May 31, 2015. The general permit is classified as construction/sand and gravel and applies to the discharge of wash water and storm water from sand and/or gravel operations. This facility is not considered to be a significant source of nutrients to the impaired segment.

The Cook Lumber Inc. (MOR22A237) is a storm water permit located near Centerville, Missouri. The storm water permit became effective on April 1, 2005. The permit expired on March 4, 2009. The storm water permit is classified as wood preserving and applies to storm water runoff discharges from Primary Lumber and Wood Product Industries. This facility is not considered to be a significant source of nutrients to the impaired segment.

The Doe Run Company (MOR10A336) is a storm water permit located in Reynolds County, Missouri, near the West Fork Black River. The storm water permit became effective on March 14, 2007, and expires on February 7, 2012. The storm water permit is classified as heavy construction and applies to construction or land disturbance activities that include clearing, grubbing, grading and other activities that result in the destruction of the root zone and/or land disturbance activity that is reasonably certain to contribute pollutants to state waters. This facility is not considered to be a significant source of nutrients to the impaired segment.

By law, the term "point source" includes CAFOs which are places where animals are confined and fed. There are currently no permitted CAFOs identified in the West Fork Black

River watershed. Animal feeding operations where animals are maintained or fed under confined conditions but which maintain fewer than 300 animal units are not legally defined as CAFOs under state regulations. Additionally, facilities that are defined as CAFOs but which maintain fewer than 1,000 animal units are not required to obtain a MSOP unless the facility discharges or proposes to discharge. Since these operations are not regulated by MDNR, there is no data available on their number or locations. However, it is possible that there are unregulated animal feeding operations within the West Fork Black River watershed. Unregulated operations that do not properly manage livestock and the waste that they produce may potentially be acting as point source contributors to the nutrient impairment.

4.1.2 Non Permitted Point Sources

Illicit straight pipe discharges of household waste are also potential point sources of nutrients in rural areas. These pollutant sources are discharges directly into streams or land areas and are different than illicitly connected sewers. There is no specific information on the number of illicit straight pipe discharges of household waste in the West Fork Black River watershed. However, these pollutant sources are not considered to be a significant source of nutrients compared to other sources in the watershed. The critical period for impacts from illicit straight pipe discharges would be during low flow periods.

Table 5. Permitted Facilities in the West Fork Black River Watershed

Facility ID[1]	Facility Name	Receiving Stream	Classification/ Description	Reporting Requirements[2]	Design Flow (MGD)[3]	Permit Expiration Date
MO0100218	Doe Run Co., West Fork Unit	West Fork Black River	Lead and Zinc Ores	BOD, Hardness, TSS, pH, Fecal Coliform, Oil and Grease, Arsenic (TR), Cadmium (TR), Lead (TR), Nickel (TR), Thallium (TR), Copper (TR), Zinc (TR), Mercury (TR), WET, NH_3-N, NO_3-N + NO_2-N, TN, TP	1.44 (average)	2015
MO0001848	Doe Run Co., Brushy Creek Mine	Bill's Creek	Lead and Zinc Ores	Hardness, pH, TSS, NO_3-N, TN, TP, Copper (TR), Lead, (TR), Zinc (TR), Cadmium (TR), Mercury (TR), WET	2.93	2015
MO0001856	Doe Run Co., Fletcher Mine Mill	Unnamed Tributary to Bee Fork	Lead and Zinc Ores	Hardness, TSS, Oil and Grease, pH, Copper (TR), Lead (TR), Zinc (TR), Cadmium (TR), Mercury (TR), WET	3.27 (average)	2014
MO0127940	Centerville WWTP	West Fork Black River	Wastewater Treatment	BOD, TSS, pH, Fecal Coliform, Total Residual Chlorine	0.023	2013
MO0117951	Bunker WWTP	Unnamed Tributary to Toms Creek	Wastewater Treatment	BOD, TSS, pH, NH_3-N, Temperature, Oil and Grease, Fecal Coliform,	Non-discharging	2013
MOG500158	Ray Johnson	West Fork Black River	Construction Sand and Gravel	NA	General Permit	2015
MOR22A237	Cook Lumber Inc.	Unnamed Tributary West Fork Black River	Wood Preserving	NA	Storm water Permit	2009
MOR10A336	Doe Run Company	Unnamed Tributary West Fork Black River	Heavy Construction, NCE	NA	Storm water Permit	2012

1 Permits that have a facility ID starting with "MO" are site-specific permits, "MOG" are general permits and "MOR" are storm water permits.

2 Where BOD = Biochemical Oxygen Demand, TSS = Total Suspended Solids, NH_3-N = Ammonia Nitrogen, NO_3-N = Nitrate Nitrogen, NO_2-N = Nitrite Nitrogen, "TR" = Total Recoverable, "WET" = Whole Effluent Toxicity, "TN" = Total Nitrogen, "TP" = Total Phosphorus and "NA" = Not Applicable. Permits identified as "NA" are storm water or general permits.

3 "MGD" = million gallons per day

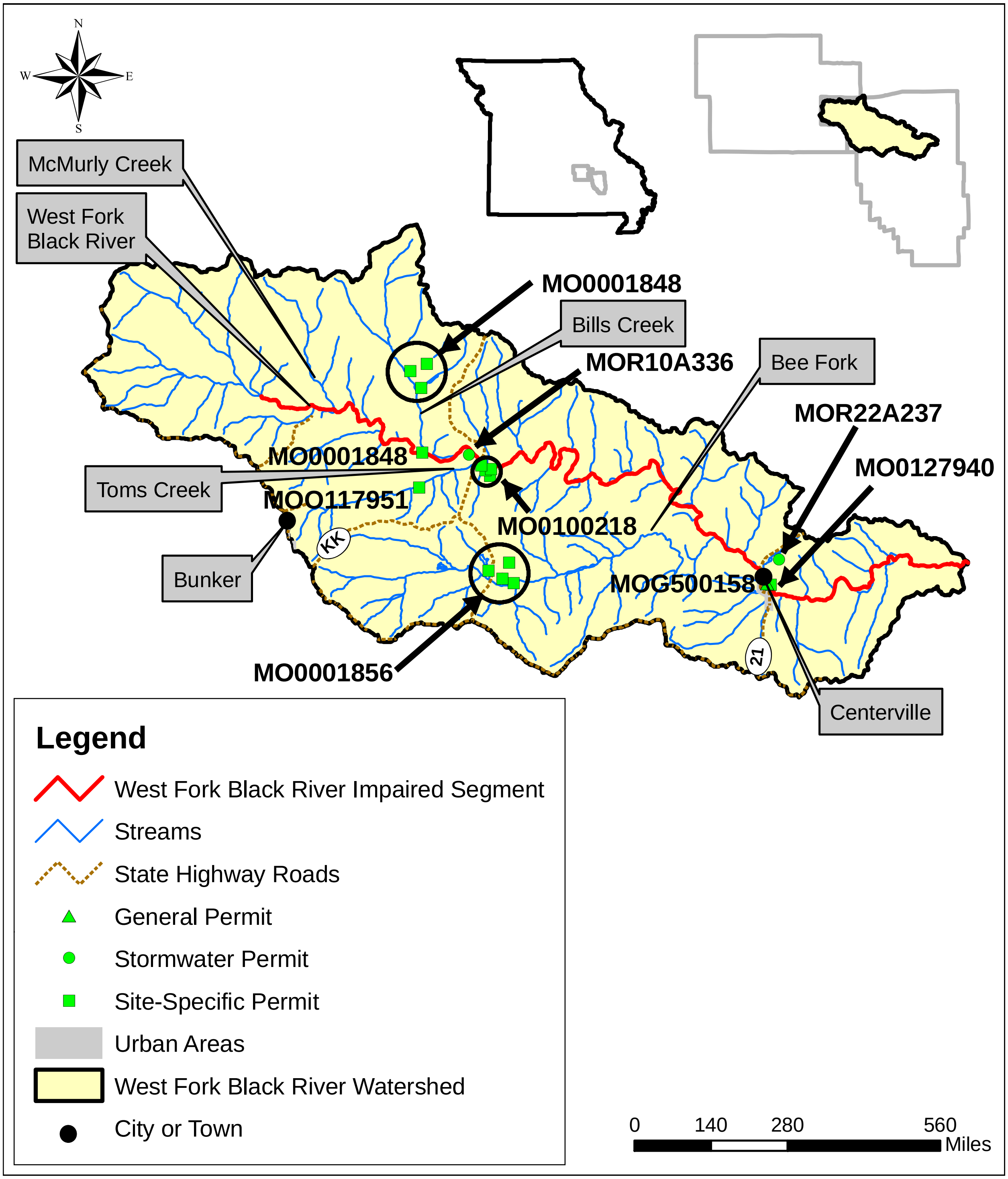

Figure 4-1. Location of Permitted Facilities in the West Fork Black River Watershed

4.2 NONPOINT SOURCES

Nonpoint sources include all other categories of pollutant sources not classified as point sources. Nonpoint sources are diffuse sources of pollutant loading that typically cannot be identified as entering a water body at a single location. Potential nonpoint sources contributing to the nutrient impairment in West Fork Black River include runoff from agricultural areas, runoff from urban areas, onsite wastewater treatment systems (e.g. septic systems) and various sources associated with stream riparian areas.

In the absence of an NPDES permit, the discharges associated with sources were applied to the LA, as opposed to the WLA for purposes of this TMDL. The decision to allocate these sources to the LA does not reflect any determination by EPA as to whether these discharges are, in fact, unpermitted point source discharges within this watershed. In addition, by establishing these TMDLs with some sources treated as LAs, EPA is not determining that these discharges are exempt from NPDES permitting requirements. If sources of the allocated pollutant in this TMDL are found to be, or become, NPDES-regulated discharges, their loads must be considered as part of the calculated sum of the WLAs in this TMDL. WLA in addition to that allocated here is not available.

4.2.1 Runoff from Agricultural Areas

Lands used for agricultural purposes can be a source of nutrients and oxygen consuming substances. Accumulation of nitrogen and phosphorus on cropland occurs from decomposition of residual crop material, fertilization with chemical and manure fertilizers, atmospheric deposition, wildlife excreta and irrigation water. The 2005 land use and land cover data indicates there are 231 acres of cropland in the watershed, which comprises 0.2 percent of the entire watershed (Table 2).

County-wide data from the National Agricultural Statistics Service (USDA, 2002) were combined with the land cover data for the West Fork Black River watershed to estimate approximately 1,569 cattle in the watershed[8]. The cattle are most likely located on the approximately 8,672 acres of grassland in the watershed. Runoff from these areas can be a potential source of nutrients to the impaired water body. For example, animals grazing in the grassland areas deposit manure directly on the land surface and their feces are readily washed to the stream channels during rainfall events. Though the grassland may be relatively large and have a low livestock density, the manure will often be concentrated near the feeding and watering areas in the field. Because of overgrazing and/or animal trespassing, these areas can become barren of plant cover and increase soil erosion and pollutant loads. In addition, if a grassland area is not fenced off from the stream, cattle or other livestock may contribute nutrients

[8] According to the National Agricultural Statistics Service there are approximately 26,917 and 9,265 head of cattle in Dent and Reynolds Counties, respectively (USDA, 2007). According to the 2005 Missouri Resource Assessment Partnership (MoRAP) there are 245 and 80 square miles of grasslands in Dent and Reynolds Counties, respectively (MoRAP, 2005). These six values result in a cattle density of approximately 110 and 115 cattle per square mile of grasslands for Dent and Reynolds Counties. This density for each county was multiplied by the number of grassland square miles in the West Fork Black River watershed to estimate the number of cattle in the watershed.

directly to the stream. Agricultural areas in the West Fork Black River watershed are considered to be a potential source of nutrients.

Permitted CAFOs identified in this TMDL are part of the assigned WLA. Animal feeding operations (AFOs) and unpermitted CAFOs are considered under the LA because we do not currently have enough detailed information to know whether these facilities are required to obtain NPDES permits. This TMDL does not reflect a determination by EPA that such facility does not meet the definition of a CAFO nor that the facility does not need to obtain a permit. To the contrary, a CAFO that discharges or proposes to discharge has a duty to obtain a permit. If it is determined that any such operation is an AFO or CAFO that discharges, any future WLA assigned to the facility must not result in an exceedance of the sum of the WLAs in this TMDL as approved.

Any CAFO that does not obtain an NPDES permit must operate as a no discharge facility. Any discharge from an unpermitted CAFO is a violation of Section 301. It is EPA's position that all CAFOs should obtain an NPDES permit because it provides clarity of compliance requirements, authorization to discharge when the discharges are the result of large precipitation events (e.g., in excess of 25-year and 24-hour frequency/duration) or are from a man-made conveyance.

4.2.2 Runoff from Urban Areas

Storm water runoff from urban areas can also be a significant source of nutrients. Lawn fertilization can lead to high nutrient loads and pet wastes can contribute both nutrient loads and oxygen consuming substances. Phosphorus loads from residential areas can be comparable to or higher than loading rates from agricultural areas (Reckhow et al., 1980; Athayde et al., 1983). Excessive discharge of suspended solids from urban areas can also lead to streambed siltation problems.

Since less than 1 percent of the West Fork Black River watershed is classified as urban (including the city of Bunker and Centerville), and neither town is adjacent to the impaired segment, urban storm water runoff is not considered a significant source of the pollutants of concern.

4.2.3 Onsite Wastewater Treatment Systems

Onsite wastewater treatment systems (i.e., septic systems) that are properly designed and maintained should not be a major source of contamination to surface waters. However, onsite wastewater treatment systems do fail for a variety of reasons. When these systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface waters. Failing onsite wastewater treatment systems are sources of nutrients that can reach nearby streams through both runoff and subsurface flows.

The exact number of onsite wastewater treatment systems in the West Fork Black River watershed is unknown. However, as discussed in Section 2.5, the estimated rural population of the West Fork Black River watershed is approximately 1,062 persons. Based on this population and an average density of 2.04 persons per system (EPA, 2009b), approximately 521 onsite wastewater treatment systems are estimated to be in the watershed. EPA reports that the statewide failure rate of onsite wastewater treatment systems in Missouri is between 30 and 50 percent (EPA, 2002b). At higher rates of failure onsite wastewater treatment systems would be a potential source of nutrients. However, very little information was identified that suggests failing onsite wastewater treatment systems are a significant problem in the West Fork Black River watershed. Therefore, onsite wastewater treatment systems are considered a potential, albeit not significant, source of nutrients.

4.2.4 Riparian Habitat Conditions

Riparian[9] habitat conditions can have a strong influence on stream water quality. Wooded riparian buffers are a vital functional component of stream ecosystems and are instrumental in the detention, removal and assimilation of nutrients from the streams. Therefore, a stream with good riparian habitat is more able to moderate the impacts of high nutrient loads than a stream with poor riparian habitat. Wooded riparian buffers can also provide shading that reduces stream temperatures and increases the dissolved oxygen (DO) saturation capacity of the stream. Riparian areas may also be sources of natural background material that contribute nutrients to the stream. For example, leaf fall from vegetation near the water's edge, aquatic plants and drainage from organically rich areas like swamps are all natural sources of material that add nutrients and organic matter.

As indicated in Table 6, about two-thirds of the land in the West Fork Black River riparian buffer is classified as grassland and wetland (MoRAP, 2005). Grassland provides limited riparian habitat and has very little shading compared to wooded areas and, therefore, the grassland can be subject to erosion and nutrient loading. In contrast, wetlands play an effective role in regulating the movement of water within watersheds (Mitsch and Gosselink, 1993). For example, wetlands can store precipitation and retain surface water and then slowly release the water back to the streams, groundwater and the atmosphere. Wetlands may act as a nutrient sink and become a permanent sink if the compounds are buried in the substrate or are released into the atmosphere. They may also temporarily retain nutrients during the growing season or under flooded conditions (Mitsch and Gosselink, 1993). In their natural state, wetlands not only can provide habitat and food sources for a variety of plants and animals but also may improve water quality (Evans, et al., 1996). The low intensity urban and impervious areas in the watershed account for less than one percent of the riparian corridor area. Therefore, these areas are insignificant contributors of nutrients to the impaired conditions in the water body.

[9] A riparian corridor (or zone or area) is the linear strip of land running adjacent to a stream bank.

Table 6. Percentage Land Use and Land Cover within a 30-meter Riparian Buffer (MoRAP, 2005)

Land Use/Land Cover	Percent of West Fork Black River Riparian Area (%)
Cropland	1.4
Forest	26.7
Herbaceous	5.0
Grassland	31.7
Impervious	0.4
Low Intensity Urban	0.1
Open Water	0.1
Wetland	34.6

5 APPLICABLE WATER QUALITY STANDARDS AND NUMERIC WATER QUALITY TARGETS

Section 303(d) of the CWA and Chapter 40 of the CFR Part 130 require states to develop TMDLs for waters not meeting designated uses. The TMDL process quantitatively assesses the impairment factors so that states can establish water quality-based controls to reduce pollutants from both point and nonpoint sources and to restore and protect the quality of their water resources.

Under the CWA, every state must adopt WQS to protect, maintain and improve the quality of the nation's surface waters (U.S. Code Title 33, Chapter 26, Subchapter III (U.S. Code, 2009)). These standards represent a level of water quality that will support the CWA's goal of "fishable/swimmable" waters. Missouri's WQS (10 Code of State Regulation [CSR] 20-7.031) consist of three components: designated uses, criteria (general and numeric) and an antidegradation policy.

Beneficial or designated uses for Missouri streams are found in the WQS at 10 CSR 20-7.031(1)(C), (1)(F) and Table H (CSR, 2009). Criteria for designated uses are found at 10 CSR 20-7.031, Tables A and B (CSR, 2009)). Missouri's antidegradation policy is outlined at 10 CSR 20-7.031(2) (CSR, 2009).

5.1 DESIGNATED BENEFICIAL USES

The impaired reach includes a 31.7 mile segment of West Fork Black River (WBID 2755)[10] with the following designated beneficial uses:

---

[10] West Fork Black River is one of a few water bodies in Missouri that is designated for the protection of both warm-water and cool-water fisheries. Under Missouri's WQS, the Warm-Water Fishery use designation assures that all numeric criteria for protecting aquatic life are applied to water bodies supporting aquatic life. Cool-Water Fishery is an additional use designation to ensure the unique biology and temperature regime are maintained in that water body.

- Livestock and Wildlife Watering
- Protection of Warm-Water Aquatic Life
- Human Health Protection (Fish Consumption)
- Protection of Cool-Water Fishery
- Whole Body Contact Recreation – Category A

The nutrient impairment of West Fork Black River is identified as applying to the General Criteria found in Missouri WQS at 10 CSR 20-7.031(3).

5.2 CRITERIA

All water bodies in Missouri are protected by the general criteria contained in Missouri's WQS at 10 CSR 20-7.031(3). These criteria are also called narrative criteria, since they do not contain specific numerical limits. The narrative criteria not being attained in West Fork Black River are (3)(A), (C) and (G):

- Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly, or harmful bottom deposits or prevent full maintenance of beneficial uses.
- Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor, or prevent full maintenance of beneficial uses.
- Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community.

In the absence of numeric nutrient criteria in Missouri's WQS for freshwater streams, ambient water quality criteria recommendations provided by EPA (2000) can be used to quantify TN and TP LCs in West Fork Black River. Reference conditions for TN and TP in Level III Ecoregion 39 (in which the impaired segment is located) are TN = 0.289 milligrams per liter (mg/L) and TP = 0.007 mg/L. For this TMDL, recommended reference TN and TP criteria are used directly in developing LCs for TN and TP. Additional discussion on watershed-specific targets used to develop TMDLs for TN and TP is provided in Section 6.1 of this report.

5.3 ANTIDEGRADATION POLICY

Missouri's WQS include EPA's "three-tiered" approach to antidegradation and can be found at 10 CSR 20-7.031(2) (CSR, 2009). The three tiers are described in this section as follows:

Tier 1 – Protects existing uses and a level of water quality necessary to maintain and protect those uses. Tier 1 provides the absolute floor of water quality for all waters of the United States. Existing instream water uses are those uses that were attained on or after November 28, 1975, the date of EPA's first WQS Regulation.

Tier 2 – Protects and maintains the existing level of water quality where it is better than applicable water quality criteria. Before water quality in Tier 2 waters can be lowered, there must be an antidegradation review consisting of: 1) a finding that it is necessary to accommodate important economic and social development in the area where the waters are located; 2) full satisfaction of all intergovernmental coordination and public participation provisions; and 3) assurance that the highest statutory and regulatory requirements for point sources and best management practices (BMPs) for nonpoint sources are achieved. Furthermore, water quality may not be lowered to less than the level necessary to fully protect the "fishable/swimmable" uses and other existing or designated uses.

Tier 3 – Protects the quality of outstanding national and state resource waters, such as waters of national and state parks, wildlife refuges and exceptional recreational or ecological significance. There may be no new or increased discharges to these waters and no new or increased discharges to tributaries of these waters that would result in lower water quality.

5.4 NUMERIC WATER QUALITY TARGETS

TN and TP TMDL targets and LCs are based on EPA-recommended Ecoregion 39 criteria and water quality observations at locations throughout the ecoregion. For this analysis, the 25th percentile of data for all seasons is used as the target. This value is calculated by taking the median of the four seasonal 25th percentiles of data within an ecoregion (EPA, 2000). TN and TP concentrations from monitoring locations within Missouri and in Ecoregion 39 are plotted with flow to define the relationship between load and flow unique to Missouri streams in this ecoregion. In developing this relationship, individual water quality measurements are "corrected" based on the ecoregion target such that the median of the dataset is equal to the ecoregion target. Allowable pollutant loads are calculated for all flow conditions by multiplying flow by either the EPA-recommended ecoregion target concentration or the concentration established using the Missouri Ecoregion 39 streams; whichever concentration is higher. Reference conditions for TN and TP in Level III Ecoregion 39 streams are provided in Table 3c of Ambient Water Quality Criteria Recommendations, Information Supporting the Development of State and Tribal Nutrient Criteria for Rivers and Streams in Nutrient Ecoregion XI (EPA, 2000) and in Section 5.2 of this report. A detailed discussion of the method used to develop the TN and TP targets is provided in Appendix B. Criteria used as targets in developing TN and TP TMDLs are presented in Table 7.

Table 7. Criteria Used to Develop TN and TP TMDLs

	TN (mg/L)	TP (mg/L)
TMDL Targets and Criteria[1]	**0.289**	**0.007**

[1] TN and TP ecoregion criteria are based on the 25th percentile of data for all seasons in Ecoregion 39. This value is calculated as the median of the four seasonal 25th percentiles of data within an ecoregion (EPA, 2000).

6 TECHNICAL APPROACH AND METHODOLOGY

A TMDL quantifies the amount of a pollutant that a water body can assimilate without violating WQS and allocates the pollutant load to known point and nonpoint sources in the watershed. The pollutant load is allocated as WLA, LA and a MOS. The MOS accounts for uncertainty in the relationship between the pollutant load and the quality of the receiving water body. Conceptually, this definition is represented by Equation 8.

$$LC = \Sigma WLAs + \Sigma LAs + MOS \qquad \textbf{Equation 8}$$

Where:

LC = Loading Capacity

WLA = Wasteload Allocations (point source)

LA = Load Allocations (nonpoint source)

MOS = Margin of Safety (may be implicit and factored into a conservative WLA or LA, or explicit)

The objective of the TMDL is to estimate an allowable pollutant load and to allocate this load to known pollutant sources within the watershed so appropriate control measures can be implemented and achieve the WQS. The CFR (40 CFR § 130.2 (1)) states that TMDLs can be expressed in terms of mass per time, toxicity or other appropriate measures. For nutrients, TMDLs are expressed as pounds per day (lbs/day) using a load duration curve (LDC) approach.

6.1 LOAD DURATION CURVE APPROACH

When stream flow information is available, a LDC can be a useful method of identifying and differentiating between storm-driven and steady-input sources of pollutants (Cleland, 2002 and Cleland, 2003). For West Fork Black River, the LDC approach was used to: 1) provide a visual representation of stream flow conditions under which TN and TP criteria exceedances have occurred, 2) assess critical conditions and 3) quantify the level of reduction necessary to meet the surface water quality targets for TN and TP in the stream.

A limited amount of flow data is available in the West Fork Black River watershed. To develop a synthetic flow record, a flow duration curve (FDC) was generated for West Fork Black River using four United States Geological Survey (USGS) stream flow stations located in the same region of the state (Table 8). Average daily flow/square mile from the four stations was calculated for each day of record and multiplied by the watershed area associated with the impaired stream segment. The watershed area selected to develop the LDCs corresponds to the length of the impaired segment. LDCs were developed for TN and TP for the entire West Fork Black River upstream of the confluence with Middle Fork Black River. The 31.7 mile impaired segment includes the entire West Fork Black River watershed area of approximately 163.4 square miles.

Continuous and storm water flows were added to the daily flow estimate based on permitted discharges in the impaired watershed. Continuous permitted flows were added to all flows, while storm water flows were estimated based on the relative flow anticipated under each percent-exceeded flow using the following approach: [(1 – percent-exceeded percentile estimated flow) * permitted storm water flow] + estimated flow using gage data. Based on this method, contributions from storm water flow increase as the percent-exceeded flow value decreases (i.e., higher flows). This approach was used to estimate average daily flow for each day during the period of record November 1, 1979, to October 31, 2009.

Table 8. Stream Flow Stations Used to Estimate Flows in the West Fork Black River

River/Station Name	Data Source	Station Number	Drainage Area (mi^2)	Discharge Period of Record
Jacks Fork at Eminence, MO	USGS	07066000	398	1921–2010
Current River at Van Buren, MO	USGS	07067000	1,667	1921-2010
Current River at Doniphan, MO	USGS	07068000	2,038	1921-2010
Eleven Point River near Bardley, MO	USGS	07071500	793	1921–2010

6.2 CRITERIA TO SUPPORT THE TMDLs

In West Fork Black River, narrative criteria are targeted for the impaired segment and a reference approach was used to define TN and TP targets. Because Missouri does not have numeric criteria for TN and TP, a statistical approach was used to develop targets for nutrients using EPA's (2000) ecoregion nutrient criteria for TN and TP. Criteria used as targets in developing TN and TP TMDLs are 0.289 mg/L and 0.007 mg/L, respectively. The TN and TP targets selected for these TMDLs are protective of the narrative criteria.

6.3 CALCULATION OF LOADING CAPACITY

For West Fork Black River, TMDLs are expressed as pounds per day using LDCs. As indicated in Figure 6-1 and Figure 6-2, the LDC represents the LC as a solid red line over the range of flow conditions. Existing pollutant loads, shown as round (black) points, are calculated from the synthetic flow record and samples collected in the West Fork Black River during 2001 – 2009.

Nutrient TMDL targets are based on EPA-recommended Ecoregion 39 criteria. As illustrated in Figure 6-1 and Figure 6-2, 18 TN excursions occurred during the low-flow, mid-flow and high-flow conditions (79-255 cubic feet per second [cfs]) while TP excursions frequently occurred at all flow conditions.

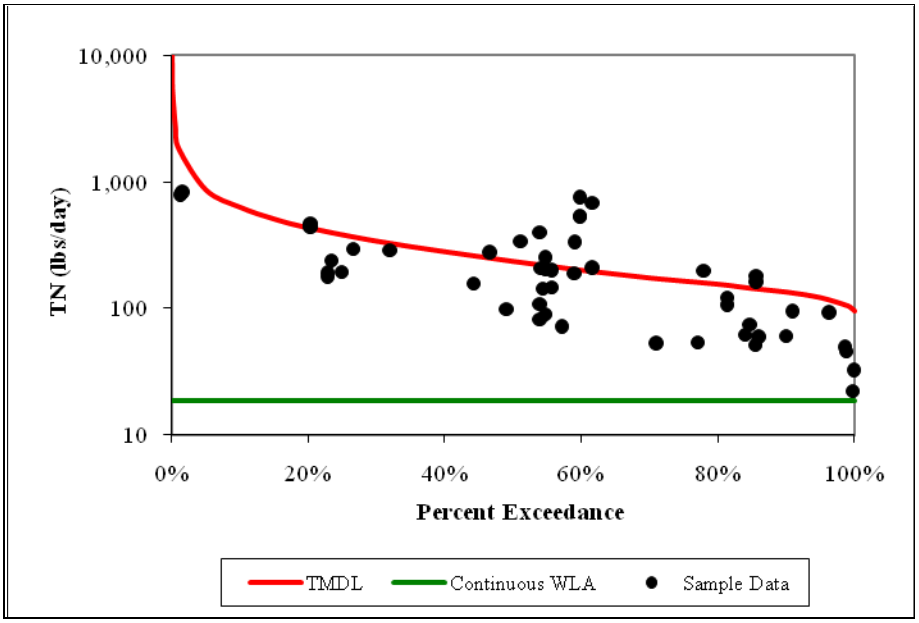

Figure 6-1. LDC for TN at the Outlet of the West Fork Black River Watershed Based on Ecoregion TN Criterion of 0.289 mg/L

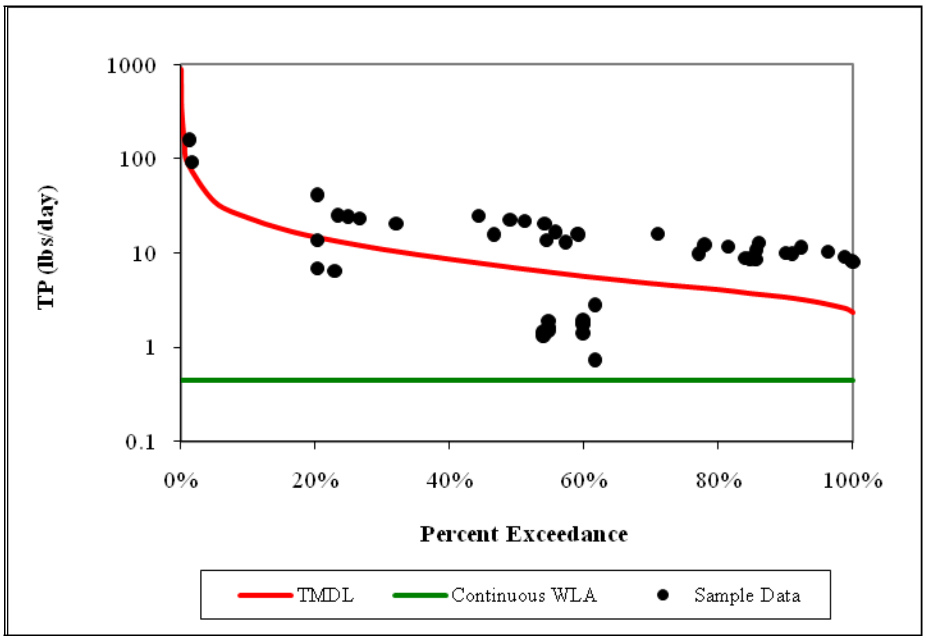

Figure 6-2. LDC for TP at the Outlet of the West Fork Black River Watershed Based on Ecoregion TP criterion of 0.007 mg/L

7 CALCULATION OF LOADING CAPACITY AND POLLUTANT ALLOCATION

Table 9 and Table 10 present the LC (i.e., the TMDL), LA, WLA and MOS values for TN and TP, respectively. These nutrient LC values were calculated based on the synthetic flow derived for the West Fork Black River watershed and the EPA-recommended ecoregion nutrient criteria.

Table 9. TN TMDL at the Outlet of the West Fork Black River Watershed

% Flow Exceedance	Estimated Flow (cfs)	TN TMDL (lbs/day)	TN MOS (lbs/day)[1]	TN LA (lbs/day)	TN WLA	
					Permitted/ Continuous (lbs/day)	Non-permitted/ Unidentified (lbs/day)
95	78.0	121.7	--	103.2	18.5	0
90	86.4	134. 7	--	116.2	18.5	0
70	111.7	174.1	--	155.6	18.5	0
50	149.3	235.7	--	217.2	18.5	0
30	212.7	340.8	--	322.3	18.5	0
10	384.6	632.2	--	613.7	18.5	0
5	520.1	865.8	--	847.3	18.5	0

[1] The TN MOS is implicit and is based on conservative assumptions (See Section 10 for more detail)

Table 10. TP TMDL at the Outlet of the West Fork Black River Watershed

% Flow Exceedance	Estimated Flow (cfs)	TP TMDL (lbs/day)	TP MOS (lbs/day)[1]	TP LA (lbs/day)	TP WLA	
					Permitted/ Continuous (lbs/day)	Non-permitted/ Unidentified (lbs/day)
95	78.0	2.95	--	2.50	0.45	0
90	86.4	3.36	--	2.91	0.45	0
70	111.7	4.69	--	4.24	0.45	0
50	149.3	6.85	--	6.40	0.45	0
30	212.7	10.84	--	10.39	0.45	0
10	384.6	23.43	--	22.98	0.45	0
5	520.1	34.68	--	34.23	0.45	0

[1] The TP MOS is implicit and is based on conservative assumptions (See Section 10 for more detail)

8 WASTE LOAD ALLOCATION (POINT SOURCE LOADS)

The WLA is the maximum allowable amount of a pollutant that can be assigned to point sources. The allowable TN and TP loads from point sources with continuous/permitted flow were determined by multiplying the total design flow of permitted facilities by the water quality targets and a unit conversion factor. The entire West Fork Black River has a total of four permitted point sources with established design flows. These facilities have a combined permitted flow of 7.669 MGD or 11.89 cfs.

Federal regulation (40 CFR Section 130.2) requires allocations of regulated storm water to be included in the WLA of the TMDL (EPA, 2002a). In cases where there are insufficient data to calculate the loads on an outfall, the storm water WLA may be expressed as an aggregate or combined allocation. Permitted storm water outfalls and sources in the West Fork Black River watershed are not expected to contribute nutrients to the impaired segment. Therefore, no nutrient WLA is necessary for these outfalls or sources.

The continuous or permitted WLAs of 18.5 lbs/day TN and 1.45 lbs/day TP are presented in Table 11. Because the three Doe Run continuous mine discharge outfalls (West Fork Unit, Brushy Creek Mine and Fletcher Mine Mill) each discharge TN and TP to West Fork Black River and all three of these facilities are considered significant sources, these facilities are covered under these WLAs.

Table 11. TN and TP Wasteload Allocations for the entire West Fork Black River

% Flow Exceedance	Estimated Flow (cfs)	TN WLA (lbs/day)	TP WLA (lbs/day)
95	78.0	18.5	0.45
90	86.4	18.5	0.45
70	111.7	18.5	0.45
50	149.3	18.5	0.45
30	212.7	18.5	0.45
10	384.6	18.5	0.45
5	520.1	18.5	0.45

9 LOAD ALLOCATION (NONPOINT SOURCE LOADS)

The LA is the maximum allowable amount of a pollutant that can be assigned to nonpoint sources. The LAs for the West Fork Black River TMDL are for all nonpoint sources of TN and TP in the watershed. These can include loads from agricultural lands, animal feeding operations and failing onsite wastewater treatment systems, as well as runoff from urban areas. Each of these nutrient LAs are the difference between the LC and WLA, minus the MOS (Table 12).

Table 12. TN and TP Load Allocations for West Fork Black River

% Flow Exceedance	Estimated Flow (cfs)	TN LA (lbs/day)	TP LA (lbs/day)
95	78.0	103.2	2.50
90	86.4	116.2	2.91
70	111.7	155.6	4.24
50	149.3	217.2	6.40
30	212.7	322.3	10.39
10	384.6	613.7	22.98
5	520.1	847.3	34.23

10 MARGIN OF SAFETY

A MOS is required in the TMDL calculation to account for uncertainties in scientific and technical understanding of water quality in natural systems. The MOS is intended to account for such uncertainties in a conservative manner. Based on EPA guidance, the MOS can be achieved through one of two approaches:

1) Explicit – Reserve a numeric portion of the LC as a separate term in the TMDL.
2) Implicit – Incorporate the MOS as part of the critical conditions for the WLA and the LA calculations by making conservative assumptions in the analysis.

For TN and TP TMDLs, an implicit MOS was incorporated into the TMDLs based on the conservative assumptions used in the development of the nutrient LDCs. The TN and TP targets are conservative because they are based on the 25th percentile value of all TN and TP data collected from Subecoregion 39 of Aggregate Nutrient Ecoregion IX, where these data are not directly influenced by permitted dischargers. These nutrient targets are the median values calculated from the four season 25th percentile values. As a result, the high nutrient concentrations seen during the periods of spring runoff and winter flow from snowmelt (or low concentrations seen during low flow conditions in both summer and fall) do not unduly influence the annual reference targets. These targets were derived by the EPA to represent the conditions of surface waters that are minimally impacted by human activities and protective of aquatic life and recreational uses (EPA, 2000).

11 CRITICAL CONDITIONS AND SEASONAL VARIATION

Critical conditions are the water body conditions associated with flow, season, water temperature, loading, beneficial use, monitoring location and other water quality factors. The critical conditions can be thought of as the “worst case” scenario of environmental conditions that occur in the water body in which the loading of a target pollutant will continue to meet the WQS. For these nutrient TMDLs, the critical condition is summer low flow when the impacts of nutrient loads to the impaired water body will have the greatest impact on algae growth instream. Nutrient loads protective of low flow conditions should also be protective of narrative criteria.

Federal regulations at 40 CFR §130.7(c)(1) require that TMDLs take into consideration seasonal variation in applicable standards. Although there were insufficient water quality data to determine any seasonal pattern that may be occurring in West Fork Black River, the use of LDCs represents the allowable pollutant load under various flow conditions and across all seasons. The results obtained using the LDC method are therefore more robust and reliable over all flows and seasons when compared with those obtained under more limited conditions. The advantage of the LDC approaches is that all flow conditions are considered and the constraints associated with using a single-flow critical condition are avoided.

12 MONITORING PLAN

In general, future stream monitoring is scheduled and conducted by MDNR approximately three years after TMDL approval or in a reasonable time frame following the completion of permit compliance schedules and/or the application of new effluent limits. Any volunteer or permittee water quality monitoring that occurs on the West Fork Black River will be used for evaluating the present stream condition to see if the state's WQS established by the TMDL are being met. MDNR routinely examines stream habitat, water quality, invertebrate and fish community data collected by the Resource Assessment and Monitoring Program of the Missouri Department of Conservation. This program randomly samples streams across Missouri on a five to six year rotating schedule.

13 REASONABLE ASSURANCES

MDNR has the authority to issue and enforce Missouri State Operating Permits. Inclusion of effluent limits into a state operating permit and requiring that effluent and instream monitoring be reported to MDNR should provide reasonable assurance that instream WQS will be met. Section 301(b)(1)(C) requires that point source permits have effluent limits as stringent as necessary to meet WQS. However, for WLAs to serve that purpose, they must themselves be stringent enough so that (in conjunction with the water body's other loadings) they meet WQS. This generally occurs when the TMDL's combined nonpoint source LAs and point source WLAs do not exceed the WQS-based LC and there is reasonable assurance that the TMDL's allocations can be achieved. Any discussion of reduction efforts relating to nonpoint sources would be found in the implementation section of the TMDL. EPA believes that point source permitting authority and nonpoint source measures discussed in the supplemental implementation plan (see Appendix D) provides reasonable assurances that the TMDL allocations can be achieved.

14 PUBLIC PARTICIPATION

EPA regulations require that TMDLs be subject to public review (40 CFR §130.7). EPA is providing public notice of this draft TMDL for West Fork Black River on the EPA, Region 7, TMDL Website at http://www.epa.gov/region07/water/tmdl_public_notice.htm. The response to comments and the final TMDL will be available at:

http://www.epa.gov/region07/water/apprtmdl.htm#Missouri.

This water quality limited segment of West Fork Black River in Reynolds County, Missouri, is included on the EPA-approved 2008 303(d) List for Missouri. This TMDL is being established by EPA to meet the requirements of the 2001 Consent Decree, *American Canoe Association, et al. v. EPA*, No. 98-1195-CV-W in consolidation with No. 98-4282-CV-W, February 27, 2001. EPA is developing this TMDL in cooperation with the state of Missouri and EPA is establishing this TMDL at this time to meet the *American Canoe* consent decree milestones. Missouri may submit, and EPA may approve, a revised or modified TMDL for this water body at any time.

Before finalizing EPA established TMDLs, the public is notified that a comment period is open on the EPA Region 7 Website for at least 30 days. EPA's public notices to comment on draft TMDLs are also distributed via mail and electronic mail to major stakeholders in the watershed and other potentially impacted parties. After the comment period closes, EPA reviews all comments, edits the TMDL as is appropriate, writes a Summary of Response to Comments and establishes the TMDL. For Missouri TMDLs, groups receiving the public notice announcement include a distribution list provided by MDNR, the Missouri Clean Water Commission, the Missouri Water Quality Coordinating Committee, stream team volunteers, state legislators, County Commissioners, the County Soil and Water Conservation District and potentially impacted cities, towns and facilities. EPA followed this public notice process for this TMDL. Links to active public notices for draft TMDLs, final (approved and established) TMDLs and Summary of Response to Comments are posted on the EPA Website: http://www.epa.gov/region07/water/tmdl.htm.

15 ADMINISTRATIVE RECORD AND SUPPORTING DOCUMENTATION

An administrative record on the West Fork Black River TMDL has been assembled and is being kept on file with EPA.

APPENDICES

Appendix A – West Fork Black River Water Quality Data
Appendix B – Development of Nutrient Targets Using Ecoregion Nutrient Criteria with LDCs
Appendix C – Stream Flow and Water Quality Stations Used to Develop TMDLs in West Fork Black River
Appendix D – Supplemental Implementation Plan

REFERENCES

Athayde, D., P. Shelley, E. Driscoll, D. Gaboury and G. Boyd, 1983. Results of the Nationwide Urban Runoff Program, Volume I.

Cleland, B.R., 2002. TMDL Development From the "Bottom Up" – Part II: Using Load Duration Curves to Connect the Pieces. Proceedings from the WEF National TMDL Science and Policy 2002 Conference.

Cleland, B.R., 2003. TMDL Development From the "Bottom Up" – Part III: Duration Curves and Wet-Weather Assessments. America's Clean Water Foundation, Washington, D.C.

Code of State Regulations (CSR), 2009. Missouri Secretary of State Web page. Title 10 - Department of Natural Resources. Division 20 – Clean Water Commission. Chapter 7 – Water Quality. 10 CSR 20-7.031 - WQS. http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7.pdf

EPA, 2000. Ambient Water Quality Criteria Recommendations. Information Supporting the Development of State and Tribal Nutrient Criteria. Rivers and Streams in Nutrient Ecoregion XI EPA 822-B-00-020. EPA, Washington, D.C.

EPA, 2002a. Establishing Total Maximum Daily Load (TMDL) WLAs for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs. USEPA Office of Water Memorandum from Robert H. Wayland, III, Director of OWOW to Water Division Directors. EPA, Washington, D.C.

EPA, 2002b. Onsite Wastewater Treatment System Manual. EPA/625/R-00/008. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. and Office of Research and Development, Cincinnati, OH. February 2002.

EPA, 2009a. Sampling for Consent Decree Waters in Missouri, West Fork Black River, Reynolds County, Missouri. Task Order No. 2008-54. Prepared by URS Group.

EPA, 2009b. United States Environmental Protection Agency Region 5 STEPL Online Database Cites NESC (National Environmental Service Center). 2002. Accessed July 28, 2009. http://bering.tetratech-ffx.com/website/stepl/viewer.htm

Evans, R., J. W. Gilliam and J. P. Lilly, 1996. Wetlands and Water Quality. Published by the North Carolina Cooperative Extension Service. Publication Number AG 473-7.

MDNR (Missouri Department of Natural Resources), 2004. Total Maximum Daily Load Information Sheet. West Fork Black River. Accessed February 27, 2009, http://dnr.mo.gov/env/wpp/tmdl/info/2755-w-fk-black-r-info.pdf

MDNR (Missouri Department of Natural Resources), 2009. Northeast Missouri Groundwater Province. Accessed July 17, 2009. http://dnr.mo.gov/env/wrc/groundwater/education/provinces/nemissouriprovince.htm.

Mitsch, W. J. and J. G. Gosselink, 1993. Wetlands. Second Edition.

MoRAP (Missouri Resource Assessment Partnership), 2005. Land Use/Land Cover Data. Accessed July 1, 2009. http:// www.msdis.missouri.edu.

NOAA (National Oceanic and Atmospheric Administration), 2009. NNDC Climate Data Online. Accessed July 17, 2009. http://cdo.ncdc.noaa.gov/climatenormals/clim20/mo/234544.pdf.

NRCS (Natural Resources Conservation Service), Accessed July 17, 2009. http://soildatamart.nrcs.usda.gov/Survey.aspx?County=MO001.

Purdue Research Foundation, 2009. Hydrologic Soil Groups. Accessed July 17, 2009. http://www.ecn.purdue.edu/runoff/documentation/hsg.html, Hydrologic Soil Groups.

Reckhow, K. H., M. N. Beaulac, and J. R. Simpson, 1980. Modeling Phosphorous Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients. EPA-440/5-8-011, U.S. Environmental Protection Agency, Washington, D.C.

Stoeser, Douglas B., Gregory N. Green, Laurie C. Morath, William D. Heran, Anna B. Wilson, David W. Moore, and Bradley S. Van Gosen, 2005. Preliminary Integrated Geologic Map Databases for the United States Central States: Montana, Wyoming, Colorado, New Mexico, Kansas, Oklahoma, Texas, Missouri, Arkansas and Louisiana, - The State of Missouri: U.S. Geological Survey Open-File Report 2005-1351, U.S. Geological Survey, Denver, CO.

United States Census Bureau, 2000. 2000 Population Estimates. Accessed July 20, 2009, http://www.census.gov/ .

United States Census Bureau, 2000. 2000 Population Estimates. Accessed November 6, 2008, http://www.census.gov/.

USDI (U.S. Department of the Interior), U.S. Geological Survey, 1997. Standards for Digital Raster Graphics: Reston, VA.

Appendix A

West Fork Black River Water Quality Data

Site	Site Name	Date	Flow (cfs)	TN (mg/L)	TP (mg/L)
2755/8.4	W. Fk. Black R. @ Centerville	1/10/2000	79	0.4	0.025
2755/8.4	W. Fk. Black R. @ Centerville	3/13/2000	76	0.5	0.025
2755/8.4	W. Fk. Black R. @ Centerville	5/8/2000	44	0.2	0.025
2755/8.4	W. Fk. Black R. @ Centerville	7/24/2000	33	0.2	0.025
2755/8.4	W. Fk. Black R. @ Centerville	9/11/2000	26	0.2	0.025
2755/8.4	W. Fk. Black R. @ Centerville	11/13/2000	57	0.1	0.0299
2755/8.4	W. Fk. Black R. @ Centerville	1/16/2001	116	0.3	0.0299
2755/8.4	W. Fk. Black R. @ Centerville	3/12/2001	65	0.5	0.0299
2755/8.4	W. Fk. Black R. @ Centerville	5/8/2001	53	0.1	0.0299
2755/8.4	W. Fk. Black R. @ Centerville	7/16/2001	26	0.2	0.0299
2755/8.4	W. Fk. Black R. @ Centerville	9/4/2001	29	0.1	0.0299
2755/8.4	W. Fk. Black R. @ Centerville	11/14/2001	35	0.1	0.0299
2755/8.4	W. Fk. Black R. @ Centerville	1/22/2002	48	0.3	0.0299
2755/8.4	W. Fk. Black R. @ Centerville	3/7/2002	133	0.2	0.0299
2755/8.4	W. Fk. Black R. @ Centerville	5/15/2002	806	0.2	0.0299
2755/8.4	W. Fk. Black R. @ Centerville	7/16/2002	63	0.1	0.0299
2755/22.7	W. Fk. Black R. 0.2 mi.bl. West Fk mine outfall	7/29/2002	17.1	0.3	0.025
2755/23.1	W. Fk. Black R. 0.2 mi.ab. West Fk mine outfall	7/29/2002	12.9	0.2	0.025
2755/8.4	W. Fk. Black R. @ Centerville	9/3/2002	36	0.1	0.0299
2755/22.7	W. Fk. Black R. 0.2 mi.bl. West Fk mine outfall	10/3/2002	16.3	0.2	0.025
2755/23.1	W. Fk. Black R. 0.2 mi.ab. West Fk mine outfall	10/3/2002	12.9	0.3	0.025
2755/8.4	W. Fk. Black R. @ Centerville	11/18/2002	48	0.1	0.0199
2755/8.4	W. Fk. Black R. @ Centerville	1/6/2003	109	0.4	0.0199
2755/22.7	W. Fk. Black R. 0.2 mi.bl. West Fk mine outfall	1/28/2003	19.7	0.4	0.025
2755/23.1	W. Fk. Black R. 0.2 mi.ab. West Fk mine outfall	1/28/2003	13.3	0.4	0.025
2755/8.4	W. Fk. Black R. @ Centerville	3/10/2003	91	0.2	0.02
2755/22.7	W. Fk. Black R. 0.2 mi.bl. West Fk mine outfall	4/23/2003	41.2	0.3	0.025
2755/23.1	W. Fk. Black R. 0.2 mi.ab. West Fk mine outfall	4/23/2003	33.1	0.3	0.025
2755/8.4	W. Fk. Black R. @Centerville	5/21/2003	185	0.2	0.0199

Site	Site Name	Date	Flow (cfs)	TN (mg/L)	TP (mg/L)
2755/8.4	W. Fk. Black R. @Centerville	7/8/2003	48	0.2	0.0199
2755/8.4	W. Fk. Black R. @Centerville	9/2/2003	79	0.3	0.0199
2755/8.4	W. Fk. Black R. @Centerville	11/17/2003	60	0.1	0.0199
2755/8.4	W. Fk. Black R. @Centerville	1/20/2004	198	0.2	0.0199
2755/8.4	W. Fk. Black R. @Centerville	3/15/2004	122	0.3	0.0199
2755/8.4	W. Fk. Black R. @Centerville	5/3/2004	602	0.2	0.0199
2755/8.4	W. Fk. Black R. @Centerville	7/6/2004	49	0.1	0.0199
2755/8.4	W. Fk. Black R. @Centerville	9/8/2004	39	0.1	0.0199
2755/22.7	W. Fk. Black R. 0.2 mi.bl. West Fk mine outfall	4/17/2009	129	0.2	0.005
2755/23.1	W. Fk. Black R. 0.2 mi.ab. West Fk mine outfall	4/17/2009	102	0.1	0.005
2755/12.2	W. Fk. Black R. at Sutton Bluff Campground	7/9/2009	41.16	0.58	0.0019
2755/22.3	W. Fk. Black R. 0.6 mile below West Fork Mine	7/9/2009	24.96	0.12	0.002
2755/22.7	W. Fk. Black R. 0.2 mi.bl. West Fk mine outfall	7/9/2009	30.11	0.16	0.0021
2755/22.8	W. Fk. Black R. 0.1 mi.bl. W. Fk mine outfall	7/10/2009	27.33	0.37	0.0022
2755/23.1	W. Fk. Black R. 0.2 mi.ab. West Fk mine outfall	7/10/2009	23.62	0.30	0.0024
2755/25.8	W. Fk. Black R. above Bills Creek	7/10/2009	14.69	0.13	0.0028
2755/12.2	W. Fk. Black R. at Sutton Bluff Campground	8/14/2009	30.34	0.85	0.0031
2755/22.3	W. Fk. Black R. 0.6 mile below West Fork Mine	8/14/2009	21.43	1.21	0.0028
2755/22.7	W. Fk. Black R. 0.2 mi.bl. West Fk mine outfall	8/14/2009	23.68	0.86	0.0023
2755/22.8	W. Fk. Black R. 0.1 mi.bl. W. Fk mine outfall	8/14/2009	22.55	0.87	0.0029
2755/23.1	W. Fk. Black R. 0.2 mi.ab. West Fk mine outfall	8/15/2009	19.12	1.12	0.0012
2755/25.8	W. Fk. Black R. above Bills Creek	8/15/2009	10.14	0.34	0.0046
2755/22.7	W. Fk. Black R. 0.2 mi.bl. West Fk mine outfall	10/13/2009	95.3	0.3	0.005
2755/23.1	W. Fk. Black R. 0.2 mi.ab. West Fk mine outfall	10/13/2009	95.3	0.3	0.01
2755/23.3	W. Fk. Black R. 0.4 mi.ab. West Fk mine outfall	10/13/2009	85.3	0.3	0.03
2755/26.7/1.9/.2	trib. Bills Cr. 0.2 mi.bl. Mine water discharge	12/1/2009			

ab. = above
bl. = below
mi = mile
W. Fk. Black R. = West Fork Black River
trib. = tributary
cfs = cubic feet per second, mg/L = milligrams per liter, TN = total nitrogen, TP = total phosphorus

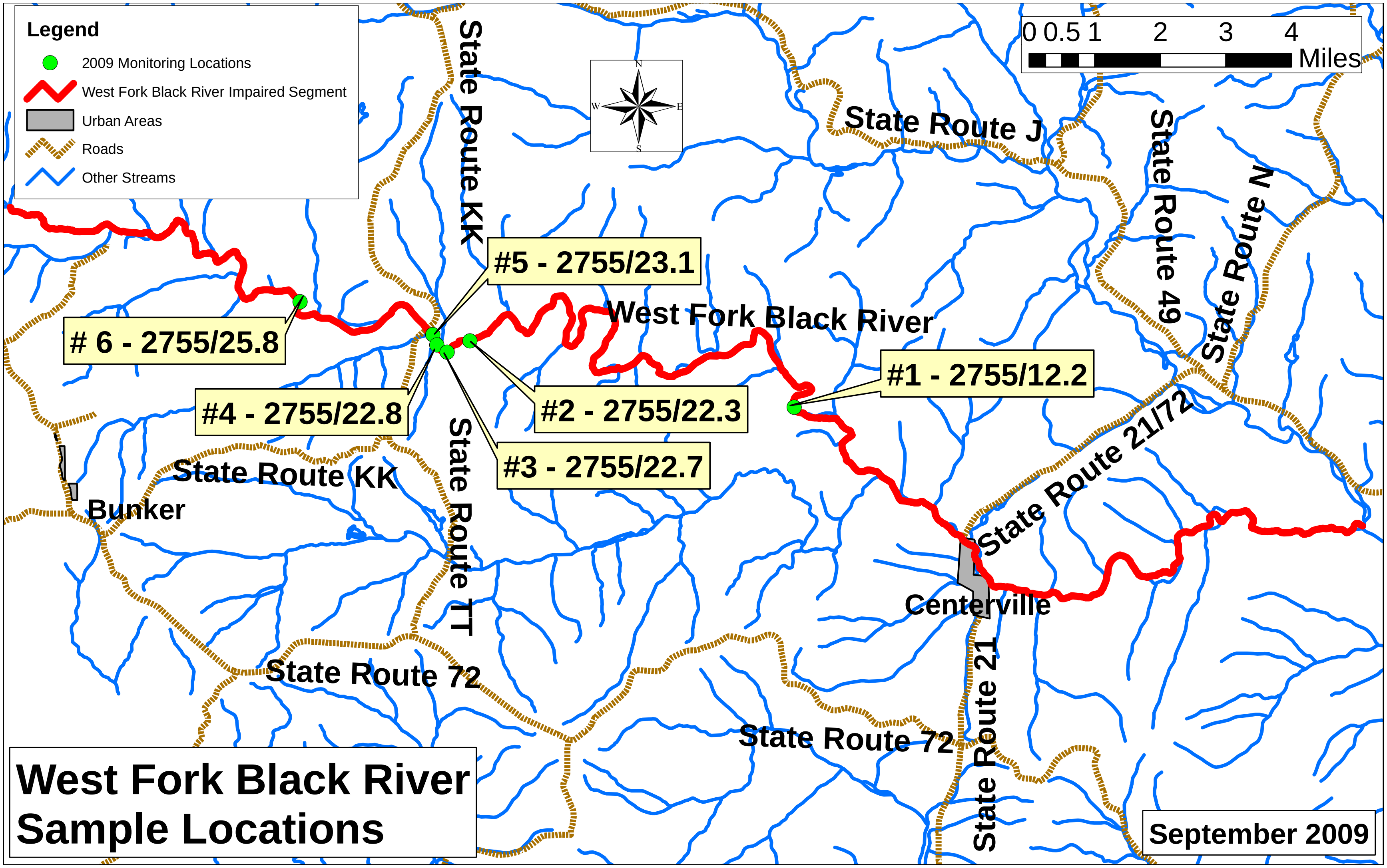

Figure A-1. Location of West Fork Black River 2009 Water Quality Monitoring Stations

Appendix B

Development of Nutrient Targets Using Ecoregion Nutrient Criteria with LDCs

Overview

This procedure is used when a lotic[11] system is placed on the 303(d) impaired water body list for nutrient pollutants and the designated use being addressed is aquatic life. In cases where EPA-approved state numeric criteria for the impaired stream is not available a reference approach is used. The target for pollutant loading is the EPA recommended ecoregion nutrient criterion for the specific ecoregion in which the water body is located (EPA, 2000). If a flow record for the impaired stream is not available a synthetic flow record is needed. To develop a synthetic flow record a user should calculate an average of the log discharge per square mile of USGS gaged rivers for which the drainage area is contained within the EDU. Selection of these gages is based on location, land use/soil/topography similarities to the West Fork Black River watershed and the availability of flow data of sufficient age and duration. From this synthetic record develop a flow duration and build a LDC for the pollutant within the EDU.

See EPA (2000) for more detailed information as to how recommended ecoregion nutrient criteria were developed. This appendix describes how the nutrient criteria (TN and TP) are expressed in this TMDL.

Methodology

The first step in this procedure is to gather available nutrient data within the ecoregion of interest. These data along with the instantaneous flow measurement taken at the time of sample collection for the specific date are required to develop the LDC. Both dates and nutrient concentrations are needed in order to match the measured data used with the synthetic EDU flow record.

Secondly, collect average daily flow data from gages with a variety of drainage areas for a period of time to cover the nutrient record. From these flow records normalize the flow to a per square mile basis. Average the log transformations of the average daily discharge for each day in the period of record. For each gage record used to build the synthetic flow record calculate the Nash-Sutcliffe value to determine if the relationship is valid for each record. This relationship must be valid in order to use this methodology. This new synthetic record of flow per square mile is then used to develop the LDC for the EDU. The flow record should be of sufficient length to be able to calculate percentiles of flow (typically 20 years or more).

The following example shows the application of the approach for the Ozark Highlands EDU. Watershed-size normalized data for the individual gages in the EDU were calculated and

[11] Lotic = pertaining to moving water

compared to a pooled data set of all the gages (Figure B-1, Table B-1). Table B-1 demonstrates the pooled data set can confidently be used as a surrogate for the EDU analyses.

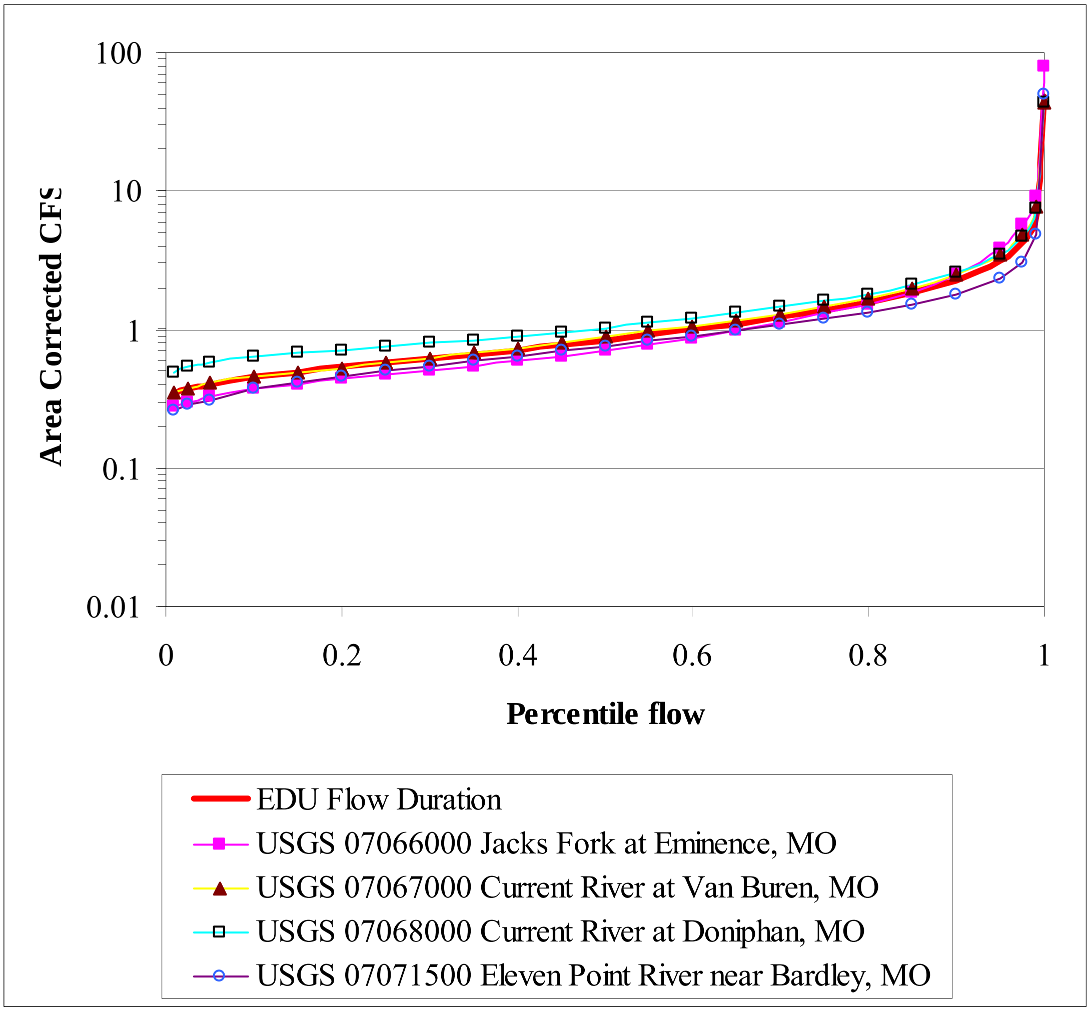

Figure B-1. Synthetic Flow Development in the Ozark Highlands EDU

Table B-1. Stream Flow Stations Used to Estimate Flows in West Fork Black River

River/Station Name	Data Source	Station Number	Drainage Area (mi^2)	Lognormal Nash-Sutcliffe
Jacks Fork at Eminence, MO	USGS	07066000	398	83%
Current River at Van Buren, MO	USGS	07067000	1,667	98%
Current River at Doniphan, MO	USGS	07068000	2,038	99%
Eleven Point River near Bardley, MO	USGS	07071500	793	99%

The next step was to collect previously measured water quality data from within the ecoregion. Measured TN concentrations are adjusted so their median is equal to the EPA recommended ecoregion TN criterion. This is accomplished by subtracting the difference between the EPA recommended ecoregion TN criterion and the median from the measured data. This results in the data retaining most of its natural variability yet having a median which meets the EPA recommended ecoregion TN criterion. Where this adjustment would result in a negative concentration the minimum measured concentration is substituted. Figure B-2 shows an example of this process where the solid line is the measured distribution of the natural log TN concentration with the natural log flow and the dashed line represents a data distribution (the adjusted data) which would comply with the EPA recommended ecoregion TN criterion.

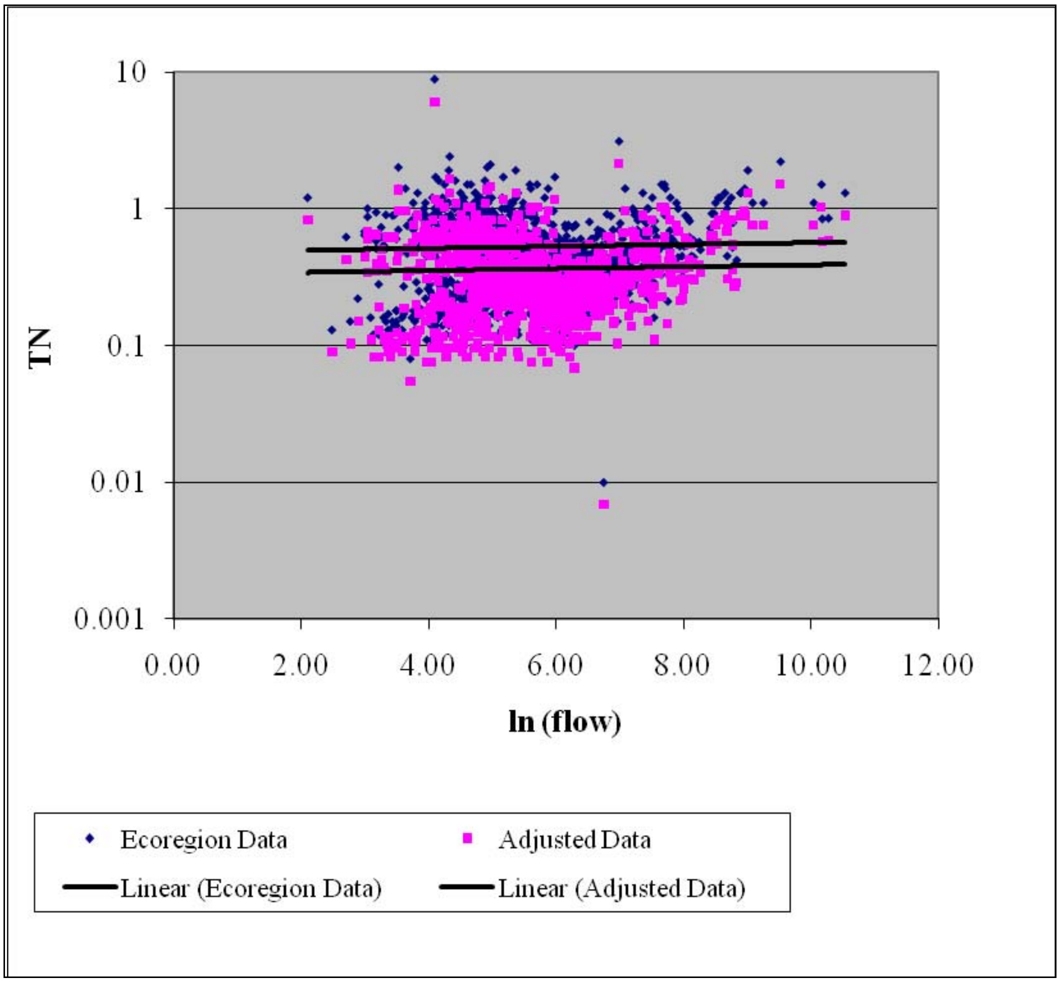

Figure B-2. Graphic Representation of Data Adjustment in Ozark Highlands EDU

The next step was to calculate the TN discharge relationship for the ecoregion using the adjusted data; this is natural log transformed data for the load (pounds /day) and the instantaneous flow (cfs). Figure B-3 shows this relationship for this TMDL.

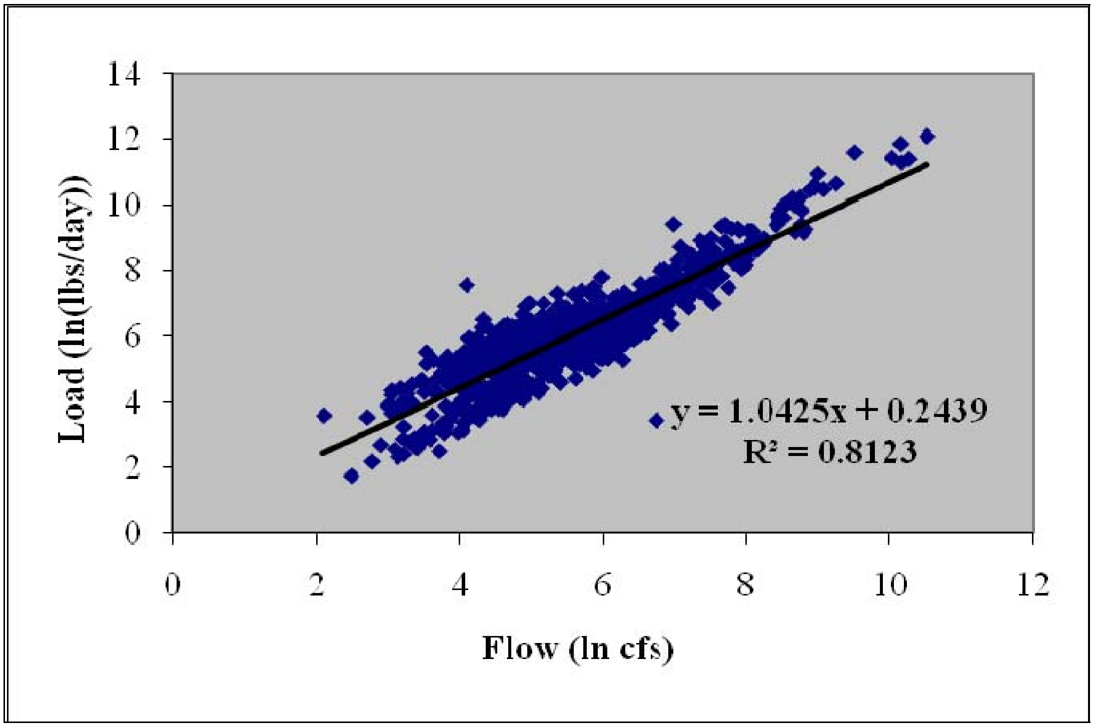

Figure B-3. Load / Flow Relationship Used to Set LDC TMDL

This relationship was used to develop a LDC for which the relationship between flow and nutrient distribution is taken into account. In this LDC the targeted concentration is allowed to change at different percentiles of flow exceedance. However, meeting the LDC will result in a water body in which the median concentration is equal to the EPA recommended ecoregion criterion.

To apply this process to a specific watershed entails using the individual watershed data compared to the TMDL curve that has been multiplied by the watershed area (square miles). Data from the impaired segment is then plotted as a load (pounds/day) for the y-axis and as the percentile of flow for the EDU on the day the sample was taken for the x-axis. These data points do not have to be collected at the segment outlet. The spreadsheet applies an outlet flow (percentile exceedance) to the concentration based on the synthetic flow estimate for the specific date the sample was taken (Figure B-4).

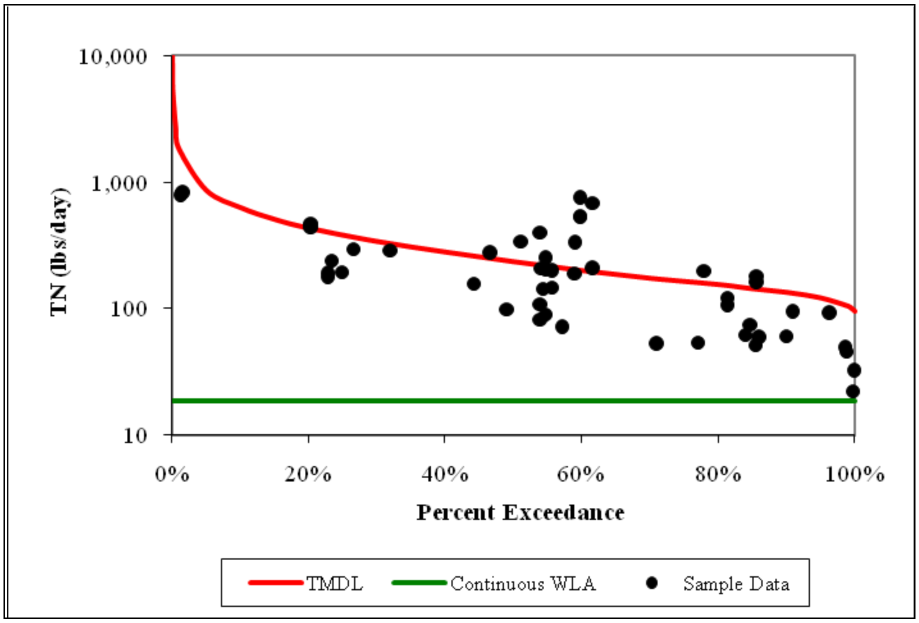

Figure B-4. Example of TMDL LDC Using This Method

The resulting LDC with plotted site specific measured data can now be used to target implementation by identifying flows in which TN concentrations are higher than would be expected in a stream meeting the EPA recommended ecoregion TN criterion.

For more information contact:

United States Environmental Protection Agency, Region 7
Water, Wetlands and Pesticides Division
Total Maximum Daily Load Program
901 North 5th Street
Kansas City, Kansas 66101
Website: http://www.epa.gov/region07/water/tmdl.htm

Appendix C

Stream Flow and Water Quality Stations Used to Develop TMDLs in West Fork Black River

Table C-1. Stream Flow Stations Used to Estimate Flows in West Fork Black River

River/Station Name	Data Source	Station Number	Drainage Area (mi^2)
Jacks Fork at Eminence, MO	USGS	07066000	398
Current River at Van Buren, MO	USGS	07067000	1,667
Current River at Doniphan, MO	USGS	07068000	2,038
Eleven Point River near Bardley, MO	USGS	07071500	793

Table C-2. Stations Used to Develop TN and TP Water Quality Data Targets in West Fork Black River

USGS Gage Number	Station Name
7010500	Meramec Springs near St. James, MO
7014000	Huzzah Creek near Steelville, MO
7014200	Courtois Creek at Berryman, MO
7014500	Meramec River near Sullivan, MO
7064400	Montauk Springs at Montauk, MO
7064440	Current River at Montauk State Park, MO
7064530	Welch Spring near Akers, MO
7064555	Pulltite Spring near Round Spring, MO
7065000	Round Spring at Round Spring, MO
7065500	Alley Spring at Alley, MO
7066000	Jacks Fork at Eminence, MO
7066110	Jacks Fork above Two Rivers, MO
7066510	Current River above Powder Mill, MO
7066550	Blue Spring near Eminence, MO
370857091265901	Jacks Fork River above Alley Spring, MO
370901091262001	Alley Spring Below Alley, MO
370905091204001	Jacks Fork Above 2nd Unnamed Hollow below Eminence, MO
371014091201301	Jacks Fork above Lick Log Hollow below Eminence, MO
371026091183301	Jacks Fork above Powell Springs above Two Rivers, MO
371054091173501	Jacks Fork below 3rd Hollow above Two Rivers, MO

Table C-3. Water Quality Data Used in TMDL Development

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)	USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
370901091262001	5/10/1999	0.8	208	370901091262001	5/10/1999	0.026	208
370901091262001	6/22/1999	0.85	136	370901091262001	6/22/1999	0.008	136
370901091262001	11/8/1999	0.71	89	370901091262001	8/10/1999	0.015	128
370901091262001	2/29/2000	0.83	173	370901091262001	11/8/1999	0.01	89
370901091262001	6/6/2000	0.64	75	370901091262001	12/14/1999	0.009	94
370901091262001	6/28/2000	0.62	99	370901091262001	1/18/2000	0.009	85
370901091262001	8/22/2000	0.62	73	370901091262001	2/29/2000	0.011	173
370901091262001	2/22/2001	0.85	208	370901091262001	4/4/2000	0.006	87
370901091262001	3/21/2001	0.95	123	370901091262001	5/10/2000	0.006	77
370901091262001	5/25/2001	0.65	75	370901091262001	5/23/2000	0.009	80
370901091262001	5/27/2001	0.65	80	370901091262001	5/25/2000	0.01	85
370901091262001	8/9/2001	0.6	69	370901091262001	6/6/2000	0.011	75
370901091262001	10/11/2001	0.98	66	370901091262001	6/28/2000	0.008	99
370901091262001	4/2/2002	0.76	200	370901091262001	7/10/2000	0.009	82
370901091262001	4/30/2002	0.59	250	370901091262001	7/28/2000	0.009	76
370901091262001	5/29/2002	0.7	293	370901091262001	8/11/2000	0.009	73
370901091262001	6/28/2002	0.77	145	370901091262001	8/22/2000	0.007	73
370901091262001	6/29/2002	0.79	142	370901091262001	9/20/2000	0.012	74
370901091262001	10/8/2002	1.1	89	370901091262001	10/4/2000	0.009	66
370901091262001	10/9/2002	0.74	89	370901091262001	11/9/2000	0.009	79
370901091262001	6/2/2003	0.71	113	370901091262001	12/20/2000	0.009	73
370901091262001	6/9/2003	0.81	117	370901091262001	1/24/2001	0.01	79
370901091262001	9/23/2003	0.71	87	370901091262001	2/22/2001	0.012	208
370901091262001	7/13/2004	0.31	108	370901091262001	3/21/2001	0.011	123
370901091262001	9/21/2004	0.72	88	370901091262001	4/25/2001	0.011	88
6930800	2/1/1999	0.89	3060	370901091262001	5/25/2001	0.009	75
6930800	3/16/1999	0.92	4780	370901091262001	5/26/2001	0.008	80
6930800	4/12/1999	0.45	2900	370901091262001	5/26/2001	0.01	80
6930800	5/26/1999	0.35	1700	370901091262001	5/27/2001	0.01	80
6930800	6/24/1999	0.42	921	370901091262001	5/27/2001	0.01	80
6930800	7/12/1999	0.44	826	370901091262001	6/7/2001	0.01	74
6930800	8/12/1999	0.32	642	370901091262001	8/1/2001	0.009	64
6930800	9/2/1999	0.27	482	370901091262001	8/8/2001	0.008	69
6930800	10/5/1999	0.47	492	370901091262001	8/8/2001	0.009	69
6930800	11/16/1999	0.25	516	370901091262001	8/9/2001	0.006	69
6930800	12/8/1999	0.36	879	370901091262001	8/9/2001	0.01	69
6930800	1/13/2000	0.6	722	370901091262001	9/18/2001	0.009	68
6930800	2/9/2000	0.31	560	370901091262001	10/2/2001	0.009	66
6930800	3/13/2000	0.49	1010	370901091262001	10/10/2001	0.008	66
6930800	4/4/2000	0.32	935	370901091262001	10/10/2001	0.009	66
6930800	5/16/2000	0.3	504	370901091262001	10/11/2001	0.009	66
6930800	6/13/2000	0.44	481	370901091262001	10/11/2001	0.01	66
6930800	7/5/2000	0.48	493	370901091262001	11/20/2001	0.002	62
6930800	8/1/2000	0.36	541	370901091262001	4/2/2002	0.015	200
6930800	9/5/2000	0.23	350	370901091262001	4/30/2002	0.013	250
6930800	10/24/2000	0.2	463	370901091262001	5/29/2002	0.021	293
6930800	11/21/2000	0.1	535	370901091262001	6/4/2002	0.019	226
6930800	12/6/2000	0.24	523	370901091262001	6/28/2002	0.012	145
6930800	1/9/2001	0.35	475	370901091262001	6/29/2002	0.012	142
6930800	2/15/2001	1.3	1570	370901091262001	7/29/2002	0.013	118
6930800	3/28/2001	0.91	894	370901091262001	8/6/2002	0.011	105
6930800	4/9/2001	0.62	1400	370901091262001	8/7/2002	0.012	105
6930800	5/3/2001	0.32	681	370901091262001	10/8/2002	0.01	89
6930800	6/13/2001	0.43	1150	370901091262001	10/9/2002	0.01	89

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
6930800	7/18/2001	0.36	547
6930800	8/14/2001	0.32	429
6930800	9/6/2001	0.25	381
6930800	10/22/2001	0.21	504
6930800	11/19/2001	0.19	469
6930800	12/4/2001	0.71	1820
6930800	1/28/2002	0.8	1630
6930800	2/13/2002	1.5	2100
6930800	3/26/2002	1.1	8780
6930800	4/9/2002	0.54	2100
6930800	5/20/2002	0.84	26100
6930800	6/11/2002	0.37	1670
6930800	7/16/2002	0.27	729
6930800	8/12/2002	0.29	547
6930800	9/3/2002	0.26	598
6930800	10/1/2002	0.12	498
6930800	11/13/2002	0.17	547
6930800	12/5/2002	0.16	547
6930800	1/15/2003	0.88	952
6930800	2/4/2003	0.53	631
6930800	3/5/2003	1.1	2660
6930800	4/8/2003	0.44	2720
6930800	5/8/2003	1.1	4900
6930800	6/9/2003	0.42	952
6930800	7/28/2003	0.19	475
6930800	9/5/2003	1.2	5300
6930800	10/29/2003	0.17	665
6930800	11/21/2003	2.2	13600
6930800	12/22/2003	1.2	2410
6930800	1/20/2004	1.1	5910
6930800	2/4/2004	1	2730
6930800	3/10/2004	1.3	5690
6930800	4/20/2004	0.28	1410
6930800	5/19/2004	0.42	1680
6930800	6/14/2004	0.44	864
6930800	7/8/2004	0.3	787
6930800	9/21/2004	0.2	481
6930800	10/13/2004	0.36	467
6930800	11/18/2004	1.2	1820
6930800	12/10/2004	1.4	7740
6930800	1/19/2005	1.2	5130
6930800	2/1/2005	1	1710
6930800	3/2/2005	0.49	1990
6930800	4/5/2005	0.27	1320
6930800	5/23/2005	0.31	763
6930800	6/9/2005	0.47	580
6930800	7/7/2005	0.28	484
6930800	8/1/2005	0.23	344
6930800	8/11/2005	0.27	343
6930800	9/1/2005	0.3	473
6930800	10/13/2005	0.17	554
6930800	11/22/2005	1	1340
6930800	12/20/2005	0.49	611
6930800	1/10/2006	0.28	117
6930800	2/6/2006	0.31	1180
6930800	3/22/2006	0.78	1660
6930800	4/25/2006	0.35	943

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
370901091262001	6/2/2003	0.011	113
370901091262001	6/9/2003	0.007	117
370901091262001	6/28/2003	0.01	91
370901091262001	7/26/2003	0.009	86
370901091262001	8/6/2003	0.01	86
370901091262001	9/23/2003	0.011	87
370901091262001	10/8/2003	0.01	74
370901091262001	6/15/2004	0.012	127
370901091262001	6/26/2004	0.013	127
370901091262001	7/13/2004	0.009	108
370901091262001	8/11/2004	0.01	103
370901091262001	8/21/2004	0.009	108
370901091262001	9/21/2004	0.012	88
370901091262001	10/5/2004	0.01	85
370901091262001	6/14/2005	0.011	100
370901091262001	7/5/2005	0.01	94
370901091262001	8/9/2005	0.009	88
6930800	3/16/1999	0.03	4780
6930800	4/12/1999	0.03	2900
6930800	7/12/1999	0.04	826
6930800	10/5/1999	0.04	492
6930800	4/4/2000	0.03	935
6930800	6/13/2000	0.04	481
6930800	7/5/2000	0.04	493
6930800	8/1/2000	0.05	541
6930800	4/9/2001	0.03	1400
6930800	6/13/2001	0.03	1150
6930800	8/14/2001	0.03	429
6930800	12/4/2001	0.03	1820
6930800	3/26/2002	0.07	8780
6930800	5/20/2002	0.13	26100
6930800	3/5/2003	0.02	2660
6930800	5/8/2003	0.09	4900
6930800	6/9/2003	0.03	952
6930800	9/5/2003	0.11	5300
6930800	11/21/2003	0.3	13600
6930800	12/22/2003	0.03	2410
6930800	1/20/2004	0.07	5910
6930800	2/4/2004	0.02	2730
6930800	3/10/2004	0.05	5690
6930800	6/14/2004	0.02	864
6930800	7/8/2004	0.03	787
6930800	10/13/2004	0.04	467
6930800	11/18/2004	0.05	1820
6930800	12/10/2004	0.1	7740
6930800	1/19/2005	0.04	5130
6930800	2/1/2005	0.03	1710
6930800	6/9/2005	0.03	580
6930800	8/1/2005	0.02	344
6930800	8/11/2005	0.02	343
6930800	11/22/2005	0.06	1340
6930800	3/22/2006	0.03	1660
6930800	4/25/2006	0.03	943
6930800	5/8/2006	0.12	5860
6930800	6/6/2006	0.03	871
6930800	7/5/2006	0.02	481
6930800	8/1/2006	0.03	463

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
6930800	5/8/2006	1	5860
6930800	6/6/2006	0.31	871
6930800	7/5/2006	0.3	481
6930800	8/1/2006	0.27	463
6930800	9/7/2006	0.25	424
6930800	10/4/2006	0.23	404
6930800	11/2/2006	0.22	637
6930800	12/11/2006	1.5	2200
6930800	1/23/2007	1.3	7240
6930800	2/7/2007	1	1680
6930800	3/14/2007	0.4	1300
6930800	4/25/2007	0.45	3360
6930800	5/8/2007	0.32	2930
6930800	6/4/2007	0.5	1540
6930800	7/11/2007	0.63	1360
6930800	8/16/2007	0.22	487
6930800	9/10/2007	0.81	1890
6930800	10/17/2007	0.24	542
6930800	11/19/2007	0.17	557
6930800	12/4/2007	0.23	580
6930800	1/9/2008	1.9	8130
6930800	2/6/2008	1.3	7290
6930800	3/18/2008	1.5	25800
6930800	4/2/2008	1.1	22900
6930800	5/14/2008	0.52	6400
6930800	6/3/2008	0.42	2470
6930800	7/31/2008	0.44	1000
6930800	8/4/2008	0.36	1080
6930800	9/3/2008	0.37	874
6930800	10/16/2008	0.31	1160
6930800	11/4/2008	0.26	927
6930800	12/1/2008	0.36	795
6930800	1/26/2009	0.66	787
6930800	2/2/2009	0.54	825
6930800	3/16/2009	0.27	1560
6930800	4/6/2009	0.55	3230
6930800	5/18/2009	0.79	6440
6930800	6/1/2009	0.21	2320
6930800	7/6/2009	0.46	1150
6930800	8/17/2009	0.38	625
6930800	9/2/2009	0.49	592
6930800	10/5/2009	0.46	856
6930800	11/2/2009	1.3	37400
371054091173501	11/10/1999	0.37	169
371054091173501	12/16/1999	0.47	276
371054091173501	3/2/2000	0.72	470
371054091173501	4/6/2000	0.45	241
371054091173501	5/12/2000	0.36	146
371054091173501	5/25/2000	0.58	225
371054091173501	6/8/2000	0.48	177
371054091173501	6/30/2000	0.3	250
371054091173501	7/12/2000	0.4	171
371054091173501	7/26/2000	0.31	165
371054091173501	8/9/2000	0.43	132
371054091173501	8/21/2000	0.35	128
371054091173501	12/12/2000	0.42	195
371054091173501	1/24/2001	0.41	186

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
6930800	11/2/2006	0.02	637
6930800	12/11/2006	0.04	2200
6930800	1/23/2007	0.04	7240
6930800	3/14/2007	0.02	1300
6930800	4/25/2007	0.04	3360
6930800	5/8/2007	0.03	2930
6930800	6/4/2007	0.02	1540
6930800	7/11/2007	0.06	1360
6930800	9/10/2007	0.07	1890
6930800	12/4/2007	0.03	580
6930800	1/9/2008	0.31	8130
6930800	2/6/2008	0.11	7290
6930800	3/18/2008	0.21	25800
6930800	4/2/2008	0.13	22900
6930800	5/14/2008	0.03	6400
6930800	6/3/2008	0.03	2470
6930800	7/31/2008	0.03	1000
6930800	8/4/2008	0.02	1080
6930800	9/3/2008	0.02	874
6930800	1/26/2009	0.04	787
6930800	2/2/2009	0.02	825
6930800	4/6/2009	0.02	3230
6930800	5/18/2009	0.06	6440
6930800	7/6/2009	0.03	1150
6930800	9/2/2009	0.03	592
6930800	10/5/2009	0.03	856
6930800	11/2/2009	0.21	37400
371054091173501	3/2/2000	0.005	470
371054091173501	5/12/2000	0.004	146
371054091173501	5/25/2000	0.014	225
371054091173501	6/8/2000	0.005	177
371054091173501	6/30/2000	0.004	250
371054091173501	7/12/2000	0.008	171
371054091173501	7/26/2000	0.005	165
371054091173501	8/9/2000	0.014	132
371054091173501	9/19/2000	0.004	113
371054091173501	12/12/2000	0.003	195
371054091173501	1/24/2001	0.002	186
371054091173501	2/21/2001	0.003	475
371054091173501	4/25/2001	0.004	235
371054091173501	5/26/2001	0.009	218
371054091173501	5/27/2001	0.006	193
371054091173501	5/27/2001	0.006	193
371054091173501	8/1/2001	0.008	150
371054091173501	8/8/2001	0.005	122
371054091173501	8/8/2001	0.006	122
371054091173501	8/9/2001	0.007	122
371054091173501	8/9/2001	0.008	122
371054091173501	9/19/2001	0.006	125
371054091173501	10/3/2001	0.004	110
371054091173501	10/10/2001	0.004	129
371054091173501	10/10/2001	0.004	129
371054091173501	10/11/2001	0.004	129
371054091173501	10/11/2001	0.006	129
371054091173501	4/3/2002	0.005	551
371054091173501	5/1/2002	0.006	728
371054091173501	5/30/2002	0.008	738

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
371054091173501	2/21/2001	0.63	475
371054091173501	4/25/2001	0.34	235
371054091173501	5/26/2001	0.33	218
371054091173501	5/27/2001	0.31	193
371054091173501	5/27/2001	0.33	193
371054091173501	8/1/2001	0.33	150
371054091173501	8/8/2001	0.33	122
371054091173501	8/8/2001	0.35	122
371054091173501	8/9/2001	0.36	122
371054091173501	8/9/2001	0.37	122
371054091173501	9/19/2001	0.33	125
371054091173501	10/10/2001	0.3	129
371054091173501	10/10/2001	0.49	129
371054091173501	10/11/2001	0.33	129
371054091173501	4/3/2002	0.46	551
371054091173501	5/1/2002	0.31	728
371054091173501	5/30/2002	0.37	738
371054091173501	6/5/2002	0.39	548
371054091173501	6/28/2002	0.48	310
371054091173501	6/29/2002	0.45	298
371054091173501	8/7/2002	0.39	226
371054091173501	10/9/2002	0.38	167
371054091173501	6/4/2003	0.4	344
371054091173501	7/26/2003	0.3	185
371054091173501	8/6/2003	0.35	229
371054091173501	9/23/2003	0.37	210
371054091173501	10/8/2003	0.35	158
371054091173501	6/15/2004	0.42	342
371054091173501	6/26/2004	0.35	266
371054091173501	7/13/2004	0.36	228
371054091173501	8/11/2004	0.37	181
371054091173501	8/21/2004	0.38	184
371054091173501	6/14/2005	0.4	186
371054091173501	7/6/2005	0.38	120
371054091173501	8/10/2005	0.37	149
371014091201301	11/9/1999	0.39	151
371014091201301	12/15/1999	0.51	298
371014091201301	1/19/2000	0.77	173
371014091201301	3/1/2000	0.73	524
371014091201301	4/5/2000	0.46	234
371014091201301	5/11/2000	0.42	138
371014091201301	5/24/2000	0.4	133
371014091201301	5/25/2000	0.4	221
371014091201301	6/7/2000	0.52	168
371014091201301	6/29/2000	0.29	265
371014091201301	7/11/2000	0.4	144
371014091201301	7/27/2000	0.38	143
371014091201301	8/10/2000	0.41	127
371014091201301	8/22/2000	0.42	122
371014091201301	10/4/2000	0.37	111
371014091201301	11/8/2000	0.28	227
371014091201301	3/21/2001	0.64	272
371014091201301	4/24/2001	0.36	226
371014091201301	5/25/2001	0.32	220
371014091201301	5/26/2001	0.33	208
371014091201301	5/26/2001	0.35	208
371014091201301	5/27/2001	0.36	208

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
371054091173501	6/5/2002	0.005	548
371054091173501	6/28/2002	0.007	310
371054091173501	6/29/2002	0.006	298
371054091173501	7/30/2002	0.006	268
371054091173501	8/6/2002	0.004	226
371054091173501	8/7/2002	0.006	226
371054091173501	10/8/2002	0.004	167
371054091173501	10/9/2002	0.005	167
371054091173501	6/4/2003	0.003	344
371054091173501	6/28/2003	0.006	209
371054091173501	7/26/2003	0.007	185
371054091173501	8/6/2003	0.009	229
371054091173501	9/23/2003	0.005	210
371054091173501	10/8/2003	0.006	158
371054091173501	6/15/2004	0.007	342
371054091173501	6/26/2004	0.005	266
371054091173501	7/13/2004	0.005	228
371054091173501	8/11/2004	0.008	181
371054091173501	8/21/2004	0.003	184
371054091173501	9/21/2004	0.005	150
371054091173501	10/5/2004	0.004	146
371054091173501	6/14/2005	0.007	186
371054091173501	7/6/2005	0.007	120
371054091173501	8/10/2005	0.007	149
371014091201301	11/9/1999	0.004	151
371014091201301	3/1/2000	0.006	524
371014091201301	5/11/2000	0.006	138
371014091201301	5/24/2000	0.005	133
371014091201301	5/25/2000	0.008	221
371014091201301	6/7/2000	0.01	168
371014091201301	6/29/2000	0.004	265
371014091201301	7/11/2000	0.008	144
371014091201301	7/27/2000	0.006	143
371014091201301	8/10/2000	0.013	127
371014091201301	8/22/2000	0.004	122
371014091201301	10/4/2000	0.005	111
371014091201301	11/8/2000	0.003	227
371014091201301	1/23/2001	0.003	204
371014091201301	3/21/2001	0.005	272
371014091201301	4/24/2001	0.005	226
371014091201301	5/25/2001	0.006	220
371014091201301	5/26/2001	0.006	208
371014091201301	5/26/2001	0.007	208
371014091201301	5/27/2001	0.005	208
371014091201301	5/27/2001	0.009	208
371014091201301	6/7/2001	0.014	192
371014091201301	7/31/2001	0.009	140
371014091201301	8/8/2001	0.012	97
371014091201301	8/9/2001	0.009	97
371014091201301	8/9/2001	0.013	97
371014091201301	9/18/2001	0.005	115
371014091201301	10/2/2001	0.004	106
371014091201301	10/10/2001	0.004	109
371014091201301	10/10/2001	0.009	109
371014091201301	10/11/2001	0.009	116
371014091201301	10/11/2001	0.015	116
371014091201301	11/21/2001	0.004	114

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
371014091201301	5/27/2001	0.38	208
371014091201301	6/7/2001	0.33	192
371014091201301	7/31/2001	0.35	140
371014091201301	8/8/2001	0.4	97
371014091201301	8/9/2001	0.4	97
371014091201301	8/9/2001	0.4	97
371014091201301	10/2/2001	0.33	106
371014091201301	10/10/2001	0.37	109
371014091201301	10/11/2001	0.39	116
371014091201301	10/11/2001	0.48	116
371014091201301	4/2/2002	0.43	590
371014091201301	4/30/2002	0.28	760
371014091201301	5/29/2002	0.39	657
371014091201301	6/4/2002	0.39	488
371014091201301	6/28/2002	0.5	309
371014091201301	6/29/2002	0.47	297
371014091201301	7/29/2002	0.41	266
371014091201301	8/6/2002	0.42	220
371014091201301	8/7/2002	0.39	216
371014091201301	10/8/2002	0.47	168
371014091201301	10/9/2002	0.48	171
371014091201301	6/3/2003	0.46	308
371014091201301	6/10/2003	0.52	296
371014091201301	6/28/2003	0.41	220
371014091201301	7/26/2003	0.36	170
371014091201301	8/6/2003	0.37	253
371014091201301	9/23/2003	0.4	208
371014091201301	10/8/2003	0.44	157
371014091201301	6/15/2004	0.45	355
371014091201301	6/26/2004	0.39	279
371014091201301	7/13/2004	0.39	223
371014091201301	8/21/2004	0.42	182
371014091201301	10/5/2004	0.4	151
371014091201301	6/15/2005	0.47	179
371014091201301	7/6/2005	0.44	164
371014091201301	8/10/2005	0.43	144
371026091183301	6/24/1999	0.49	267
371026091183301	8/12/1999	0.48	186
371026091183301	11/10/1999	0.39	164
371026091183301	12/15/1999	0.46	298
371026091183301	3/2/2000	0.76	489
371026091183301	4/5/2000	0.45	258
371026091183301	5/11/2000	0.38	144
371026091183301	5/24/2000	0.36	137
371026091183301	6/7/2000	0.45	191
371026091183301	6/29/2000	0.3	246
371026091183301	7/11/2000	0.34	155
371026091183301	7/27/2000	0.37	147
371026091183301	8/10/2000	0.34	133
371026091183301	8/22/2000	0.37	125
371026091183301	10/4/2000	0.33	114
371026091183301	12/20/2000	0.4	164
371026091183301	3/20/2001	0.64	302
371026091183301	4/24/2001	0.37	235
371026091183301	5/25/2001	0.38	235
371026091183301	5/26/2001	0.3	207
371026091183301	5/26/2001	0.33	207

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
371014091201301	4/2/2002	0.005	590
371014091201301	4/30/2002	0.006	760
371014091201301	5/29/2002	0.007	657
371014091201301	6/4/2002	0.005	488
371014091201301	6/28/2002	0.008	309
371014091201301	6/29/2002	0.009	297
371014091201301	7/29/2002	0.007	266
371014091201301	8/6/2002	0.009	220
371014091201301	8/7/2002	0.007	216
371014091201301	10/8/2002	0.005	168
371014091201301	10/9/2002	0.007	171
371014091201301	6/3/2003	0.007	308
371014091201301	6/10/2003	0.022	296
371014091201301	6/28/2003	0.006	220
371014091201301	7/26/2003	0.009	170
371014091201301	8/6/2003	0.012	253
371014091201301	9/23/2003	0.005	208
371014091201301	10/8/2003	0.009	157
371014091201301	6/15/2004	0.008	355
371014091201301	6/26/2004	0.006	279
371014091201301	7/13/2004	0.009	223
371014091201301	8/11/2004	0.006	195
371014091201301	8/21/2004	0.003	182
371014091201301	9/21/2004	0.011	135
371014091201301	10/5/2004	0.004	151
371014091201301	6/15/2005	0.011	179
371014091201301	7/6/2005	0.008	164
371014091201301	8/10/2005	0.012	144
371026091183301	5/12/1999	0.004	582
371026091183301	8/12/1999	0.005	186
371026091183301	3/2/2000	0.005	489
371026091183301	5/24/2000	0.005	137
371026091183301	6/7/2000	0.008	191
371026091183301	6/29/2000	0.005	246
371026091183301	7/11/2000	0.007	155
371026091183301	7/27/2000	0.006	147
371026091183301	8/10/2000	0.006	133
371026091183301	9/20/2000	0.005	114
371026091183301	10/4/2000	0.004	114
371026091183301	12/20/2000	0.002	164
371026091183301	3/20/2001	0.006	302
371026091183301	4/24/2001	0.004	235
371026091183301	5/25/2001	0.008	235
371026091183301	5/26/2001	0.007	207
371026091183301	5/26/2001	0.007	207
371026091183301	5/27/2001	0.006	207
371026091183301	5/27/2001	0.006	207
371026091183301	6/7/2001	0.009	201
371026091183301	7/31/2001	0.01	147
371026091183301	8/8/2001	0.005	121
371026091183301	8/8/2001	0.008	121
371026091183301	8/9/2001	0.007	121
371026091183301	8/9/2001	0.01	121
371026091183301	9/18/2001	0.004	118
371026091183301	10/2/2001	0.004	108
371026091183301	10/10/2001	0.005	109
371026091183301	10/10/2001	0.005	109

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
371026091183301	5/27/2001	0.28	207
371026091183301	5/27/2001	0.32	207
371026091183301	6/7/2001	0.31	201
371026091183301	7/31/2001	0.36	147
371026091183301	8/8/2001	0.33	121
371026091183301	8/8/2001	0.43	121
371026091183301	8/9/2001	0.36	121
371026091183301	8/9/2001	0.38	121
371026091183301	9/18/2001	0.3	118
371026091183301	10/10/2001	0.3	109
371026091183301	10/11/2001	0.33	116
371026091183301	10/11/2001	0.34	116
371026091183301	6/28/2002	0.49	314
371026091183301	6/29/2002	0.45	312
371026091183301	7/29/2002	0.4	249
371026091183301	8/7/2002	0.4	216
371026091183301	10/8/2002	0.4	168
371026091183301	10/9/2002	0.55	171
371026091183301	6/3/2003	0.45	308
371026091183301	6/10/2003	0.43	296
371026091183301	6/28/2003	0.36	220
371026091183301	7/26/2003	0.34	170
371026091183301	8/6/2003	0.35	253
371026091183301	9/23/2003	0.35	208
371026091183301	10/8/2003	0.41	157
371026091183301	6/15/2004	0.43	355
371026091183301	6/26/2004	0.36	279
371026091183301	7/13/2004	0.41	223
371026091183301	8/11/2004	0.39	195
371026091183301	8/21/2004	0.4	182
371026091183301	9/21/2004	0.37	135
371026091183301	6/15/2005	0.42	179
371026091183301	7/6/2005	0.39	164
371026091183301	8/10/2005	0.4	144
370857091265901	5/10/1999	0.24	307
370857091265901	6/22/1999	0.22	82
370857091265901	8/10/1999	0.17	61
370857091265901	12/14/1999	0.37	233
370857091265901	2/29/2000	0.79	359
370857091265901	4/4/2000	0.3	117
370857091265901	5/10/2000	0.22	52
370857091265901	5/23/2000	0.16	42
370857091265901	5/25/2000	0.24	129
370857091265901	6/6/2000	0.22	73
370857091265901	6/28/2000	0.18	123
370857091265901	7/28/2000	0.15	44
370857091265901	8/11/2000	0.16	36
370857091265901	8/22/2000	0.18	33
370857091265901	9/20/2000	0.12	25
370857091265901	11/9/2000	0.18	121
370857091265901	2/22/2001	0.54	328
370857091265901	3/21/2001	0.34	127
370857091265901	4/25/2001	0.2	107
370857091265901	5/25/2001	0.17	102
370857091265901	5/26/2001	0.15	94
370857091265901	5/26/2001	0.17	94
370857091265901	5/27/2001	0.14	85

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
371026091183301	10/11/2001	0.006	116
371026091183301	10/11/2001	0.006	116
371026091183301	11/21/2001	0.003	119
371026091183301	4/2/2002	0.007	590
371026091183301	4/30/2002	0.006	751
371026091183301	5/29/2002	0.008	657
371026091183301	6/4/2002	0.006	492
371026091183301	6/28/2002	0.005	314
371026091183301	6/29/2002	0.007	312
371026091183301	7/29/2002	0.007	249
371026091183301	8/6/2002	0.005	216
371026091183301	8/7/2002	0.005	216
371026091183301	10/8/2002	0.004	168
371026091183301	10/9/2002	0.006	171
371026091183301	6/3/2003	0.004	308
371026091183301	6/10/2003	0.003	296
371026091183301	6/28/2003	0.007	220
371026091183301	7/26/2003	0.008	170
371026091183301	8/6/2003	0.013	253
371026091183301	9/23/2003	0.004	208
371026091183301	10/8/2003	0.007	157
371026091183301	6/15/2004	0.008	355
371026091183301	6/26/2004	0.005	279
371026091183301	7/13/2004	0.008	223
371026091183301	8/11/2004	0.005	195
371026091183301	8/21/2004	0.005	182
371026091183301	9/21/2004	0.004	135
371026091183301	10/5/2004	0.004	151
371026091183301	6/15/2005	0.007	179
371026091183301	7/6/2005	0.007	164
371026091183301	8/10/2005	0.008	144
370905091204001	5/11/1999	0.006	616
370905091204001	6/23/1999	0.005	239
370905091204001	8/11/1999	0.008	190
370905091204001	3/1/2000	0.006	547
370905091204001	5/11/2000	0.005	142
370905091204001	5/24/2000	0.007	129
370905091204001	6/7/2000	0.007	177
370905091204001	7/11/2000	0.009	155
370905091204001	7/27/2000	0.007	144
370905091204001	8/10/2000	0.006	128
370905091204001	8/21/2000	0.007	124
370905091204001	10/2/2001	0.008	104
370905091204001	10/10/2001	0.007	109
370905091204001	10/10/2001	0.009	109
370905091204001	10/11/2001	0.01	116
370905091204001	10/11/2001	0.018	116
370905091204001	11/20/2001	0.002	112
370905091204001	4/2/2002	0.006	590
370905091204001	5/29/2002	0.008	657
370905091204001	6/4/2002	0.006	488
370905091204001	6/28/2002	0.008	309
370905091204001	6/29/2002	0.009	297
370905091204001	7/29/2002	0.008	266
370905091204001	8/6/2002	0.004	220
370905091204001	8/7/2002	0.007	216
370905091204001	10/8/2002	0.007	161

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
370857091265901	5/27/2001	0.15	85
370857091265901	6/7/2001	0.15	94
370857091265901	8/1/2001	0.16	45
370857091265901	8/8/2001	0.12	30
370857091265901	8/8/2001	0.18	33
370857091265901	8/9/2001	0.14	33
370857091265901	8/9/2001	0.15	33
370857091265901	9/18/2001	0.13	30
370857091265901	4/30/2002	0.15	382
370857091265901	5/29/2002	0.21	303
370857091265901	6/4/2002	0.23	201
370857091265901	6/28/2002	0.23	99
370857091265901	6/29/2002	0.22	90
370857091265901	10/8/2002	0.11	53
370857091265901	10/9/2002	0.26	54
370857091265901	6/2/2003	0.24	112
370857091265901	6/9/2003	0.2	101
370857091265901	8/6/2003	0.13	128
370857091265901	9/23/2003	0.21	94
370857091265901	10/8/2003	0.18	62
370857091265901	6/15/2004	0.26	162
370857091265901	6/26/2004	0.18	117
370857091265901	8/21/2004	0.16	64
370857091265901	6/14/2005	0.21	75
370857091265901	7/5/2005	0.18	59
370857091265901	8/9/2005	0.13	44
370905091204001	5/11/1999	0.34	616
370905091204001	6/23/1999	0.5	239
370905091204001	8/11/1999	0.52	190
370905091204001	11/9/1999	0.38	154
370905091204001	12/15/1999	0.56	299
370905091204001	1/19/2000	0.45	172
370905091204001	3/1/2000	0.76	547
370905091204001	4/5/2000	0.47	240
370905091204001	5/24/2000	0.41	129
370905091204001	6/7/2000	0.5	177
370905091204001	6/29/2000	0.36	244
370905091204001	7/27/2000	0.46	144
370905091204001	8/10/2000	0.31	128
370905091204001	8/21/2000	0.43	124
370905091204001	10/2/2001	0.41	104
370905091204001	10/10/2001	0.39	109
370905091204001	10/10/2001	0.4	109
370905091204001	10/11/2001	0.37	116
370905091204001	4/2/2002	0.43	590
370905091204001	4/30/2002	0.34	760
370905091204001	5/29/2002	0.36	657
370905091204001	6/4/2002	0.42	488
370905091204001	6/28/2002	0.51	309
370905091204001	6/29/2002	0.46	297
370905091204001	7/29/2002	0.42	266
370905091204001	8/7/2002	0.42	216
370905091204001	10/8/2002	0.47	161
370905091204001	10/9/2002	0.48	164
370905091204001	6/3/2003	0.47	270
370905091204001	6/10/2003	0.5	263
370905091204001	6/28/2003	0.43	185

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
370905091204001	10/9/2002	0.009	164
370905091204001	6/3/2003	0.007	270
370905091204001	6/10/2003	0.014	263
370905091204001	6/28/2003	0.022	185
370905091204001	7/26/2003	0.009	169
370905091204001	8/6/2003	0.011	226
370905091204001	9/23/2003	0.006	201
370905091204001	10/8/2003	0.009	151
370905091204001	6/15/2004	0.007	368
370905091204001	6/26/2004	0.005	266
370905091204001	7/13/2004	0.008	216
370905091204001	8/11/2004	0.005	186
370905091204001	8/21/2004	0.005	174
370905091204001	9/21/2004	0.012	147
370905091204001	10/5/2004	0.006	135
370905091204001	6/14/2005	0.008	156
370905091204001	7/6/2005	0.005	164
370905091204001	4/30/2002	0.006	760
7066110	6/20/1973	0.03	478
7066110	8/1/1973	0.02	288
7066110	10/17/1973	0.04	439
7066110	1/18/1974	0.03	560
7066110	4/17/1974	0.03	680
7066110	7/10/1974	0.01	326
7066110	10/22/1974	0.02	233
7066110	1/21/1975	0.01	490
7066110	5/4/1977	0.01	242
7066110	5/16/1979	0.01	980
7066110	9/5/1979	0.01	293
7066110	5/6/1980	0.09	279
7066110	6/10/1981	0.01	395
7066110	9/22/1981	0.02	127
7066110	6/30/1982	0.04	464
7066110	5/25/1983	0.01	700
7066110	5/16/1984	0.01	775
7066110	5/7/1986	0.01	300
7066110	5/12/1987	0.01	220
7066110	5/18/1988	0.02	282
7066110	10/12/1988	0.01	172
7066110	10/24/1989	0.01	159
7066110	11/20/1990	0.03	126
7066110	10/23/1991	0.01	166
7066110	11/12/1992	0.13	2200
7066110	12/8/1992	0.01	344
7066110	1/22/1993	0.02	1200
7066110	4/7/1993	0.05	1100
7066110	4/14/1993	0.02	702
7066110	6/3/1993	0.03	366
7066110	4/14/1994	0.04	4140
7066110	10/20/1994	0.06	251
7066110	5/22/1995	0.02	680
7066110	8/7/1995	0.12	262
7066110	10/11/1995	0.02	189
7066110	4/1/1996	0.03	1340
7066110	4/7/1997	0.03	3200
7066110	11/13/2000	0.17	215
7066110	5/13/2002	0.06	2400

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
370905091204001	7/26/2003	0.36	169
370905091204001	8/6/2003	0.35	226
370905091204001	9/23/2003	0.47	201
370905091204001	10/8/2003	0.45	151
370905091204001	6/15/2004	0.47	368
370905091204001	6/26/2004	0.4	266
370905091204001	7/13/2004	0.42	216
370905091204001	8/11/2004	0.44	186
370905091204001	8/21/2004	0.46	174
370905091204001	9/21/2004	0.5	147
370905091204001	6/14/2005	0.45	156
370905091204001	7/6/2005	0.43	164
370905091204001	8/10/2005	0.46	138
7066110	6/20/1973	0.37	478
7066110	8/1/1973	0.45	288
7066110	10/17/1973	0.58	439
7066110	1/18/1974	0.39	560
7066110	4/17/1974	0.46	680
7066110	7/10/1974	0.46	326
7066110	10/22/1974	0.35	233
7066110	1/21/1975	0.48	490
7066110	4/15/1975	0.53	530
7066110	9/23/1976	0.3	132
7066110	5/4/1977	0.53	242
7066110	9/22/1977	0.69	210
7066110	5/11/1978	0.53	626
7066110	9/13/1978	0.56	140
7066110	5/16/1979	0.29	980
7066110	9/5/1979	0.34	293
7066110	5/6/1980	0.54	279
7066110	8/27/1980	0.73	121
7066110	6/10/1981	1.7	395
7066110	9/22/1981	0.6	127
7066110	6/30/1982	0.76	464
7066110	5/25/1983	0.6	700
7066110	9/14/1983	0.6	180
7066110	5/16/1984	0.7	775
7066110	5/15/1985	0.6	1140
7066110	9/11/1985	0.6	329
7066110	10/15/1986	1.1	205
7066110	5/12/1987	0.8	220
7066110	10/14/1987	0.5	145
7066110	5/18/1988	0.6	282
7066110	10/12/1988	0.5	172
7066110	5/24/1989	0.9	1380
7066110	11/20/1990	0.6	126
7066110	11/12/1992	0.9	2200
7066110	1/22/1993	0.52	1200
7066110	7/9/1993	0.59	274
7066110	8/7/1995	0.58	262
7066110	4/1/1996	0.69	1340
7066110	11/6/1996	0.54	123
7066110	6/10/1997	0.49	410
7066110	1/26/1999	0.45	530
7066110	3/2/1999	0.52	390
7066110	4/5/1999	0.29	860
7066110	6/17/1999	0.51	220

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
7066110	2/14/2007	0.04	2400
7064555	4/3/1973	0.007	151
7064555	6/18/1973	0.04	164
7064555	7/30/1973	0.02	93
7064555	5/5/1977	0.02	55
7064555	5/11/1978	0.01	105
7064555	5/15/1979	0.01	110
7064555	9/5/1979	0.01	57
7064555	5/7/1980	0.02	61
7064555	8/26/1980	0.01	21
7064555	6/11/1981	0.02	98
7064555	9/21/1981	0.02	9.8
7064555	7/1/1982	0.05	119
7064555	5/26/1983	0.02	132
7064555	5/15/1984	0.01	141
7064555	5/6/1986	0.01	101
7064555	10/14/1986	0.01	70
7064555	5/11/1987	0.01	85
7064555	10/13/1987	0.01	23
7064555	5/17/1988	0.02	75
7064555	10/11/1988	0.01	32
7064555	10/23/1989	0.01	28
7064555	10/22/1991	0.02	34
7064555	4/13/1993	0.04	124
7064555	10/19/1993	0.03	112
7064555	10/10/1995	0.04	49
7064555	10/1/1996	0.18	126
7064530	4/2/1973	0.004	500
7064530	6/18/1973	0.02	232
7064530	7/30/1973	0.03	272
7064530	5/5/1977	0.03	130
7064530	5/12/1978	0.01	299
7064530	5/15/1979	0.01	387
7064530	9/4/1979	0.01	127
7064530	5/8/1980	0.03	158
7064530	8/26/1980	0.01	103
7064530	6/11/1981	0.19	144
7064530	9/21/1981	0.02	111
7064530	6/29/1982	0.05	337
7064530	5/24/1983	0.01	356
7064530	9/15/1983	0.01	90
7064530	5/15/1984	0.01	271
7064530	9/18/1984	0.01	172
7064530	9/10/1985	0.01	244
7064530	5/6/1986	0.01	209
7064530	10/14/1986	0.01	176
7064530	5/11/1987	0.01	173
7064530	10/13/1987	0.01	97
7064530	5/17/1988	0.02	240
7064530	10/11/1988	0.01	115
7064530	10/23/1989	0.01	101
7064530	11/19/1990	0.01	171
7064530	10/22/1991	0.01	117
7064530	10/19/1994	0.18	169
7064530	10/10/1995	0.02	138
7065500	9/23/1976	0.01	78
7065500	5/10/1978	0.01	189

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7066110	8/18/1999	0.5	196
7066110	11/1/1999	0.41	179
7066110	3/20/2000	0.66	333
7066110	5/8/2000	0.43	180
7066110	7/17/2000	0.4	170
7066110	9/11/2000	0.35	145
7066110	11/13/2000	1.2	215
7066110	5/10/2001	0.39	225
7066110	7/17/2001	0.29	152
7066110	9/4/2001	0.31	110
7066110	1/22/2002	0.51	144
7066110	3/5/2002	0.4	504
7066110	5/13/2002	0.5	2400
7066110	7/15/2002	0.37	304
7066110	9/5/2002	0.48	288
7066110	3/11/2003	0.48	398
7066110	5/19/2003	0.37	1170
7066110	7/7/2003	0.41	271
7066110	9/5/2003	0.53	761
7066110	11/17/2003	0.33	340
7066110	1/22/2004	0.42	853
7066110	5/5/2004	0.44	1020
7066110	7/6/2004	0.35	404
7066110	9/7/2004	0.42	230
7066110	11/22/2004	0.54	425
7066110	1/25/2005	0.62	760
7066110	3/15/2005	0.45	428
7066110	5/19/2005	0.37	310
7066110	7/18/2005	0.38	210
7066110	9/1/2005	0.33	206
7066110	1/4/2006	0.5	165
7066110	3/1/2006	0.34	170
7066110	5/8/2006	0.29	1170
7066110	7/10/2006	0.39	166
7066110	11/15/2006	0.49	384
7066110	1/24/2007	0.29	984
7066110	2/14/2007	0.69	2400
7066110	4/3/2007	0.31	440
7066110	5/2/2007	0.34	530
7066110	6/11/2007	0.38	282
7066110	7/16/2007	0.44	206
7066110	9/4/2007	0.36	162
7066110	5/5/2008	0.35	650
7066110	7/7/2008	0.39	340
7066110	10/6/2008	0.4	230
7066110	1/12/2009	0.5	250
7066110	3/2/2009	0.49	322
7066110	5/28/2009	0.38	613
7066110	7/6/2009	0.48	310
7066110	9/9/2009	0.42	334
7066110	10/28/2009	0.51	1600
7064555	6/18/1973	0.76	164
7064555	7/30/1973	0.63	93
7064555	10/15/1973	0.68	114
7064555	9/24/1976	0.51	24
7064555	5/5/1977	0.67	55
7064555	9/22/1977	0.62	15

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
7065500	9/5/1979	0.01	118
7065500	8/27/1980	0.01	73
7065500	9/22/1981	0.01	82
7065500	5/16/1984	0.01	297
7065500	5/7/1986	0.01	139
7065500	5/12/1987	0.01	115
7065500	10/25/1989	0.01	88
7065500	5/30/1991	0.01	163
7065500	10/16/1973	0.02	201
7065500	5/4/1977	0.02	148
7065500	5/16/1979	0.02	320
7065500	5/6/1980	0.02	138
7065500	6/10/1981	0.02	137
7065500	5/25/1983	0.02	197
7065500	5/18/1988	0.02	129
7065500	10/12/1988	0.02	96
7065500	10/22/1991	0.02	87
7065500	10/10/1995	0.02	103
7065500	10/8/2002	0.02	98
7065500	4/4/1973	0.021	309
7065500	6/19/1973	0.03	179
7065500	7/31/1973	0.03	141
7065500	7/10/1974	0.03	169
7065500	4/14/1993	0.03	204
7065500	6/30/1982	0.04	147
7066550	6/21/1973	0.03	176
7066550	8/1/1973	0.02	155
7066550	10/17/1973	0.02	180
7066550	5/4/1977	0.01	154
7066550	5/16/1979	0.01	273
7066550	9/5/1979	0.01	103
7066550	5/6/1980	0.03	102
7066550	6/10/1981	0.01	114
7066550	6/30/1982	0.04	128
7066550	5/25/1983	0.02	237
7066550	5/16/1984	0.01	254
7066550	9/11/1985	0.01	121
7066550	5/12/1987	0.01	118
7066550	5/18/1988	0.02	118
7066550	10/12/1988	0.01	96
7066550	10/23/1991	0.01	108
7066550	10/20/1994	0.02	98
7066550	5/23/1995	0.03	242
7066550	10/2/1996	0.02	232
7066550	10/7/2002	0.02	96
7014000	11/23/1993	0.03	244
7014000	3/11/1994	0.02	266
7014000	3/11/1994	0.02	266
7014000	6/23/1994	0.02	175
7014000	8/29/1994	0.09	115
7014000	1/13/1995	0.03	352
7014000	3/20/1995	0.02	245
7014000	8/7/1995	0.02	127
7014000	4/9/1996	0.02	245
7014000	6/24/1996	0.02	310
7014000	3/10/1997	0.03	330
7014000	11/15/2000	0.078	105

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7064555	5/11/1978	0.69	105
7064555	9/14/1978	1	21
7064555	5/15/1979	0.48	110
7064555	9/5/1979	0.66	57
7064555	5/7/1980	0.9	61
7064555	8/26/1980	0.87	21
7064555	6/11/1981	1	98
7064555	7/1/1982	1	119
7064555	5/26/1983	0.8	132
7064555	9/15/1983	0.9	49
7064555	5/14/1985	0.8	153
7064555	9/10/1985	0.9	77
7064555	10/14/1986	1.1	70
7064555	5/11/1987	0.7	85
7064555	10/11/1988	0.9	32
7064555	10/23/1989	0.9	28
7064555	5/30/1991	0.63	115
7064555	5/2/2000	0.62	26
7064555	5/8/2001	0.58	24
7064555	5/30/2002	0.42	150
7064555	10/8/2002	0.6	33
7064555	5/6/2003	0.54	113
7064530	6/18/1973	0.81	232
7064530	7/30/1973	0.87	272
7064530	10/15/1973	0.91	284
7064530	9/24/1976	0.58	65
7064530	5/5/1977	0.86	130
7064530	9/23/1977	0.8	75
7064530	5/12/1978	1.5	299
7064530	9/14/1978	1.1	113
7064530	5/15/1979	0.96	387
7064530	9/4/1979	1.1	127
7064530	5/8/1980	0.82	158
7064530	8/26/1980	1	103
7064530	6/11/1981	2.1	144
7064530	9/21/1981	1.1	111
7064530	6/29/1982	1.2	337
7064530	5/24/1983	1.4	356
7064530	9/15/1983	1.1	90
7064530	5/15/1984	1.4	271
7064530	9/10/1985	0.9	244
7064530	10/14/1986	1.7	176
7064530	5/11/1987	1.2	173
7064530	10/13/1987	0.9	97
7064530	10/11/1988	1	115
7064530	5/30/1991	0.83	300
7064530	10/1/1996	1.1	241
7065500	6/19/1973	0.74	179
7065500	7/31/1973	0.74	141
7065500	10/16/1973	0.97	201
7065500	7/10/1974	0.7	169
7065500	9/23/1976	0.57	78
7065500	5/4/1977	0.96	148
7065500	9/21/1977	0.82	105
7065500	5/10/1978	1	189
7065500	9/13/1978	0.77	96
7065500	5/16/1979	0.62	320

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
7014000	5/9/2002	0.06	3050
7014500	1/19/1993	0.02	1450
7014500	4/8/1993	0.03	2090
7014500	5/19/1993	0.08	5020
7014500	6/1/1993	0.02	870
7014500	7/6/1993	0.05	833
7014500	8/12/1993	0.17	6830
7014500	9/30/1993	0.03	3210
7014500	10/6/1993	0.02	1640
7014500	11/3/1993	0.02	1070
7014500	12/2/1993	0.04	1840
7014500	2/14/1994	0.03	703
7014500	3/1/1994	0.04	1580
7014500	3/8/1994	0.02	1190
7014500	5/25/1994	0.02	1660
7014500	6/23/1994	0.02	966
7014500	8/31/1994	0.02	811
7014500	9/12/1994	0.02	669
7014500	3/22/1995	0.02	1270
7014500	5/9/1995	0.07	5890
7014500	6/12/1995	0.03	4620
7014500	7/18/1995	0.02	727
7014500	9/11/1995	0.02	405
7014500	10/3/1995	0.03	392
7014500	2/27/1996	0.02	500
7014500	7/24/1996	0.02	505
7014500	1/14/1997	0.02	670
7014500	2/5/1997	0.02	3450
7014500	3/13/1997	0.03	2230
7014500	4/7/1997	0.02	3800
7014500	1/19/1999	0.04	3180
7014500	2/9/1999	0.16	7760
7014500	4/26/1999	0.07	4540
7014500	5/20/1999	0.04	1260
7014500	8/10/1999	0.08	1380
7014500	10/6/1999	0.03	267
7014500	11/16/1999	0.04	302
7014500	6/13/2000	0.04	274
7014500	8/2/2000	0.03	242
7014500	11/7/2000	0.04	322
7014500	7/25/2001	0.03	226
7014500	3/28/2002	0.04	3000
7014500	5/23/2002	0.03	2800
7014500	8/12/2002	0.03	373
7014500	4/8/2003	0.02	1870
7014500	5/5/2003	0.06	2450
7014500	8/6/2003	0.03	373
7014500	12/17/2003	0.02	772
7014500	1/21/2004	0.02	1770
7014500	5/4/2004	0.05	3140
7014500	9/1/2004	0.03	642
7014500	11/3/2004	0.07	1570
7014500	12/14/2004	0.02	1180
7014500	5/17/2006	0.03	1710
7014500	4/2/2007	0.05	2660
7014500	7/10/2007	0.02	425
7014500	2/6/2008	0.02	1950

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7065500	9/5/1979	0.79	118
7065500	5/6/1980	0.86	138
7065500	8/27/1980	0.68	73
7065500	6/10/1981	2	137
7065500	9/22/1981	1	82
7065500	6/30/1982	1.2	147
7065500	5/25/1983	1.1	197
7065500	9/14/1983	1	93
7065500	5/16/1984	1	297
7065500	5/15/1985	0.8	213
7065500	9/11/1985	1.1	139
7065500	5/7/1986	0.9	139
7065500	10/15/1986	1.5	100
7065500	5/12/1987	1.1	115
7065500	10/12/1988	1.1	96
7065500	5/25/1989	0.8	202
7065500	5/29/2002	0.68	311
7065500	5/6/2003	0.7	175
7065500	5/18/2004	0.66	262
7065500	5/9/2006	0.62	350
7066550	6/21/1973	0.45	176
7066550	8/1/1973	0.68	155
7066550	10/17/1973	0.63	180
7066550	9/23/1976	0.37	91
7066550	5/4/1977	0.58	154
7066550	9/22/1977	0.54	104
7066550	5/11/1978	0.66	115
7066550	9/13/1978	1	93
7066550	5/16/1979	0.63	273
7066550	9/5/1979	0.9	103
7066550	5/6/1980	0.86	102
7066550	8/27/1980	0.78	92
7066550	6/10/1981	1.1	114
7066550	9/22/1981	1.1	116
7066550	6/30/1982	1.1	128
7066550	5/25/1983	1	237
7066550	9/14/1983	0.9	88
7066550	5/16/1984	0.9	254
7066550	9/11/1985	0.6	121
7066550	10/15/1986	1.2	119
7066550	5/12/1987	0.6	118
7066550	5/29/1991	1.9	214
7066550	5/7/2001	0.43	100
7066550	5/28/2002	0.65	239
7066550	5/9/2006	0.31	154
7014000	11/23/1993	0.48	244
7014000	8/7/1995	0.39	127
7014000	3/4/1999	0.36	200
7014000	4/8/1999	0.28	394
7014000	6/14/1999	0.36	153
7014000	8/19/1999	0.73	66
7014000	11/15/1999	0.25	56
7014000	1/11/2000	0.26	92
7014000	3/14/2000	0.26	100
7014000	5/17/2000	0.25	47
7014000	7/6/2000	0.24	76
7014000	9/7/2000	0.17	29

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
7014500	3/25/2008	0.04	3270
7014500	4/15/2008	0.04	3310
7014500	6/3/2008	0.02	903
7014500	7/22/2008	0.02	415
7014500	9/2/2008	0.03	440
7014500	4/20/2009	0.18	10400
7014500	10/29/2009	0.04	3870
7010500	11/17/1993	0.04	1100
7010500	1/20/1994	0.02	135
7010500	3/8/1994	0.03	255
7010500	6/23/1994	0.03	135
7010500	8/29/1994	0.02	80
7010500	11/3/1994	0.04	130
7010500	1/13/1995	0.02	285
7010500	3/22/1995	0.05	90
7010500	8/8/1995	0.02	140
7010500	3/5/1996	0.18	55
7010500	4/10/1996	0.04	163
7010500	6/25/1996	0.03	170
7010500	11/13/1996	0.02	207
7010500	3/10/1997	0.04	318
7010500	11/16/1999	0.05	92
7010500	3/14/2000	0.03	114
7010500	5/17/2000	0.04	95
7010500	9/14/2000	0.04	75
7010500	11/8/2000	0.05	115
7010500	5/14/2001	0.04	72
7010500	7/20/2001	0.04	63
7010500	11/2/2001	0.04	72
7010500	9/5/2002	0.03	103
7010500	11/13/2002	0.03	105
7010500	1/14/2003	0.03	92
7010500	3/4/2003	0.02	129
7010500	5/5/2003	0.04	215
7010500	7/30/2003	0.03	129
7010500	11/10/2003	0.03	141
7010500	1/6/2004	0.03	287
7010500	3/15/2004	0.04	208
7010500	5/5/2004	0.03	190
7010500	7/27/2004	0.03	205
7010500	9/2/2004	0.02	197
7066000	5/11/1999	0.068	627
7066000	8/11/1999	0.004	194
7066000	11/8/1999	0.006	154
7066000	3/1/2000	0.004	542
7066000	5/24/2000	0.005	130
7066000	5/25/2000	0.01	235
7066000	7/11/2000	0.004	160
7066000	7/27/2000	0.004	143
7066000	8/10/2000	0.005	129
7066000	12/20/2000	0.002	160
7066000	2/21/2001	0.005	410
7066000	3/21/2001	0.004	242
7066000	4/24/2001	0.004	218
7066000	5/25/2001	0.006	215
7066000	5/26/2001	0.003	202
7066000	5/26/2001	0.006	202

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7014000	11/15/2000	0.76	105
7014000	3/22/2001	0.64	110
7014000	5/10/2001	0.36	66
7014000	7/11/2001	0.27	37
7014000	11/1/2001	0.11	57
7014000	1/23/2002	0.35	70
7014000	3/28/2002	0.37	469
7014000	5/9/2002	0.55	3050
7014000	9/3/2002	0.3	77
7014000	11/12/2002	0.19	84
7014000	1/13/2003	0.47	127
7014000	3/3/2003	0.34	255
7014000	5/6/2003	0.28	478
7014000	7/29/2003	0.31	69
7014000	9/11/2003	0.28	56
7014000	1/8/2004	0.38	88
7014000	3/17/2004	0.43	63
7014000	5/5/2004	0.31	438
7014000	7/27/2004	0.28	64
7014000	9/2/2004	0.28	163
7014000	11/9/2004	0.28	101
7014000	3/1/2005	0.28	175
7014000	5/18/2005	0.22	135
7014000	7/6/2005	0.23	58
7014000	9/7/2005	0.28	67
7014000	11/22/2005	0.38	139
7014000	1/10/2006	0.28	86
7014000	3/21/2006	0.43	408
7014000	5/9/2006	0.24	238
7014000	11/8/2006	0.24	163
7014000	2/14/2007	0.46	659
7014000	4/2/2007	0.28	579
7014000	5/22/2007	0.24	114
7014000	6/5/2007	0.26	86
7014000	7/13/2007	0.24	57
7014000	3/24/2008	0.54	629
7014000	5/19/2008	0.18	394
7014000	7/21/2008	0.28	70
7014000	9/2/2008	0.28	81
7014000	10/27/2008	0.14	141
7014000	5/26/2009	0.15	494
7014000	7/21/2009	0.24	221
7014000	10/27/2009	0.46	255
7014500	1/19/1993	0.82	1450
7014500	5/19/1993	0.81	5020
7014500	7/6/1993	0.67	833
7014500	11/3/1993	0.35	1070
7014500	3/1/1994	0.64	1580
7014500	3/21/1994	0.34	854
7014500	8/31/1994	0.68	811
7014500	9/12/1994	0.41	669
7014500	10/12/1994	0.41	480
7014500	4/24/1995	0.44	3490
7014500	5/9/1995	0.45	5890
7014500	6/12/1995	0.92	4620
7014500	7/5/1995	0.42	1260
7014500	7/18/1995	0.48	727

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
7066000	5/27/2001	0.003	190
7066000	5/27/2001	0.003	186
7066000	6/6/2001	0.007	211
7066000	7/31/2001	0.005	136
7066000	8/8/2001	0.004	112
7066000	8/8/2001	0.005	112
7066000	8/9/2001	0.005	116
7066000	8/9/2001	0.008	116
7066000	9/18/2001	0.003	112
7066000	10/2/2001	0.003	104
7066000	10/10/2001	0.002	109
7066000	10/10/2001	0.007	109
7066000	10/11/2001	0.003	116
7066000	10/11/2001	0.004	116
7066000	11/20/2001	0.002	112
7066000	4/2/2002	0.005	590
7066000	4/30/2002	0.006	760
7066000	5/29/2002	0.009	657
7066000	6/4/2002	0.005	488
7066000	6/28/2002	0.006	309
7066000	6/29/2002	0.01	297
7066000	7/29/2002	0.006	266
7066000	8/6/2002	0.004	220
7066000	8/7/2002	0.004	216
7066000	10/8/2002	0.005	161
7066000	10/9/2002	0.004	164
7066000	6/3/2003	0.003	270
7066000	6/9/2003	0.019	263
7066000	6/28/2003	0.004	185
7066000	7/26/2003	0.005	169
7066000	8/6/2003	0.005	226
7066000	9/23/2003	0.004	201
7066000	10/8/2003	0.004	151
7066000	6/15/2004	0.01	368
7066000	6/26/2004	0.005	266
7066000	7/13/2004	0.005	216
7066000	8/11/2004	0.002	186
7066000	8/21/2004	0.003	174
7066000	9/21/2004	0.005	147
7066000	10/5/2004	0.004	125
7066000	6/14/2005	0.005	150
7066000	7/5/2005	0.005	127
7066000	8/9/2005	0.005	142
7065000	4/3/1973	0.013	158
7065000	6/19/1973	0.04	60
7065000	7/31/1973	0.02	48
7065000	10/16/1973	0.02	71
7065000	5/5/1977	0.04	28
7065000	5/16/1979	0.01	118
7065000	9/5/1979	0.01	40
7065000	5/7/1980	0.03	31
7065000	6/9/1981	0.03	34
7065000	9/23/1981	0.01	20
7065000	7/1/1982	0.06	38
7065000	5/24/1983	0.02	100
7065000	5/17/1984	0.01	52
7065000	5/6/1986	0.01	58

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7014500	9/11/1995	0.4	405
7014500	10/3/1995	0.3	392
7014500	1/9/1996	0.56	500
7014500	1/22/1996	0.7	1440
7014500	4/16/1996	0.48	1470
7014500	5/22/1996	0.46	1450
7014500	7/24/1996	0.51	505
7014500	10/7/1996	0.6	592
7014500	12/5/1996	0.56	2460
7014500	2/5/1997	0.59	3450
7014500	4/7/1997	0.57	3800
7014500	6/17/1997	0.54	2220
7014500	7/9/1997	0.27	812
7014500	1/19/1999	0.85	3180
7014500	2/9/1999	1.3	7760
7014500	3/24/1999	0.37	1800
7014500	4/26/1999	0.72	4540
7014500	5/20/1999	0.24	1260
7014500	6/29/1999	0.42	1170
7014500	7/21/1999	0.24	381
7014500	8/10/1999	0.95	1380
7014500	9/9/1999	0.28	272
7014500	10/6/1999	1.5	267
7014500	11/16/1999	0.16	302
7014500	12/8/1999	0.25	494
7014500	1/11/2000	0.16	517
7014500	2/8/2000	0.22	338
7014500	3/15/2000	0.22	662
7014500	4/4/2000	0.2	576
7014500	6/13/2000	0.59	274
7014500	7/5/2000	0.27	288
7014500	1/24/2001	0.16	333
7014500	2/15/2001	0.6	895
7014500	3/27/2001	0.35	489
7014500	4/18/2001	0.4	1000
7014500	5/14/2001	0.23	324
7014500	6/13/2001	0.21	523
7014500	7/25/2001	0.28	226
7014500	8/14/2001	0.23	355
7014500	9/6/2001	0.19	175
7014500	12/5/2001	0.34	673
7014500	1/23/2002	0.3	312
7014500	2/12/2002	0.66	821
7014500	3/28/2002	0.53	3000
7014500	4/10/2002	0.29	1860
7014500	5/23/2002	0.53	2800
7014500	6/20/2002	0.26	729
7014500	7/30/2002	0.24	419
7014500	8/12/2002	0.39	373
7014500	9/3/2002	0.3	411
7014500	11/14/2002	0.15	411
7014500	12/2/2002	0.11	351
7014500	1/14/2003	0.32	580
7014500	2/4/2003	0.29	388
7014500	3/4/2003	0.4	1050
7014500	4/8/2003	0.39	1870
7014500	5/5/2003	0.6	2450

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
7065000	10/14/1986	0.02	34
7065000	5/11/1987	0.01	52
7065000	5/17/1988	0.02	38
7065000	10/11/1988	0.01	21
7065000	10/22/1991	0.01	25
7065000	4/14/1993	0.04	214
7065000	10/21/1993	0.1	47
7065000	5/23/1995	0.02	82
7065000	10/1/1996	0.08	65
7064440	4/2/1973	0.013	253
7064440	6/18/1973	0.04	139
7064440	7/30/1973	0.04	107
7064440	10/15/1973	0.01	152
7064440	1/18/1974	0.04	160
7064440	4/17/1974	0.04	204
7064440	7/9/1974	0.03	146
7064440	10/21/1974	0.13	109
7064440	1/22/1975	0.04	153
7064440	4/15/1975	0.01	165
7064440	9/24/1976	0.03	64
7064440	5/6/1977	0.07	74
7064440	9/23/1977	0.03	45
7064440	5/12/1978	0.02	155
7064440	9/14/1978	0.02	58
7064440	5/15/1979	0.01	181
7064440	9/4/1979	0.04	90
7064440	5/8/1980	0.03	76
7064440	8/26/1980	0.03	62
7064440	6/9/1981	0.09	75
7064440	9/21/1981	0.03	52
7064440	6/29/1982	0.06	114
7064440	5/24/1983	0.01	172
7064440	9/13/1983	0.01	90
7064440	5/15/1984	0.02	181
7064440	9/18/1984	0.01	100
7064440	5/14/1985	0.01	196
7064440	9/10/1985	0.02	125
7064440	5/6/1986	0.02	130
7064440	10/14/1986	0.02	113
7064440	5/11/1987	0.02	114
7064440	10/13/1987	0.03	77
7064440	5/17/1988	0.02	116
7064440	10/11/1988	0.03	82
7064440	5/23/1989	0.02	221
7064440	10/23/1989	0.02	76
7064440	11/19/1990	0.01	90
7064440	5/30/1991	0.01	167
7064440	10/22/1991	0.03	81
7064440	4/14/1992	0.01	122
7064440	9/30/1992	0.03	100
7064440	4/29/1993	0.02	173
7064440	10/21/1993	0.02	122
7064440	10/19/1994	0.02	91
7064440	5/22/1995	0.03	164
7064440	10/10/1995	0.07	98
7064440	5/8/2001	0.03	53
7064440	10/3/2001	0.03	48

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7014500	6/9/2003	0.28	621
7014500	7/30/2003	0.29	351
7014500	8/6/2003	0.28	373
7014500	9/4/2003	0.46	626
7014500	10/20/2003	0.14	396
7014500	12/17/2003	0.41	772
7014500	1/21/2004	0.48	1770
7014500	2/9/2004	0.3	766
7014500	3/2/2004	0.23	506
7014500	4/20/2004	0.28	637
7014500	5/4/2004	0.54	3140
7014500	6/1/2004	0.24	784
7014500	7/19/2004	0.26	358
7014500	9/1/2004	0.53	642
7014500	10/14/2004	0.27	367
7014500	11/3/2004	0.67	1570
7014500	12/14/2004	0.47	1180
7014500	1/3/2005	0.31	465
7014500	2/2/2005	0.6	877
7014500	3/10/2005	0.24	754
7014500	4/5/2005	0.17	760
7014500	5/4/2005	0.15	1050
7014500	6/8/2005	0.37	386
7014500	7/25/2005	0.2	353
7014500	8/17/2005	0.39	896
7014500	9/1/2005	0.22	283
7014500	10/12/2005	0.17	381
7014500	11/9/2005	0.21	581
7014500	12/5/2005	0.33	760
7014500	1/9/2006	0.23	425
7014500	2/7/2006	0.16	620
7014500	3/6/2006	0.2	415
7014500	4/12/2006	0.17	742
7014500	5/17/2006	0.49	1710
7014500	6/14/2006	0.29	420
7014500	7/20/2006	0.22	214
7014500	9/5/2006	0.19	206
7014500	10/11/2006	0.12	222
7014500	11/7/2006	0.14	401
7014500	12/4/2006	0.7	1910
7014500	1/8/2007	0.33	522
7014500	2/15/2007	0.59	1690
7014500	3/13/2007	0.22	642
7014500	4/2/2007	0.55	2660
7014500	5/21/2007	0.2	648
7014500	6/5/2007	0.53	565
7014500	7/10/2007	0.25	425
7014500	8/13/2007	0.33	214
7014500	9/5/2007	0.13	218
7014500	10/23/2007	0.2	278
7014500	11/5/2007	0.11	274
7014500	1/24/2008	0.57	396
7014500	2/6/2008	0.62	1950
7014500	3/25/2008	0.81	3270
7014500	4/15/2008	0.58	3310
7014500	5/21/2008	0.22	1710
7014500	6/3/2008	0.28	903

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
7064440	10/9/2002	0.02	71
7064440	10/7/2004	0.03	51
7064440	5/8/2006	0.02	120
7066510	6/20/1973	0.03	1560
7066510	8/1/1973	0.02	1240
7066510	1/18/1974	0.03	1820
7066510	4/17/1974	0.03	2420
7066510	7/10/1974	0.02	1260
7066510	10/22/1974	0.02	850
7066510	1/21/1975	0.01	1870
7066510	5/4/1977	0.01	928
7066510	9/22/1977	0.01	738
7066510	5/16/1979	0.01	3000
7066510	9/5/1979	0.01	894
7066510	5/6/1980	0.01	798
7066510	6/10/1981	0.01	1190
7066510	9/22/1981	0.01	462
7066510	6/30/1982	0.04	1150
7066510	5/25/1983	0.02	2240
7066510	9/14/1983	0.04	680
7066510	5/12/1987	0.01	985
7066510	5/18/1988	0.02	932
7066510	10/12/1988	0.01	639
7066510	10/23/1991	0.01	659
7066510	4/13/1993	0.03	3500
7066510	5/23/1995	0.05	2400
7066510	10/7/2002	0.02	1000
7061600	1/13/2009	0.02	136
7061600	8/10/1995	0.01	248
7061600	9/8/2009	0.02	280
7061600	2/15/1994	0.01	360
7061600	2/12/2007	0.03	370
7061600	3/22/1995	0.02	416
7061600	7/11/1995	0.02	565
7061600	5/7/2008	0.03	735
7061600	1/29/2006	0.04	1140
7061600	5/21/2003	0.02	1320
7061600	11/18/2003	0.17	6280
7061600	5/14/2002	0.06	6630
7061600	5/11/2006	0.07	6830
7061600	4/12/1994	0.17	28800
7064400	9/24/1976	0.01	51
7064400	5/6/1977	0.03	60
7064400	5/12/1978	0.01	112
7064400	5/15/1979	0.01	140
7064400	9/4/1979	0.02	70
7064400	8/26/1980	0.01	43
7064400	6/9/1981	0.02	64
7064400	9/21/1981	0.01	46
7064400	6/29/1982	0.07	106
7064400	5/24/1983	0.01	132
7064400	9/13/1983	0.05	70
7064400	5/15/1984	0.01	123
7064400	9/18/1984	0.01	77
7064400	5/14/1985	0.05	151
7064400	9/10/1985	0.02	95
7064400	5/6/1986	0.01	102

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7014500	7/22/2008	0.36	415
7014500	8/5/2008	0.2	425
7014500	9/2/2008	0.33	440
7014500	10/28/2008	0.13	430
7014500	11/13/2008	0.2	559
7014500	12/8/2008	0.31	363
7014500	1/20/2009	0.37	363
7014500	2/3/2009	0.19	460
7014500	3/23/2009	0.16	548
7014500	4/20/2009	1.1	10400
7014500	6/1/2009	0.35	1580
7014500	7/21/2009	0.24	815
7014500	8/24/2009	0.28	614
7014500	9/2/2009	0.22	543
7014500	10/29/2009	0.5	3870
7010500	11/17/1993	0.78	1100
7010500	8/8/1995	0.93	140
7010500	11/13/1996	0.88	207
7010500	6/19/1997	0.76	384
7010500	11/16/1999	0.87	92
7010500	1/12/2000	0.88	102
7010500	5/17/2000	0.72	95
7010500	7/5/2000	0.64	79
7010500	9/14/2000	0.84	75
7010500	11/8/2000	0.77	115
7010500	1/9/2001	0.89	58
7010500	3/27/2001	1	104
7010500	5/14/2001	0.75	72
7010500	7/20/2001	0.76	63
7010500	9/6/2001	0.66	72
7010500	11/2/2001	0.75	72
7010500	1/28/2002	0.87	77
7010500	5/21/2002	0.6	411
7010500	7/29/2002	0.88	135
7010500	9/5/2002	0.91	103
7010500	11/13/2002	0.47	105
7010500	1/14/2003	0.89	92
7010500	5/5/2003	0.7	215
7010500	7/30/2003	0.92	129
7010500	9/4/2003	0.84	123
7010500	1/6/2004	0.78	287
7010500	3/15/2004	0.89	208
7010500	5/5/2004	0.63	190
7010500	9/2/2004	0.96	197
7066000	5/11/1999	0.37	627
7066000	6/23/1999	0.5	227
7066000	8/11/1999	0.59	194
7066000	11/8/1999	0.35	154
7066000	12/15/1999	0.45	305
7066000	3/1/2000	0.75	542
7066000	4/5/2000	0.46	241
7066000	5/25/2000	0.36	235
7066000	6/7/2000	0.41	172
7066000	6/29/2000	0.34	245
7066000	7/27/2000	0.4	143
7066000	8/10/2000	0.36	129
7066000	8/22/2000	0.41	127

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)
7064400	10/14/1986	0.02	83
7064400	5/11/1987	0.01	8.2
7064400	10/13/1987	0.02	61
7064400	5/17/1988	0.02	93
7064400	10/11/1988	0.02	68
7064400	10/23/1989	0.02	62
7064400	5/30/1991	0.01	132
7064400	10/22/1991	0.02	69
7064400	4/29/1993	0.02	92
7064400	10/21/1993	0.02	70
7064400	10/19/1994	0.04	78
7064400	10/10/1995	0.03	81
7014200	11/23/1993	0.04	240
7014200	8/7/1995	0.02	45
7014200	4/9/1996	0.02	140
7014200	6/24/1996	0.02	47
7014200	3/10/1997	0.03	240
7014200	8/19/1999	0.03	68
7014200	11/15/2000	0.09	39
7014200	5/9/2002	0.07	3250
7014200	2/14/2007	0.04	264

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7066000	9/19/2000	0.4	113
7066000	2/21/2001	0.63	410
7066000	3/21/2001	0.6	242
7066000	5/25/2001	0.33	215
7066000	5/26/2001	0.31	202
7066000	5/26/2001	0.34	202
7066000	5/27/2001	0.22	186
7066000	5/27/2001	0.33	190
7066000	6/6/2001	0.29	211
7066000	7/31/2001	0.34	136
7066000	8/8/2001	0.32	112
7066000	8/8/2001	0.34	112
7066000	8/9/2001	0.34	116
7066000	8/9/2001	0.38	116
7066000	10/11/2001	0.35	116
7066000	10/11/2001	0.36	116
7066000	4/2/2002	0.44	590
7066000	4/30/2002	0.26	760
7066000	5/29/2002	0.37	657
7066000	6/28/2002	0.49	309
7066000	6/29/2002	0.31	297
7066000	8/7/2002	0.38	216
7066000	10/8/2002	0.44	161
7066000	6/3/2003	0.46	270
7066000	6/9/2003	0.46	263
7066000	6/28/2003	0.4	185
7066000	7/26/2003	0.35	169
7066000	8/6/2003	0.32	226
7066000	9/23/2003	0.37	201
7066000	10/8/2003	0.39	151
7066000	6/15/2004	0.46	368
7066000	6/26/2004	0.42	266
7066000	8/21/2004	0.44	174
7066000	9/21/2004	0.45	147
7066000	7/5/2005	0.39	127
7066000	8/9/2005	0.46	142
7065000	6/19/1973	0.47	60
7065000	7/31/1973	0.53	48
7065000	10/16/1973	0.5	71
7065000	9/22/1976	0.28	25
7065000	5/5/1977	0.51	28
7065000	9/22/1977	0.94	24
7065000	5/11/1978	0.47	39
7065000	9/13/1978	0.73	26
7065000	5/16/1979	0.5	118
7065000	9/5/1979	0.51	40
7065000	5/7/1980	0.89	31
7065000	8/26/1980	0.64	20
7065000	6/9/1981	2	34
7065000	9/23/1981	0.68	20
7065000	7/1/1982	1.4	38
7065000	5/24/1983	0.8	100
7065000	9/13/1983	0.7	34
7065000	5/17/1984	0.7	52
7065000	5/16/1985	0.5	97
7065000	9/11/1985	0.7	43
7065000	5/6/1986	0.5	58

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7065000	10/14/1986	1.4	34
7065000	5/11/1987	0.9	52
7065000	10/11/1988	0.5	21
7065000	5/23/1989	0.8	179
7065000	5/8/2001	0.54	27
7065000	5/29/2002	0.5	153
7065000	5/5/2003	0.45	53
7065000	5/18/2004	0.5	88
7065000	5/10/2006	0.42	250
7064440	6/18/1973	1.2	139
7064440	7/30/1973	0.97	107
7064440	10/15/1973	0.93	152
7064440	1/18/1974	0.66	160
7064440	4/17/1974	0.79	204
7064440	7/9/1974	0.86	146
7064440	10/21/1974	0.84	109
7064440	1/22/1975	0.82	153
7064440	4/15/1975	0.84	165
7064440	9/24/1976	0.9	64
7064440	5/6/1977	1.1	74
7064440	9/23/1977	0.91	45
7064440	5/12/1978	0.9	155
7064440	9/14/1978	1.2	58
7064440	5/15/1979	0.55	181
7064440	9/4/1979	0.89	90
7064440	5/8/1980	2.4	76
7064440	8/26/1980	1	62
7064440	6/9/1981	1.9	75
7064440	9/21/1981	1.1	52
7064440	6/29/1982	1.1	114
7064440	5/24/1983	1	172
7064440	9/13/1983	1.3	90
7064440	5/15/1984	1	181
7064440	5/14/1985	0.9	196
7064440	5/6/1986	1	130
7064440	10/14/1986	1.3	113
7064440	5/11/1987	1.3	114
7064440	10/11/1988	1.1	82
7064440	5/23/1989	1.3	221
7064440	4/29/1993	0.86	173
7064440	5/29/1996	0.79	182
7064440	10/6/1999	0.96	96
7064440	5/3/2000	0.87	72
7064440	5/8/2001	0.79	53
7064440	10/3/2001	0.58	48
7064440	5/30/2002	0.56	189
7064440	10/9/2002	0.85	71
7064440	5/7/2003	0.64	151
7064440	10/7/2003	0.79	57
7064440	5/17/2004	0.62	186
7064440	10/7/2004	0.82	51
7064440	5/25/2005	0.83	80
7064440	5/8/2006	0.59	120
7066510	6/20/1973	0.38	1560
7066510	8/1/1973	0.5	1240
7066510	10/17/1973	0.52	1480
7066510	1/18/1974	0.34	1820

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7066510	4/17/1974	0.49	2420
7066510	7/10/1974	0.46	1260
7066510	10/22/1974	0.01	850
7066510	1/21/1975	0.16	1870
7066510	4/15/1975	0.58	1880
7066510	9/23/1976	0.25	533
7066510	5/4/1977	0.36	928
7066510	9/22/1977	0.49	738
7066510	5/11/1978	0.51	2050
7066510	9/13/1978	0.58	532
7066510	5/16/1979	0.38	3000
7066510	9/5/1979	0.42	894
7066510	5/6/1980	0.48	798
7066510	8/27/1980	0.35	441
7066510	6/10/1981	1.4	1190
7066510	9/22/1981	0.59	462
7066510	6/30/1982	0.97	1150
7066510	5/25/1983	1.4	2240
7066510	9/14/1983	0.8	680
7066510	5/16/1984	0.6	2350
7066510	5/15/1985	0.6	2480
7066510	9/11/1985	0.7	1080
7066510	5/7/1986	0.5	1290
7066510	10/15/1986	3.1	1080
7066510	5/12/1987	0.7	985
7066510	5/29/1991	0.66	1750
7066510	5/1/2000	0.32	600
7066510	5/7/2001	0.38	720
7066510	10/7/2002	0.37	1000
7066510	5/5/2003	0.43	2500
7066510	10/6/2003	0.32	552
7066510	5/17/2004	0.33	2100
7066510	5/24/2005	0.31	713
7066510	5/8/2006	0.31	2800
7061600	4/12/1994	0.85	28800
7061600	11/2/1999	0.13	172
7061600	1/10/2000	0.39	316
7061600	7/24/2000	0.21	121
7061600	9/14/2000	0.12	99
7061600	1/16/2001	0.21	599
7061600	3/12/2001	0.58	271
7061600	5/8/2001	0.38	164
7061600	7/16/2001	0.18	95
7061600	9/4/2001	0.13	93
7061600	5/14/2002	0.39	6630
7061600	9/5/2002	0.12	163
7061600	3/10/2003	0.29	329
7061600	5/21/2003	0.2	1320
7061600	7/7/2003	0.19	203
7061600	9/2/2003	0.26	468
7061600	11/18/2003	1.2	6280
7061600	5/5/2004	0.22	1000
7061600	11/23/2004	0.27	374
7061600	1/25/2005	0.34	444
7061600	3/15/2005	0.19	136
7061600	5/16/2005	0.13	322
7061600	9/6/2005	0.12	133

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7061600	11/2/2005	0.21	501
7061600	1/4/2006	0.38	203
7061600	1/29/2006	0.34	1140
7061600	2/2/2006	0.24	802
7061600	2/13/2006	0.25	305
7061600	3/7/2006	0.24	225
7061600	4/18/2006	0.17	268
7061600	5/11/2006	0.42	6830
7061600	6/20/2006	0.17	191
7061600	7/12/2006	0.18	204
7061600	8/3/2006	0.17	134
7061600	10/23/2006	0.25	287
7061600	11/13/2006	0.34	348
7061600	12/19/2006	0.38	422
7061600	1/4/2007	0.23	614
7061600	3/29/2007	0.29	866
7061600	4/3/2007	0.21	990
7061600	9/10/2007	0.5	1020
7061600	5/7/2008	0.17	735
7061600	10/7/2008	0.14	110
7061600	3/3/2009	0.28	430
7061600	5/26/2009	0.15	497
7061600	7/6/2009	0.18	312
7061600	9/8/2009	0.18	280
7061600	10/27/2009	0.39	936
7064400	7/9/1974	1	101
7064400	9/23/1975	0.82	42
7064400	9/24/1976	0.84	51
7064400	5/6/1977	1	60
7064400	9/23/1977	0.82	42
7064400	5/12/1978	0.89	112
7064400	9/14/1978	1	51
7064400	5/15/1979	0.67	140
7064400	9/4/1979	1	70
7064400	5/8/1980	8.8	60
7064400	8/26/1980	1.1	43
7064400	6/9/1981	1.6	64
7064400	9/21/1981	1.3	46
7064400	6/29/1982	1.5	106
7064400	5/24/1983	1.6	132
7064400	9/13/1983	1.5	70
7064400	5/15/1984	1.2	123
7064400	5/14/1985	0.9	151
7064400	9/10/1985	1.2	95
7064400	10/14/1986	1.6	83
7064400	5/11/1987	1.2	8.2
7064400	10/13/1987	1.7	61
7064400	10/11/1988	1.2	68
7064400	10/6/1999	1.1	75
7064400	5/3/2000	0.89	61
7064400	5/30/2002	0.5	155
7064400	5/7/2003	0.63	111
7064400	5/17/2004	0.62	113
7064400	5/8/2006	0.59	90
7014200	8/7/1995	0.29	45
7014200	6/24/1996	0.52	47
7014200	6/19/1997	0.29	313

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)

USGS Gage	Sample Date	TN (mg/L)	Flow (cfs)
7014200	3/4/1999	0.24	88
7014200	4/8/1999	0.21	359
7014200	6/14/1999	0.19	90
7014200	8/19/1999	0.31	68
7014200	3/14/2000	0.14	68
7014200	5/17/2000	0.16	27
7014200	7/6/2000	0.19	25
7014200	9/7/2000	0.13	12
7014200	11/15/2000	0.75	39
7014200	3/22/2001	0.32	60
7014200	5/10/2001	0.16	43
7014200	7/11/2001	0.22	18
7014200	11/1/2001	0.13	29
7014200	1/23/2002	0.19	47
7014200	3/28/2002	0.17	328
7014200	5/9/2002	0.62	3250
7014200	7/30/2002	0.15	31
7014200	9/3/2002	0.14	32
7014200	11/12/2002	0.14	57
7014200	1/13/2003	0.27	97
7014200	3/3/2003	0.17	150
7014200	5/6/2003	0.16	441
7014200	9/11/2003	0.14	61
7014200	1/8/2004	0.21	210
7014200	3/17/2004	0.2	114
7014200	5/5/2004	0.16	289
7014200	7/27/2004	0.17	37
7014200	9/2/2004	0.18	46
7014200	11/9/2004	0.17	68
7014200	1/4/2005	0.15	61
7014200	3/1/2005	0.15	117
7014200	7/6/2005	0.16	22
7014200	9/7/2005	0.15	16
7014200	11/22/2005	0.24	82
7014200	3/21/2006	0.29	311
7014200	5/9/2006	0.16	162
7014200	11/8/2006	0.14	75
7014200	2/14/2007	0.34	264
7014200	4/2/2007	0.15	414
7014200	5/22/2007	0.12	72
7014200	6/5/2007	0.18	43
7014200	7/10/2007	0.15	28
7014200	3/24/2008	0.32	355
7014200	7/21/2008	0.17	80
7014200	10/27/2008	0.08	41
7014200	5/26/2009	0.28	73
7014200	7/21/2009	0.12	23
7014200	9/1/2009	0.13	36
7014200	10/27/2009	0.31	228

USGS Gage	Sample Date	TP (mg/L)	Flow (cfs)

Appendix D

Supplemental Implementation Plan

States are not required under Section 303(d) of the Clean Water Act to develop TMDL implementation plans and EPA does not approve or disapprove them. However, the Missouri Department of Natural Resources (MDNR) included an implementation plan in this TMDL to provide information regarding how point and nonpoint sources can or should be controlled to ensure implementation efforts achieve the loading reductions identified in this TMDL. EPA recognizes that technical guidance and support are critical to determining the feasibility of and achieving the goals outlined in this TMDL. Therefore, this informational plan is included to be used by local professionals, watershed managers and citizens for decision-making support and planning purposes. It should not be considered to be a part of the established West Fork Black River TMDL.

This TMDL addresses a water quality impairment attributed to excess nutrients, as identified on the 2008 Missouri 303(d) List of impaired waters. The pollutants targeted by this TMDL are TN and TP. The source for these pollutants has historically been identified as the Doe Run West Fork mine, but other potential point sources include the Brushy Creek and Fletcher mines, abandoned mine lands and the Bunker and Centerville wastewater treatment plants. In addition, runoff from urban areas and agricultural lands are considered potential nonpoint sources of nutrients. Therefore, any practices or permit modifications used to implement this TMDL will focus on these sources.

POINT SOURCES

This TMDL will be implemented primarily through permit action. Effluent limits and monitoring requirements for existing operating permits will be reevaluated to reflect the water quality targets set by the TMDL as the permits approach renewal. This includes new or revised effluent limits and instream monitoring for TN and TP using the WLA developed for this TMDL. Discharge permits may need to be amended to include additional measures (e.g., a storm water pollution prevention plan) that ensure the facilities do not continue to cause or contribute to the impairment of West Fork Black River. Additionally, permitted facilities identified as contributing to the pollutant loading of the impaired segment shall adopt appropriate BMPs to reduce such loading from their storm water outfalls. BMPs are recommended methods, structures and practices designed to prevent or reduce water pollution.

NONPOINT SOURCES

Nonpoint sources of nutrients are not regulated in Missouri. While cropland accounts for only 231 acres in the watershed, grassland accounts for approximately 8, 672 acres, or 8 percent of the land area in the watershed and there are an estimated 1,569 cattle in the watershed.

Agricultural runoff from grazing land is a potential component of nonpoint source contributions of nutrients to the impaired segment and should be reduced to meet TMDL targets.

To reduce the loading and effect of nutrients on West Fork Black River, efforts should be made to encourage agricultural producers in the watershed to adopt BMPs. The concept of BMPs is one of a voluntary and site specific approach to water quality management. In the West Fork Black River watershed, agricultural BMPs should focus on erosion and storm water control measures such as the expansion or enhancement of riparian zones, off-stream watering of livestock and rotational grazing practices. In addition, efforts should be made to encourage agricultural producers in the watershed to adopt sound nutrient management practices, including the proper management and storage of manure.

In an effort to most effectively implement voluntary BMPs, MDNR may work with the Natural Resources Conservation Service, local university extension offices and the local Soil and Water Conservation District to encourage area land owners to implement these practices. An additional approach may be to work with these agencies to form a watershed group comprised of local stakeholders to promote the use of erosion and storm water control practices.