Total Maximum Daily Loads (TMDLs) for Turbidity in Long Creek, McAlpine Creek, Sugar Creek, Little Sugar Creek, Irwin Creek, Henry Fork, and Mud Creek in North Carolina

Final Report
January 2005
(Approved February 8th, 2005)

Catawba River and French Broad River Basins

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INDEX OF TMDL SUBMITTAL

303(d) List Information

State: North Carolina
Counties: Burke, Catawba, Henderson, Mecklenburg, Union
Basin: Catawba River and French Broad River Basins

303(d) Listed Waters in Catawba River Basin

Stream name	Description	Class	Index #	Subbasin	14 Digit HUC	Miles
Long Creek	From source to a point 0.6 mile downstream of Mecklenburg County SR 2074	C	11-120-(0.5)	30834	03050101170020	5.1
Long Creek	From a point 0.6 mile downstream of Mecklenburg County SR 2074 to a point 0.4 mile upstream of Mecklenburg County SR 1606	WS-IV	11-120-(2.5)	30834	03050101170020	8.4
Long Creek	From a point 0.4 mile upstream of Mecklenburg County SR 1606 to Lake Wylie, Catawba River	WS-IV CA	11-120-(7)	30834	03050101170020	1.8
McAlpine Ck	From source to SR 3356, (Sardis Rd)	C	11-137-9a	30834	03050103020050	8.3
McAlpine Ck	From SR 3356 to NC 51	C	11-137-9b	30834	03050103020050	6.3
McAlpine Ck	From NC 51 to NC 521	C	11-137-9c	30834	03050103020050	4.7
McAlpine Ck	From NC Hwy 521 to NC/SC stateline	C	11-137-9d	30834	03050103020050	1.1
Sugar Creek	From SR 1156 Mecklenburg, to HWY 51	C	11-137b	30834	03050103020020	11.9
Sugar Creek	From Hwy 51 to NC/SC border	C	11-137c	30834	03050103020020	1.2
Little Sugar Ck	From NC 51 to state line	C	11-137-8c	30834	03050103020030	3.6
Irwin Creek	From source to Sugar Creek	C	11-137-1	30834	03050103020020	11.8
Henry Fork	From SR 1143 to South Fork	C	11-129-1-(12.5)c	30835	03050102010010 03050102010020 03050102010030	8.0

303(d) Listed Waters in French Broad River Basin

Stream name	Description	Class	Index #	Subbasin	14 Digit HUC	Miles
Mud Creek	From source to Byers Cr	C	6-55a	40302	06010105030040 06010105030030 06010105030020	15.2

Area of Impairment:	87.4 miles
Water Quality Standard Violated:	Turbidity
Pollutant of Concern	Turbidity
Water Quality Standards - Class C and WS-IV Waters:	Turbidity not to exceed 50 NTU
Sources of Impairment:	Land Development, Urban Runoff/Storm Sewers, Municipal Point Sources, Agriculture

Public Notice Information

A draft of the TMDL was publicly noticed through various means, including notification in local newspapers, in *The Charlotte Observer* on November 17, 2004, and the *Asheville Citizen-Times* on November 24, 2004. The TMDL was also available from the Division of Water Quality's website during the comment period at: http://h2o.enr.state.nc.us/tmdl/TMDL_list.htm. The public comment period began November 17, 2004 and was held for 30 days.

Public Notice Date: *November 17, 2004*
Submittal Date: *January 7, 2005*
Establishment Date:
Did notification contain specific mention of TMDL proposal? *Yes*
Were comments received from the public? *Yes*
Was a responsiveness summary prepared? *Yes*

TMDL Information

Critical conditions: Turbidity exceedences occur under both wet and dry conditions predominantly during late spring to early fall seasons.

Seasonality: Seasonal variation in hydrology, climatic conditions, and watershed activities are represented through the use of a continuous flow gage and the use of all readily available water quality data collected in the watershed.

Development tools: Load duration curves for Total Suspended Solids (TSS) were based on cumulative frequency distribution of flow conditions in the watershed. A predictive upper confidence limit about the regression line on load versus flow is compared to a criterion limit curve, calculated as the load that would occur at 90 percent of the water quality criterion (thus incorporating a margin of safety). Necessary reductions in load are calculated as the maximum distance between the confidence bound on the regression line and the limit curve.

TMDL Allocation Summary for Long Creek

Source	Percent of Total Land Area	Estimated Percent of the Non-background TSS Load	Allocations (lbs/day at critical flow conditions (15.3 cfs))		
			Natural Background	Additional Allocation	Total
Wasteload Allocation (WLA)					
MS4 area	59.45%	90.07%	324.6	675.4	1000.0
NCG010000 (Construction Activities)					50 NTU
Load Allocation (LA)					
Forest	36.40%	3.69%	198.6	27.7	226.2
Residential	3.90%	5.92%	21.3	44.4	65.7
Agriculture	0.20%	0.26%	0.9	2.0	2.9
Other	0.10%	0.06%	0.7	0.4	1.1
Total LAs	40.60%	9.93%	222	74.4	296.0
Margin of Safety (MOS)					10%
Grand Total	**100%**	**100%**	**546**	**750**	**1296**

Streams Proposed for Delisting

Stream name	Description	Index #	Subbasin	Miles
McAlpine Creek	From source to NC/SC border	11-137-9a, 11-137-9b, 11-137-9c, 11-137-9d	30834	20.4
Sugar Creek	From SR 1156 Mecklenburg to NC/SC border	11-137b, 11-137c	30834	13.1
Little Sugar Ck	From NC 51 to state line	11-137-8c	30834	3.6
Irwin Creek	From source to Sugar Creek	11-137-1	30834	11.8
Henry Fork	From SR 1143 to South Fork	11-129-1-(12.5)c	30835	8.0
Mud Creek	From source to Byers Cr	6-55a	40302	15.2

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1.0 Introduction

1.1 Problem Definition

The 2002 North Carolina Water Quality Assessment and Impaired Waters List (also known as the Integrated 305(b) and 303(d) Report) identified Long Creek, McAlpine Creek, Sugar Creek, Little Sugar Creek, Irwin Creek, Henry Fork, and Mud Creek in the Catawba River and French Broad River Basins as impaired by elevated turbidity. Based on this report, the impaired segments (assessment units 11-120-(0.5), 11-120-(2.5), 11-120-(7), 11-137-9a, 11-137-9b, 11-137-9c, 11-137-9d, 11-137b, 11-137c, 11-137-8c, 11-137-1, 11-129-1-(12.5)c, 6-55a) include the portions of the above mentioned creeks as described in Table 1. This report will establish a Total Maximum Daily Load (TMDL) for turbidity for each of the stream segments listed in Table 1 and will serve as a management approach aimed toward reducing loadings of sediment from various sources in order to attain applicable surface water quality standards for turbidity.

Table 1 Detailed land use/ land cover distribution within Long Creek watershed.

Stream name	Description	Class	Index #	Subbasin	Miles
Long Creek	From source to a point 0.6 mile downstream of Mecklenburg County SR 2074	C	11-120-(0.5)	30834	5.1
Long Creek	From a point 0.6 mile downstream of Mecklenburg County SR 2074 to a point 0.4 mile upstream of Mecklenburg County SR 1606	WS-IV	11-120-(2.5)	30834	8.4
Long Creek	From a point 0.4 mile upstream of Mecklenburg County SR 1606 to Lake Wylie, Catawba River	WS-IV CA	11-120-(7)	30834	1.8
McAlpine Creek	From source to SR 3356, (Sardis Rd)	C	11-137-9a	30834	8.3
McAlpine Creek	From SR 3356 to NC 51	C	11-137-9b	30834	6.3
McAlpine Creek	From NC 51 to NC 521	C	11-137-9c	30834	4.7
McAlpine Creek	From NC Hwy 521 to NC/SC stateline	C	11-137-9d	30834	1.1
Sugar Creek	From SR 1156 Mecklenburg, to HWY 51	C	11-137b	30834	11.9
Sugar Creek	From Hwy 51 to NC/SC border	C	11-137c	30834	1.2
Little Sugar Creek	From NC 51 to state line	C	11-137-8c	30834	3.6
Irwin Creek	From source to Sugar Creek	C	11-137-1	30834	11.8
Henry Fork	From SR 1143 to South Fork	C	11-129-1-(12.5)c	30835	8
Mud Creek	From source to Byers Cr	C	6-55a	40302	15.2

1.2 TMDL Components

In accordance with Section 305(b) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), the State of North Carolina is required to biennially prepare and submit to the USEPA a report addressing the overall water quality of the State's waters. This report is commonly referred to as the 305(b) Report or the Water Quality Inventory Report. In accordance with Section 303(d) of the Clean Water Act (CWA), the State is also required to biennially prepare and submit to USEPA a report that identifies waters that do not meet or are not expected to meet surface water quality standards (SWQS) after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. The 303(d) process requires that a TMDL be developed for each of the waters appearing on Category 5 of North Carolina's

Water Quality Assessment and Impaired Waters List. The objective of a TMDL is to quantify the amount of a pollutant a water body can assimilate without violating a state's water quality standards and allocate that load capacity to point and nonpoint sources in the form of wasteload allocations (WLAs), load allocations (LAs), and a margin of safety (MOS) (USEPA, 1991). Generally, the primary components of a TMDL, as identified by EPA (1991, 2000) and the Federal Advisory Committee (USEPA FACA, 1998) are as follows:

Target identification or selection of pollutant(s) and end-point(s) for consideration. The pollutant and end-point are generally associated with measurable water quality related characteristics that indicate compliance with water quality standards. North Carolina indicates known pollutants on the 303(d) list.

Source assessment. All sources that contribute to the impairment should be identified and loads quantified, where sufficient data exist.

Reduction target. Estimation or level of pollutant reduction needed to achieve water quality goal. The level of pollution should be characterized for the waterbody, highlighting how current conditions deviate from the target end-point. Generally, this component is identified through water quality modeling.

Allocation of pollutant loads. Allocating pollutant control responsibility to the sources of impairment. The wasteload allocation portion of the TMDL accounts for the loads associated with existing and future point sources. Similarly, the load allocation portion of the TMDL accounts for the loads associated with existing and future non-point sources, stormwater, and natural background.

Margin of Safety. The margin of safety addresses uncertainties associated with pollutant loads, modeling techniques, and data collection. Per EPA (2000), the margin of safety may be expressed explicitly as unallocated assimilative capacity or implicitly due to conservative assumptions.

Seasonal variation. The TMDL should consider seasonal variation in the pollutant loads and end-point. Variability can arise due to stream flows, temperatures, and exceptional events (e.g., droughts, hurricanes).

Critical Conditions. Critical conditions indicate the combination of environmental factors that result in just meeting the water quality criterion and have an acceptably low frequency of occurrence.

Section 303(d) of the CWA and the Water Quality Planning and Management regulation (USEPA, 2000) require EPA to review all TMDLs for approval or disapproval. Once EPA approves a TMDL, then the waterbody may be moved to Category 4a of the Integrated 305(b) and 303(d) Report. Waterbodies remain in Category 4a until compliance with all water quality standards is achieved. Where conditions are not appropriate for the development of a TMDL, management strategies may still result in the restoration of water quality.

The goal of the TMDL program is to restore designated uses to water bodies. Thus, the implementation of sediment controls throughout the watersheds will be necessary to restore uses in the most downstream portion of each creek. Although a site-specific implementation plan is not included as part of this TMDL, reduction strategies are needed. The involvement of local governments and agencies will be critical in order to develop implementation plans and reduction strategies. Implementation discussion will begin during public review of the TMDL.

1.3 Water Quality Target

Turbidity is a unit of measurement quantifying the degree to which light traveling through a water column is scattered by the suspended organic and inorganic particles. The scattering of light increases with a greater suspended load. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU), but may also be measured in Jackson Turbidity Units (JTU).

With the exception of portions of Long Creek, all of the impaired segments addressed in this report have been classified by the NC DWQ as Class C. Class C waters are defined as “Waters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture and other uses suitable for Class C. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner.” Long Creek is classified as Class C from its source to a point 0.6 mile downstream of Mecklenburg County SR 2074, as Class WS-IV from a point 0.6 mile downstream of Mecklenburg County SR 2074 to a point 0.4 mile upstream of Mecklenburg County SR 1606, and as WS-IV CA from a point 0.4 mile upstream of Mecklenburg County SR 1606 to Lake Wylie, Catawba River. The water supply watershed (WS) classification is assigned to watersheds based on land use characteristics of the area. A Critical Area (CA) designation is also listed for watershed areas within a half-mile and draining to the water supply intake or reservoir where an intake is located. For turbidity, Class WS-IV, and WS-IV (CA) have the same water quality standard as Class C. The North Carolina fresh water quality standard for turbidity in Class C waters (T15A: NCAC 2B.0211 (3)k) states:

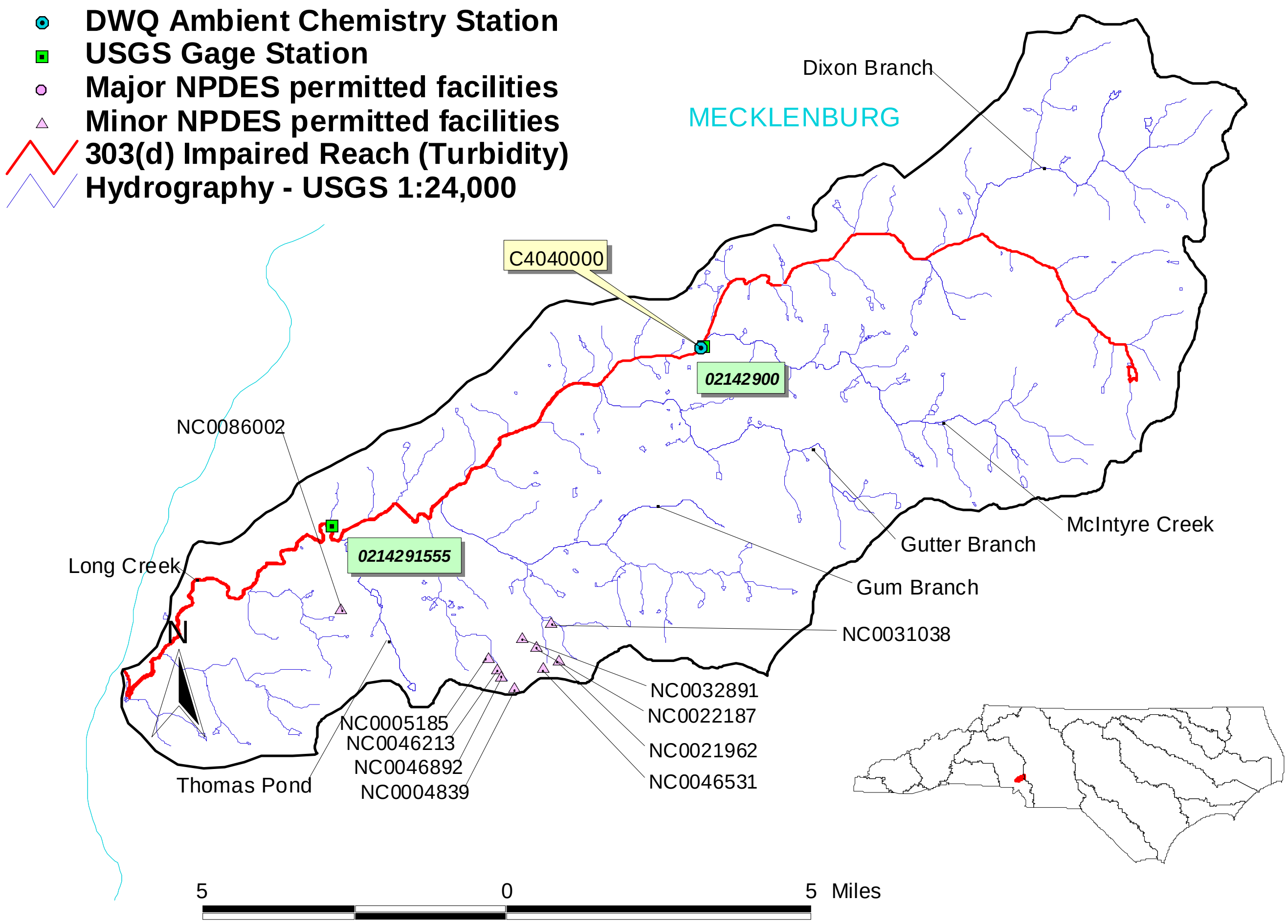
> *The turbidity in the receiving water shall not exceed 50 Nephelometric Turbidity Units (NTU) in streams not designated as trout waters and 10 NTU in streams, lakes or reservoirs designated as trout waters; for lakes and reservoirs not designated as trout waters, the turbidity shall not exceed 25 NTU; if turbidity exceeds these levels due to natural background conditions, the existing turbidity level cannot be increased. Compliance with this turbidity standard can be met when land management activities employ Best Management Practices (BMPs) [as defined by Rule .0202 of this Section] recommended by the Designated Nonpoint Source Agency [as defined by Rule .0202 of this Section]. BMPs must be in full compliance with all specifications governing the proper design, installation, operation and maintenance of such BMPs;*

The in-stream numeric target is the restoration objective that is expected to be reached by implementing the specified load reductions in this TMDL. The target allows for evaluation of progress toward the goal of reaching water quality standards for the impaired stream by comparing the in-stream data to the target. In all of the impaired stream segments discussed in this report, the applicable water quality target is 50 NTUs.

1.4 Watershed Description

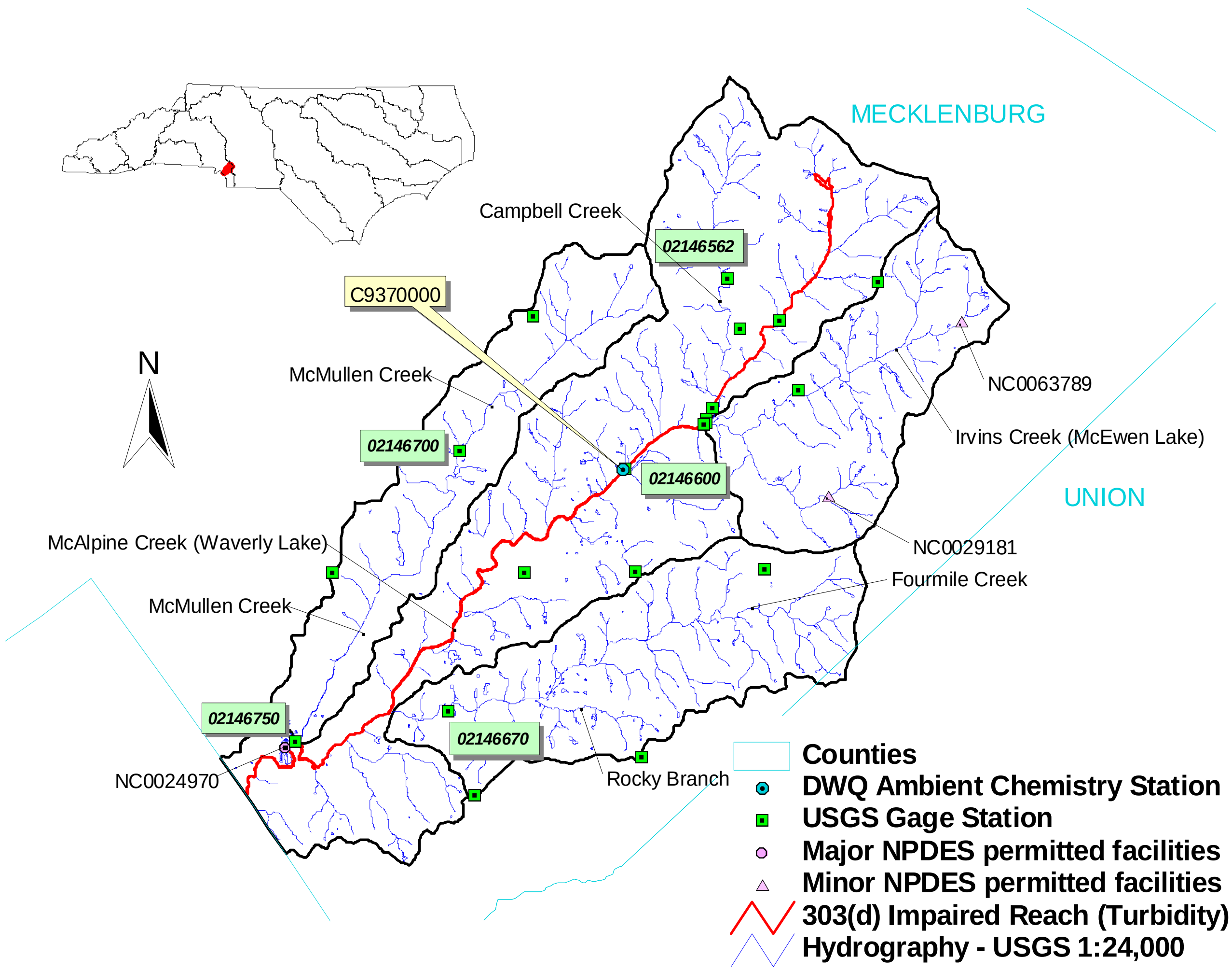
The Long Creek watershed includes portions of the city of Charlotte and drains north central Mecklenburg County between Charlotte and Huntersville in the Southern Outer Piedmont Ecoregion. The watershed is located within hydrologic unit 3050101170020 and includes Vances Twin Lakes, Dixon Branch, Swaringer Lake and McIntyre Creek. Figure 1 identifies USGS gages, NCDWQ ambient stations, and major and minor NPDES permitted facilities in the Long Creek watershed.

Figure 1. Long Creek watershed. Impaired stream length is based on the 2004 Integrated List of Impaired Waters (2004 Integrated 305(b) and 303(d) Report).



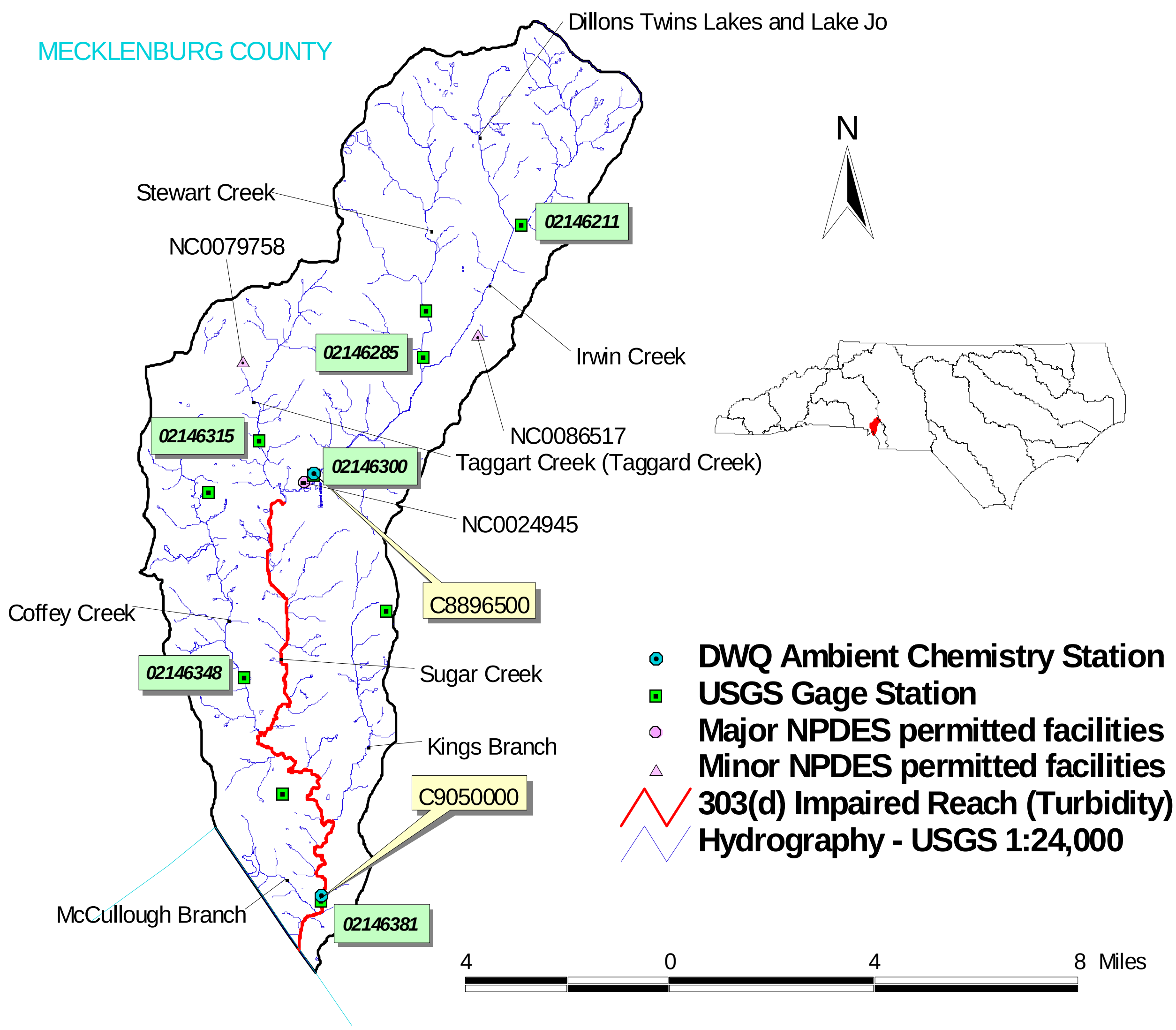
The McAlpine Creek watershed is located entirely within the city of Charlotte in the Southern Outer Piedmont Ecoregion. The watershed is located in four USGS 14-digit HUCs: 3050103020050, 3050103020060, 3050103020040, 3050103020070 and drains McMullen Creek, Campbell Creek, Irvins Creek, and Rocky Branch. Figure 2 identifies USGS gages, NCDWQ ambient stations, and major and minor NPDES permitted facilities in the McAlpine Creek watershed.

Figure 2. McAlpine Creek watershed. Impaired stream length is based on the 2004 Integrated List of Impaired Waters (2004 Integrated 305(b) and 303(d) Report).



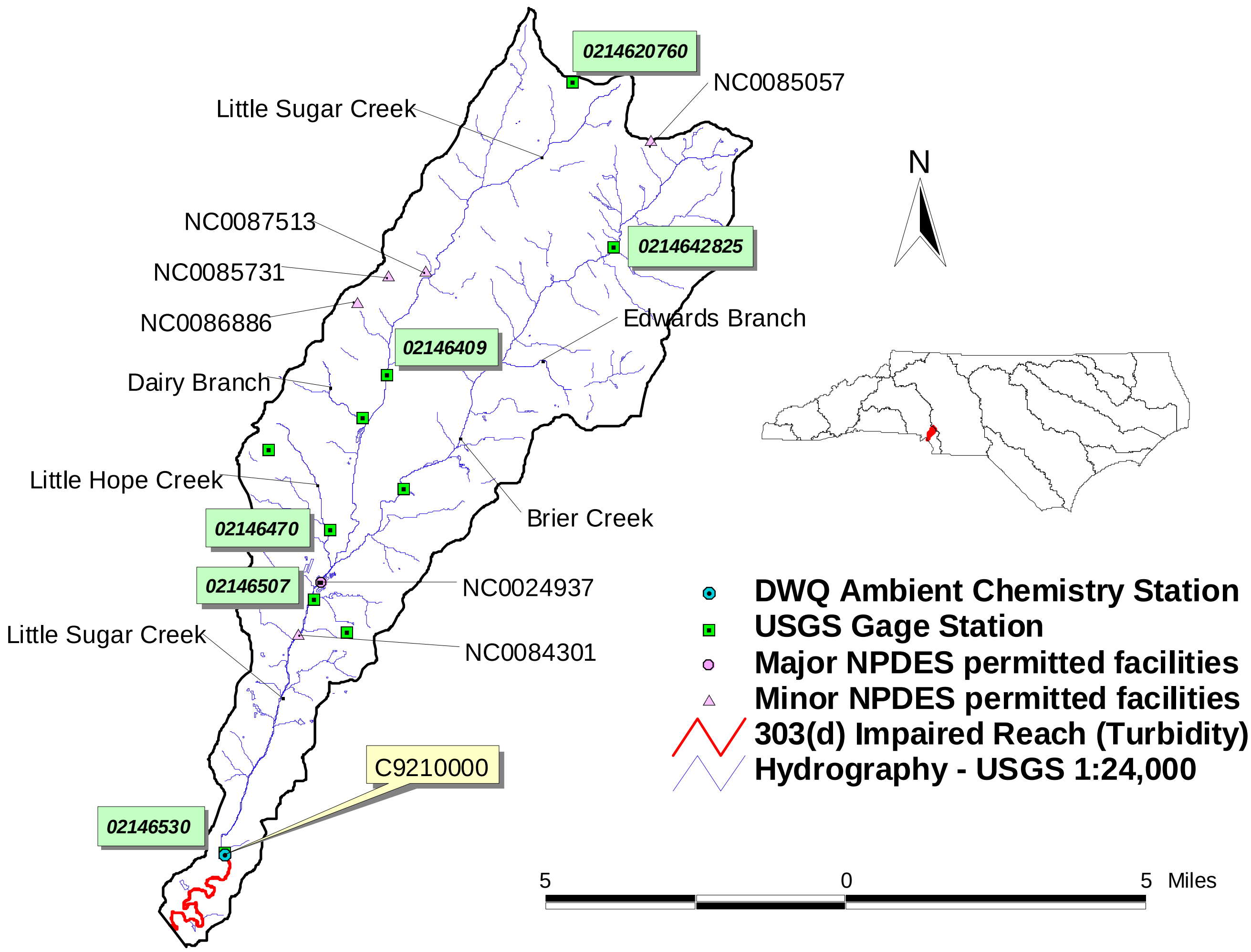
The Sugar Creek watershed is located entirely within the city of Charlotte in the Southern Outer Piedmont Ecoregion. The watershed is located within hydrologic unit 3050103020020 and drains McCullough Branch, Kings Branch, Coffey Creek, Irwin Creek, Stewart Creek, Dillons Twins Lakes, and Lake Jo. Figure 3 identifies USGS gages, NCDWQ ambient stations, and major and minor NPDES permitted facilities in the Sugar Creek watershed.

Figure 3. Sugar Creek watershed. Impaired stream length is based on the 2004 Integrated List of Impaired Waters (2004 Integrated 305(b) and 303(d) Report).



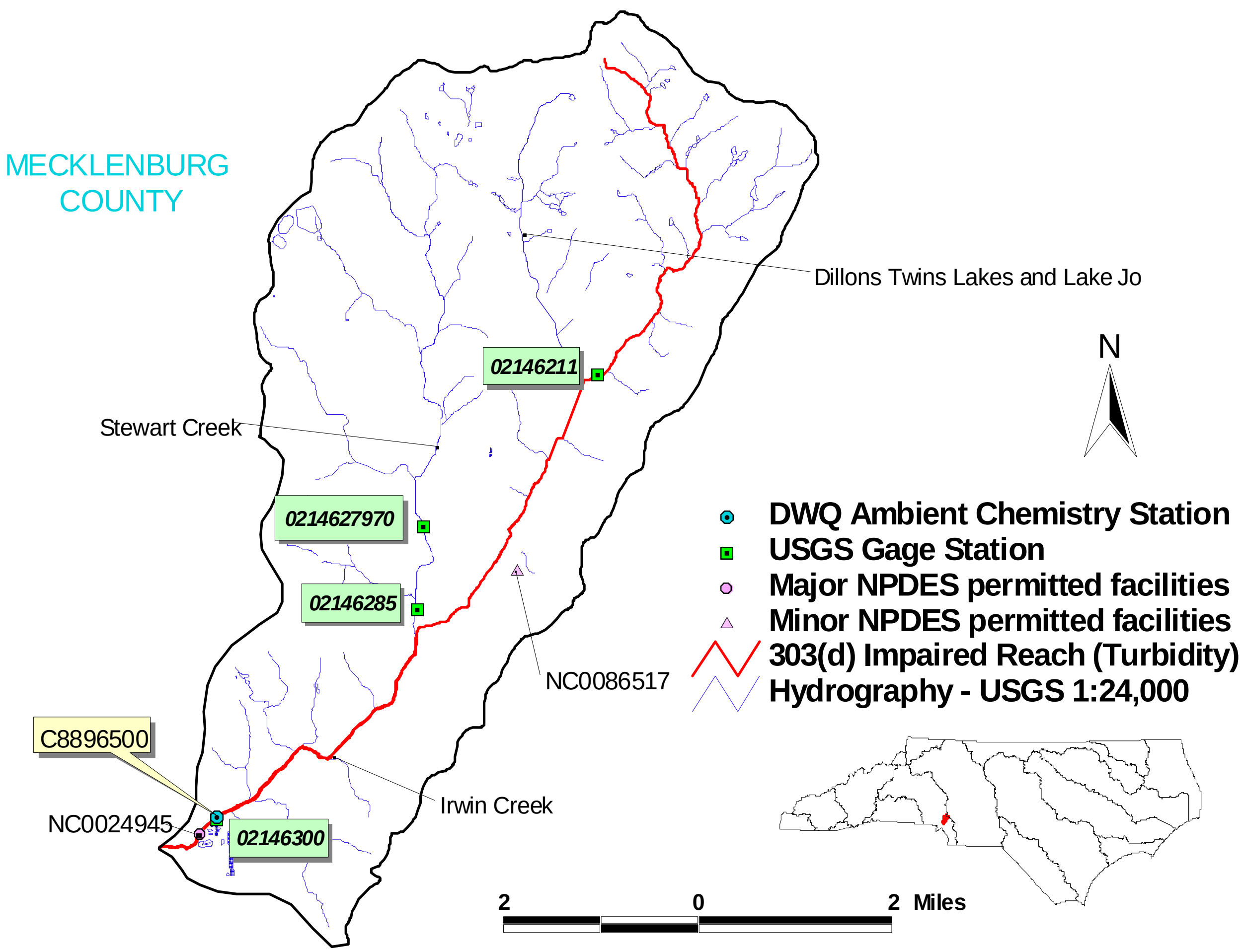
The Little Sugar Creek watershed is located entirely within the city of Charlotte in the Southern Outer Piedmont Ecoregion. The watershed is located within hydrologic unit 3050103020030 and drains Little Hope Creek, Dairy Branch, Edwards Branch, and Brier Creek. Figure 4 identifies USGS gages, NCDWQ ambient stations, and major and minor NPDES permitted facilities in the Little Sugar Creek watershed.

Figure 4. Little Sugar Creek watershed. Impaired stream length is based on the 2004 Integrated List of Impaired Waters (2004 Integrated 305(b) and 303(d) Report).



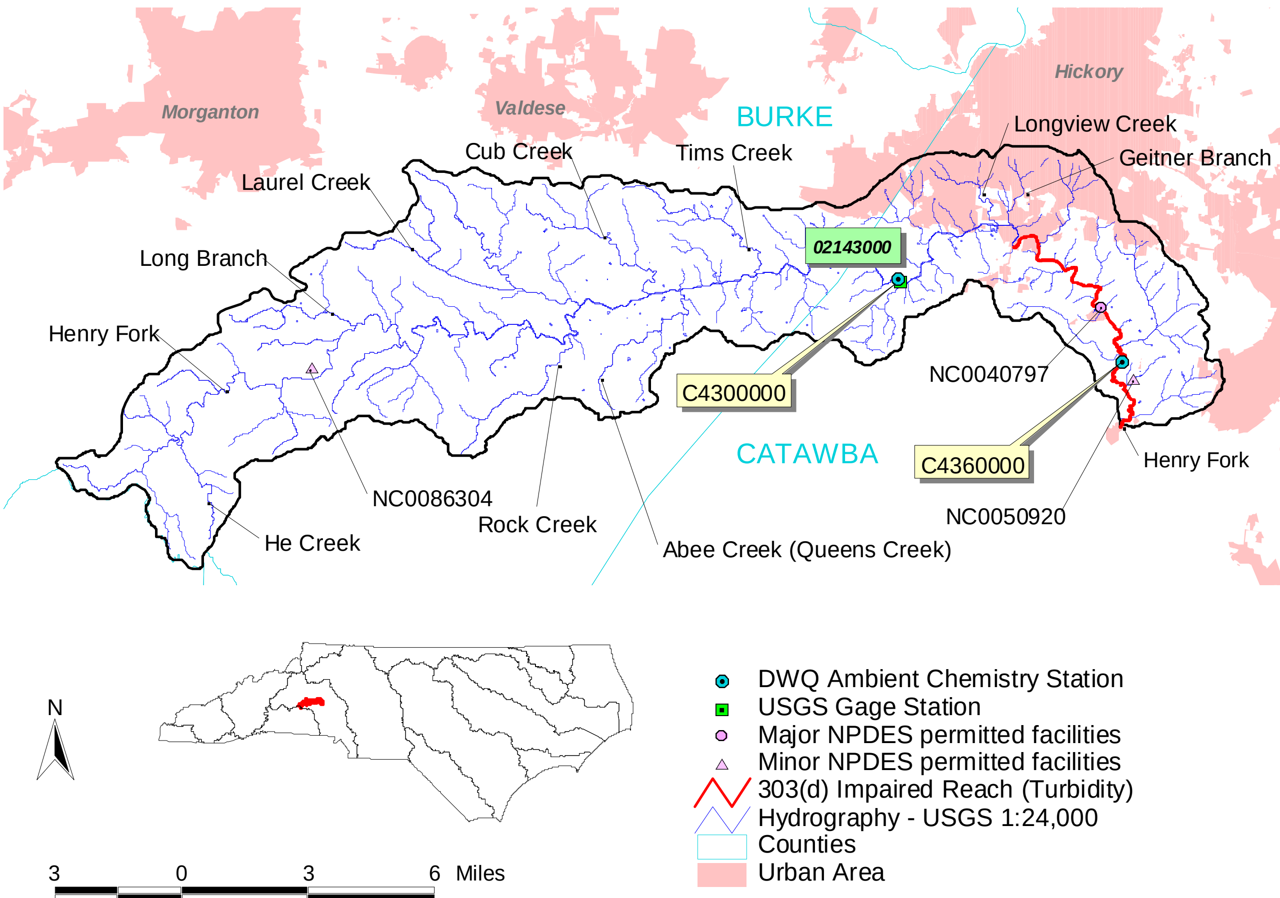
The Irwin Creek watershed is located entirely within the city of Charlotte in the Southern Outer Piedmont Ecoregion. The watershed is located within hydrologic unit 3050103020020 and drains Stewart Creek, Dillons Twins Lakes, and Lake Jo. Figure 5 identifies USGS gages, NCDWQ ambient stations, and major and minor NPDES permitted facilities in the Irwin Creek watershed.

Figure 5. Irwin Creek watershed. Impaired stream length is based on the 2004 Integrated List of Impaired Waters (2004 Integrated 305(b) and 303(d) Report).



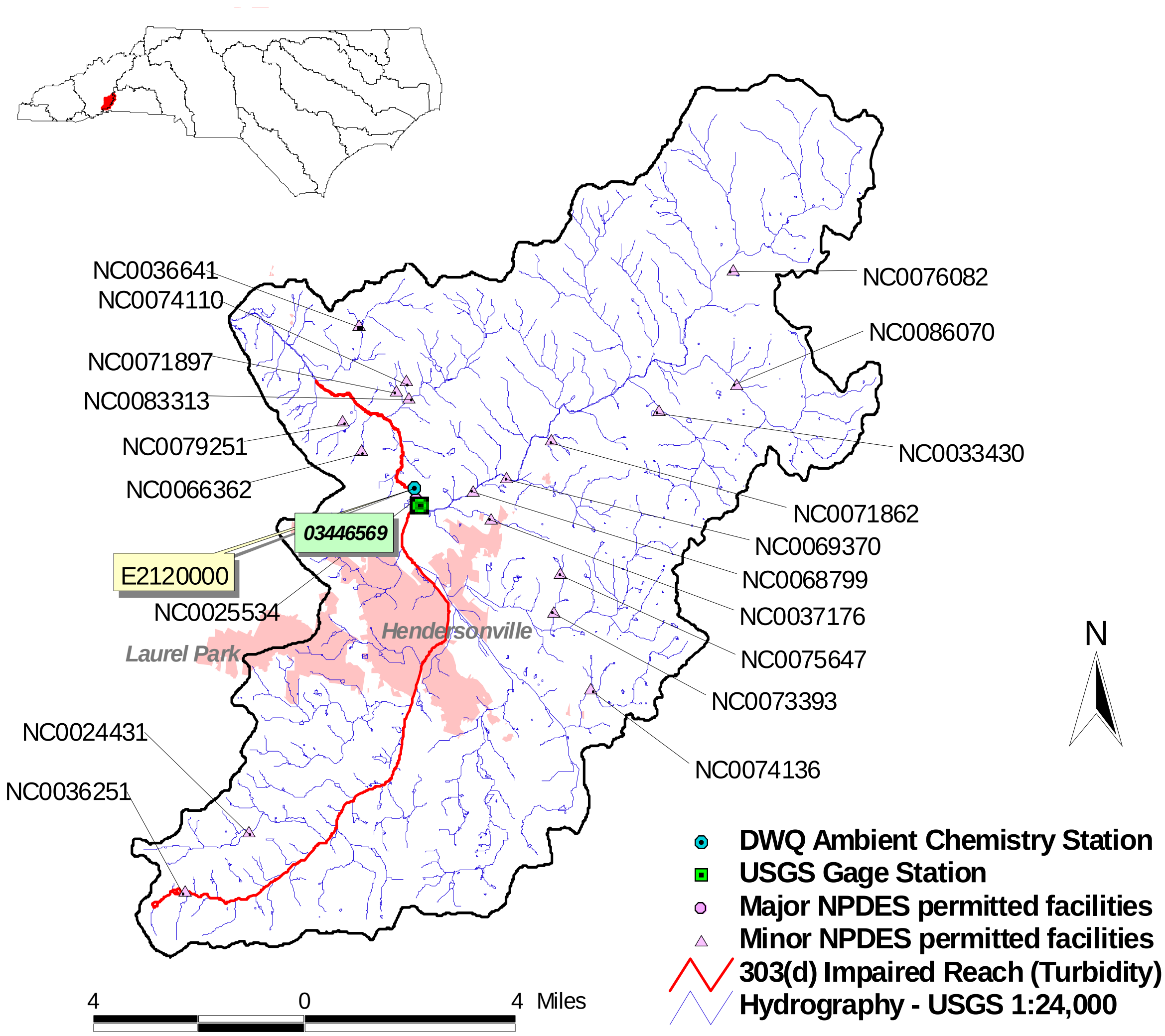
Henry Fork drains central Burke County south of Morganton. It flows along the south side of Hickory before joining with Jacob Fork to form the South Fork Catawba River in Catawba County. The watershed is located within hydrologic units 3050102010010, 3050102010020, 3050102010030 and drains Jerry Branch, Hipp Creek, Ivy Creek, Stacy Creek, Long Branch, Black Fox Branch, Daffy Creek, Ben Branch, Rock Creek, Abee Creek (Queens Creek), Laurel Creek, Tims Creek, Longview Creek, Geitner Branch, Barger Branch, and Muddy Creek. Figure 6 identifies USGS gages, NCDWQ ambient stations, and major and minor NPDES permitted facilities in the Henry Fork watershed.

Figure 6. Henry Fork watershed. Impaired stream length is based on the 2004 Integrated List of Impaired Waters (2004 Integrated 305(b) and 303(d) Report).



The Mud Creek watershed is located entirely within Henderson County and drains Hendersonville and portions of Laurel Park. Mud Creek is located in the Southern Crystalline Ridges and Mountains and Broad Basins Ecoregions. The watershed is located within hydrologic units 6010105030020, 6010105030030, 601010503004 0 and drains Clear Creek, Lewis Creek, Henderson Creek, Laurel Branch, Wolfpen Creek, Allen Branch, Devils Fork, Bat Fork, King Creek, Mud Creek, Perry Creek, Finley Creek, Wash Creek, Britton Creek, Byers Creek, Featherstone Creek, Harper Creek, Lanning Mill Creek, Kyles Creek, Puncheon Camp Creek, and Mill Creek. Figure 7 identifies USGS gages, NCDWQ ambient stations, and major and minor NPDES permitted facilities in the Mud Creek watershed.

Figure 7. Mud Creek watershed. Impaired stream length is based on the 2004 Integrated List of Impaired Waters (2004 Integrated 305(b) and 303(d) Report).



1.4.1 Land use/ Land cover

The land use/land cover characteristics of the watershed were determined using 1996 land cover data that were developed from 1993-94 LANDSAT satellite imagery. The North Carolina Center for Geographic Information and Analysis, in cooperation with the NC Department of Transportation and the United States Environmental Protection Agency Region IV Wetlands Division, contracted Earth Satellite Corporation of Rockville, Maryland to generate comprehensive land cover data for the entire state of North Carolina. Land cover/land use data for the Long Creek watershed are identified in Figures 8-14 and are summarized in Table 2. During the formation of this geographic dataset, the proportion of synthetic cover was used to identify developed land as either low density developed (50-80% synthetic cover) or high density developed (80-100% synthetic cover) (Earth Satellite Corporation, 1997).

As shown in Figures 8-14 and Table 2, predominant landuses in each watershed vary significantly. Sugar, Little Sugar, and Irwin Creeks are dominated by high density, urban landuses with secondary landuses as mixed upland hardwoods, managed herbaceous cover, and low density development. McAlpine Creek is dominated by southern yellow pine, and low and high-density development. Long Creek, Henry Fork, and Mud Creek are all predominately composed of mixed upland hardwoods and mixed herbaceous cover.

Figure 8. Land use/ land cover distribution within the Long Creek watershed.

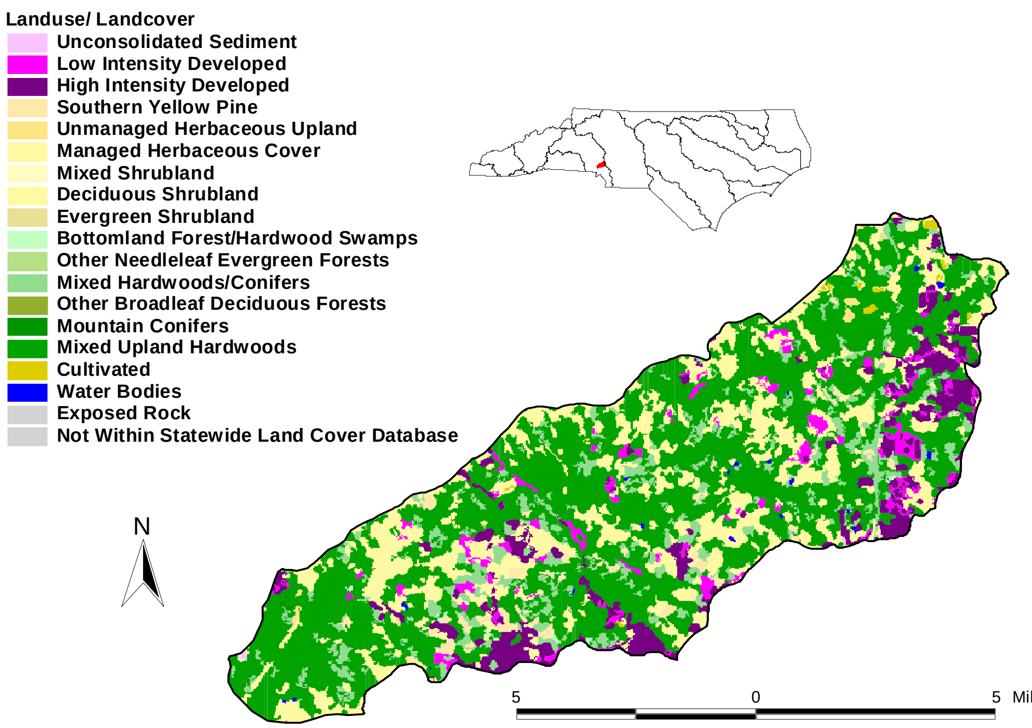


Figure 9. Land use/ land cover distribution within the McAlpine Creek watershed.

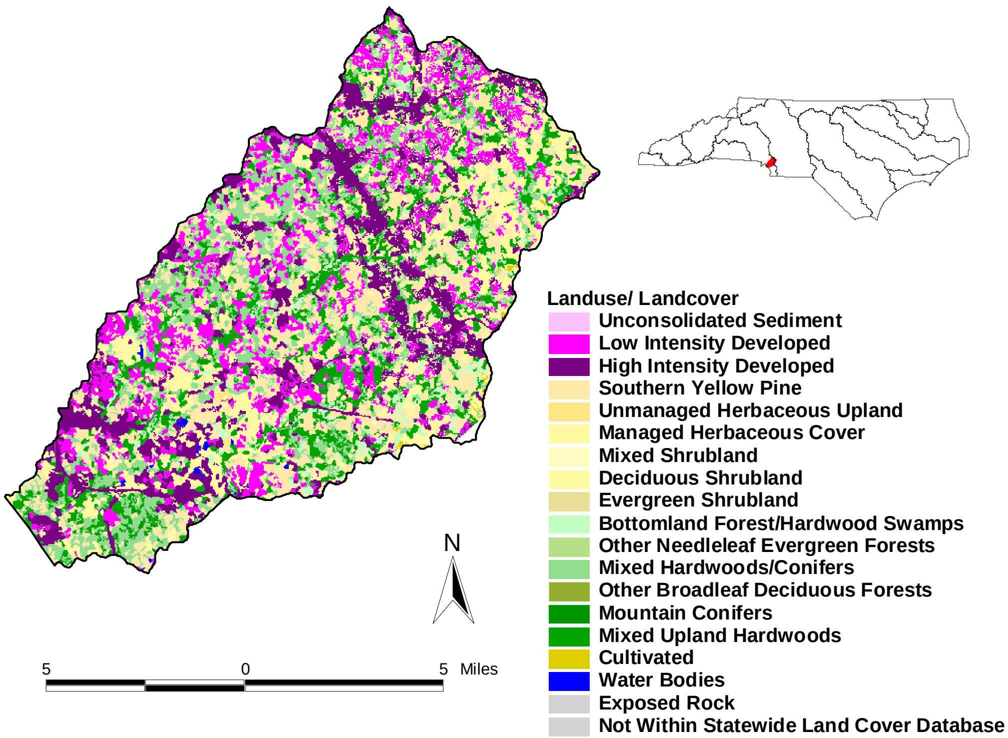


Figure 10. Land use/ land cover distribution within the Sugar Creek watershed.

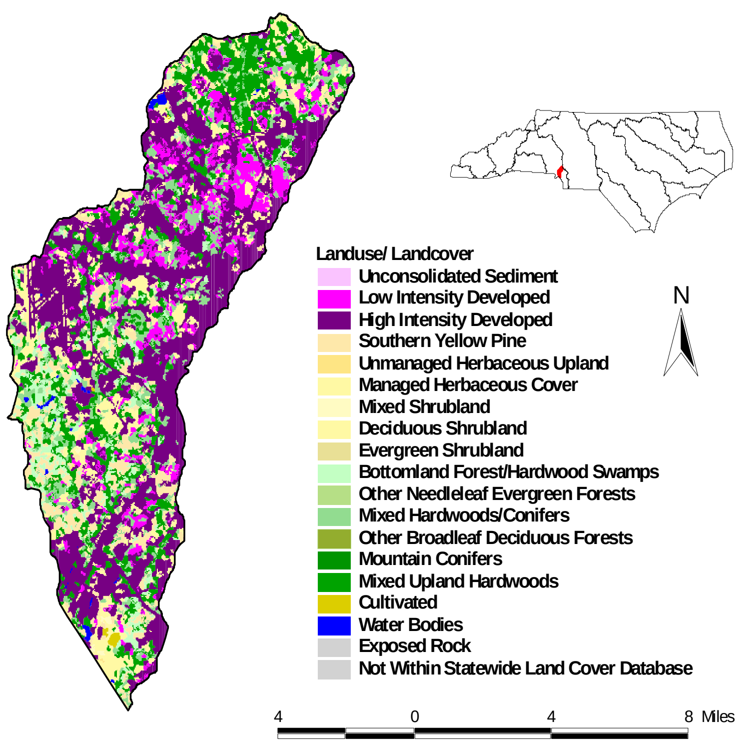


Figure 11. Land use/ land cover distribution within the Little Sugar Creek watershed.

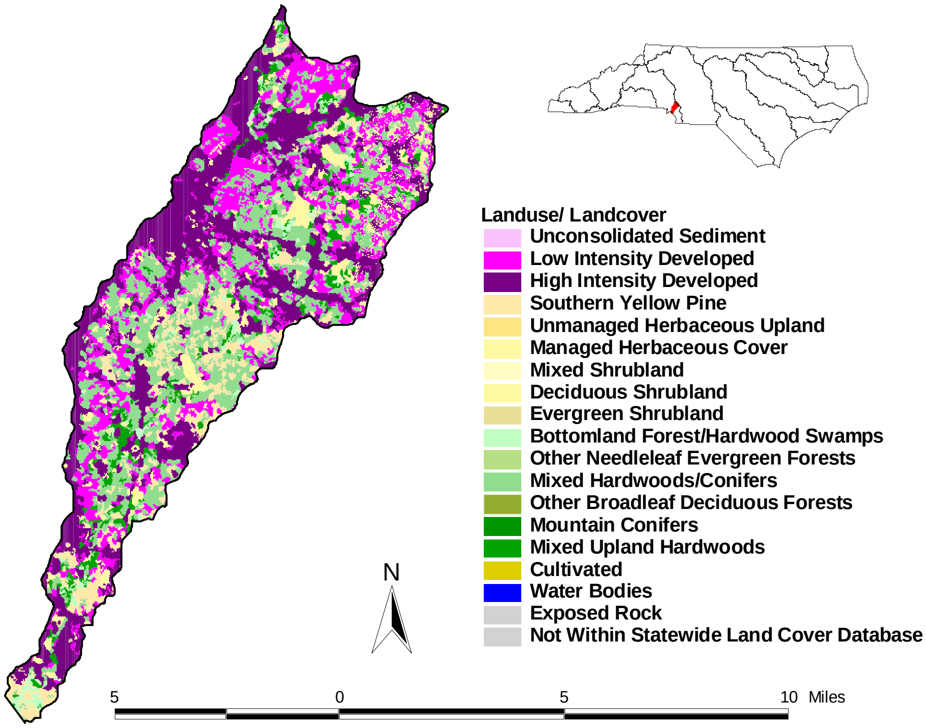


Figure 12. Land use/ land cover distribution within the Irwin Creek watershed.

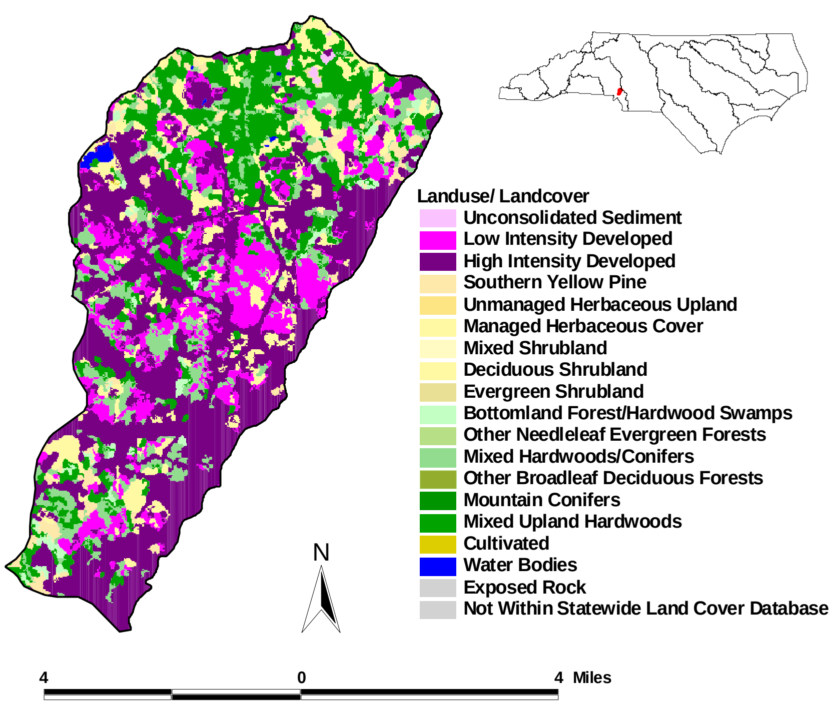


Figure 13. Land use/ land cover distribution within the Henry Fork watershed.

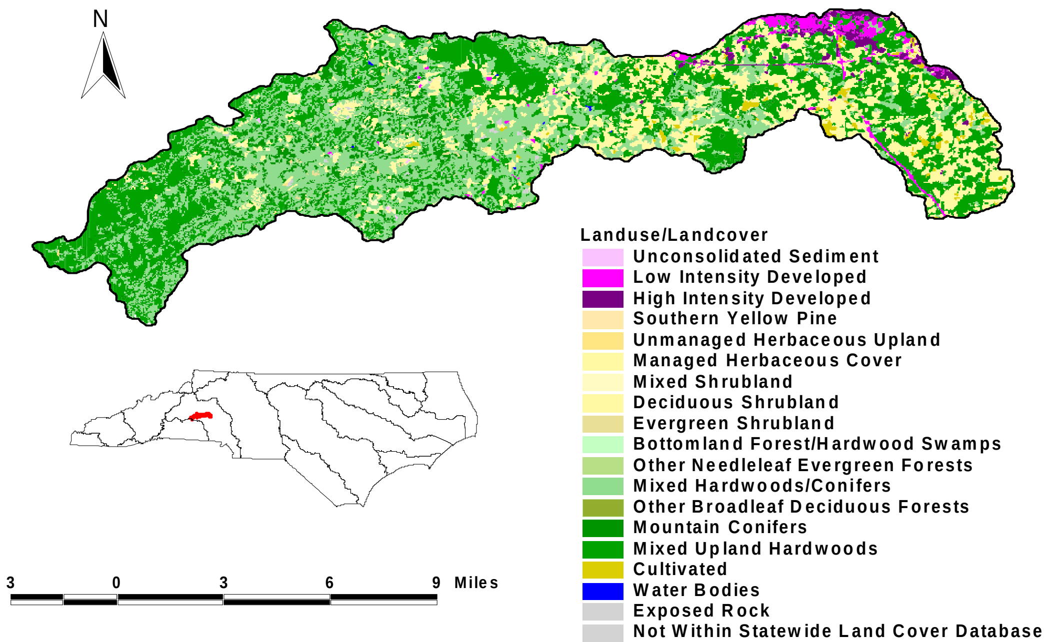


Figure 14. Land use/ land cover distribution within the Mud Creek watershed.

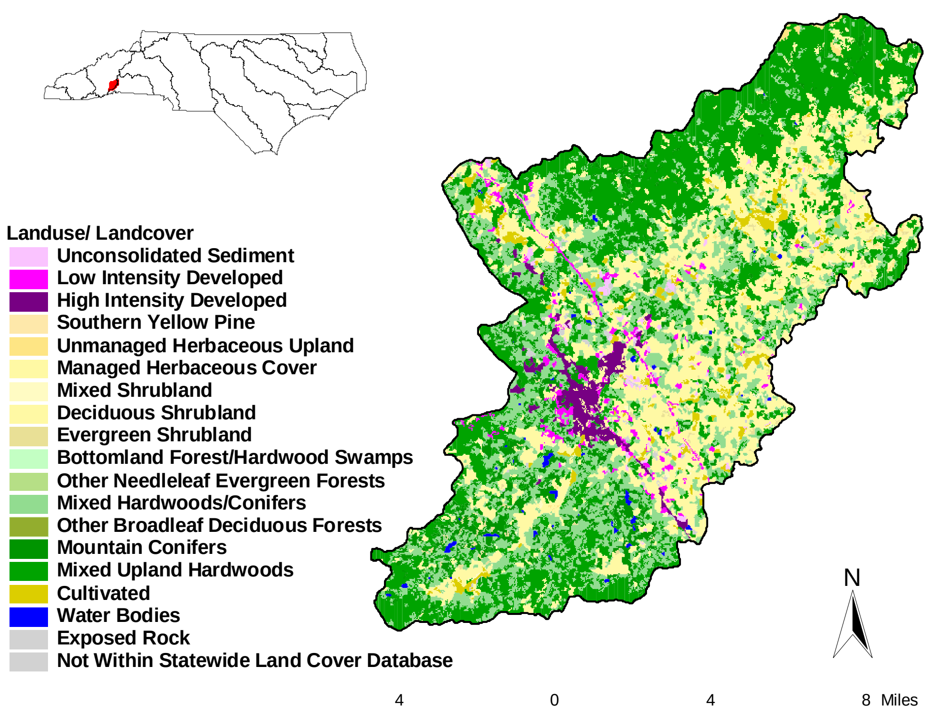


Table 2 Detailed land use/ land cover distribution by acres and percent of area within each of the impaired watersheds.

Land use/ Land cover acres and % of area	Long Creek		McAlpine Creek		Sugar Creek		Little Sugar Creek		Irwin Creek		Henry Fork		Mud Creek	
Open Water	50	0.2%	122	0.2%	198	0.5%	0	0.0%	77	0.4%	33	0.0%	331	0.5%
Bottomland Forest/Hardwood Swamps	37	0.2%	1,750	2.9%	1,977	4.6%	764	2.4%	358	1.8%	50	0.1%	0	0.0%
Cultivated	73	0.3%	123	0.2%	80	0.2%	0	0.0%	3	0.0%	930	1.3%	1,897	2.6%
Deciduous Shrubland	56	0.2%	7	0.0%	28	0.1%	0	0.0%	6	0.0%	78	0.1%	0	0.0%
Evergreen Shrubland	23	0.1%	0	0.0%	16	0.0%	0	0.0%	16	0.1%	272	0.4%	479	0.7%
Exposed Rock	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	240	0.3%	423	0.6%
Low Intensity Developed	850	3.7%	9,032	15.0%	4,052	9.4%	6,304	19.4%	2785	14.2%	1,410	1.9%	1,235	1.7%
High Intensity Developed	1,926	8.3%	10,430	17.4%	16,905	39.0%	10,420	32.1%	8067	41.0%	1,303	1.8%	1,593	2.2%
Managed Herbaceous Cover	5,132	22.1%	8,866	14.8%	4,572	10.6%	2,004	6.2%	1889	9.6%	13,592	18.6%	19,963	27.7%
Mixed Hardwoods/Conifers	2,031	8.7%	9,209	15.3%	4,232	9.8%	7,846	24.2%	2195	11.2%	22,537	30.8%	16,331	22.6%
Mixed Shrubland	0	0.0%	64	0.1%	75	0.2%	9	0.0%	0	0.0%	258	0.4%	194	0.3%
Mixed Upland Hardwoods	12,525	53.9%	8,151	13.6%	7,192	16.6%	1,789	5.5%	3454	17.6%	27,050	37.0%	23,546	32.6%
Mountain Conifers	16	0.1%	133	0.2%	27	0.1%	4	0.0%	0	0.0%	4,915	6.7%	5,152	7.1%
Not Within Statewide Land Cover Database	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.0%	0	0.0%
Other Broadleaf Deciduous Forests	1	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	0.0%	0	0.0%
Other Needleleaf Evergreen Forests	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	0.0%	0	0.0%
Southern Yellow Pine	467	2.0%	12,090	20.1%	3,899	9.0%	3,308	10.2%	770	3.9%	60	0.1%	19	0.0%
Unconsolidated Sediment	13	0.1%	0	0.0%	52	0.1%	0	0.0%	52	0.3%	33	0.0%	457	0.6%
Unmanaged Herbaceous Upland	52	0.2%	82	0.1%	28	0.1%	0	0.0%	0	0.0%	355	0.5%	577	0.8%
Sum (acres)	23,253		60,059		43,333		32,451		19,673		73,126		72,195	

1.4.2 Geology

Mecklenburg County includes Long Creek, McAlpine Creek, Sugar Creek and Little Sugar Creek and lies within the Southern Outer Piedmont Ecoregion. Predominant rock formations in this region include metamorphosed quartz diorite (PzZq), Granitic rock (Dogb), Quartzite (CZq), and Metamorphosed mafic rock (PzZm). Henry Fork is located in Catawba and Burke Counties in the Eastern Blackridge foothills and Northern Inner Piedmont ecoregions. The Amphibolite and biotite gneiss (Czab), Megacrystic biotite gneiss (Czba), Biotite gneiss and schist (CZbg) formations are the predominant formations in Catawba and Burke Counties. Mud Creek, located in Henderson County, is within the Southern Crystalline Ridges and Mountains and Broad Basins ecoregions. Three predominant rock types occur in these regions: Henderson Gneiss (Chg), Granite gneiss (Sogg), Garnet-mica schist (CZgms) (NCGS, 1991).

1.4.3 Soils

A full list of soils found in Mecklenburg, Burke, Catawba, and Henderson Counties is located in Appendix A. The predominant soils in Mecklenburg County include Cecil sandy loam, Cecil-Urban, Monacan, and Enon Sandy loam. The predominant soils in Burke County include Evard-Cowee complex, Rhodhiss sandy loam, and Fairview sandy clay loam. Predominat soils in Catawba County include Cecil clay loam, Pacolet soils, Hiwassee loam, and Cecil sandy loam. Predominate soils in Henderson County include Ashe stony sandy loam, Evard soils, Edneyville (Edneytown) fine sandy loam, and Hayesville loam (USDA, 1991). With the exception of Cecil clay loam, Monacan, and Pacolet soils, each of these soils has an erosion hazard of “severe” or “very severe” indicating their potential for future erosion in inadequately protected areas. The estimated erosion for each erosion classification is based on estimated annual soil loss in metric tons per hectare. Values were determined using the Universal Soil Loss Equation assuming bare soil conditions and using rainfall and climate factors for North Carolina. A “severe” classification indicates a estimated loss of 10 to 25 tons per hectare and a “very severe” indicates more than 25 tons per hectare of annual erosion (USDA online).

1.5 Water Quality Monitoring Program

As part of this TMDL, chemical and biological assessments were conducted throughout the each watershed to characterize the impact and extent of turbidity impairment. Results of this monitoring have shown occasional violations of the water quality standard for turbidity in each of the waterbodies under discussion. Assessment of chemical and biological data suggest continued water quality and habitat impairment for turbidity in some of these waterbodies, while in others, water quality improvement in recent years.

1.5.1 Biological Monitoring

The NCDWQ maintains an extensive biological monitoring network of ambient stations. A detailed 10-year history of fish and benthic invertebrate results at each station in the impaired watersheds are presented in Appendix B. Recent benthic and fish monitoring in McAlpine Creek, Sugar Creek, Little Sugar Creek, portions of Irwin Creek, and Mud Creek resulted in fair and poor biological conditions. Recent monitoring in portions of Irwin Creek and Henry Fork has shown good to fair biological conditions. No recent monitoring is available for Long Creek.

1.5.2 Chemical Monitoring

Long Creek, McAlpine Creek, Sugar Creek, Little Sugar Creek, Irwin Creek, Henry Fork, and Mud Creek were listed as impaired on North Carolina's 1998 or 2000 303(d) Reports based on turbidity data collected throughout the early and mid 1990's (NCDENR 2004b). Monthly ambient monitoring has continued at each station since the listing cycle in which each of the waters were originally classified as impaired. As such, recent data (collected between 1997-early 2004) will be analyzed to establish if turbidity remains a parameter of impairment in each water. In the event that recent data supports the status of impairement, a TMDL will be developed for that waterbody as appropriate. A summary of turbidity monitoring for years 1997-2003 in each of these waterbodies is presented below in Table 3. Raw datasets for turbidity and TSS in each of the below waterbodies are presented in Appendix C.

Table 3 Summary of 1997-2004 turbidity data in Long Creek, McAlpine Creek, Sugar Creek, Little Sugar Creek, Irwin Creek, Henry Fork, and Mud Creek.

Basin	Listed Waterbody	NCDWQ Ambient station	Samples (N)	Number > 50 NTU standard	Average Turbidity (NTU)	Median Turbidity (NTU)	Percent exceed standard
Catawba	Long Creek	C4040000	86	10	29.0	11.5	**12%**
Catawba	McAlpine Ck	C9370000	85	6	19.6	8.6	**7%**
Catawba	Sugar Creek	C9050000	86	7	32.1	7.6	**8%**
Catawba	Little Sugar Ck	C9210000	86	5	15.7	5.2	**6%**
Catawba	Irwin Creek	C8896500	84	6	17.3	5.1	**7%**
Catawba	Henry Fork	C4300000	84	4	11.1	6.4	**5%**
Catawba	Henry Fork	C4360000	82	4	18.3	8.2	**5%**
French Br	Mud Creek	E2120000	82	4	15.3	8.2	**5%**

An impaired waterbody is one that does not meet water quality uses, such as water supply, fishing or propagation of aquatic life. Best professional judgment along with numeric and narrative standards criteria and anti-degradation requirements defined in 40 CFR 131 is considered when evaluating the ability of a waterbody to serve its uses (NCDWQ, 2004a). In the case of turbidity in the above stream segments, common practice in applying professional judgment has been to apply impairment status to waters in which the percent-exceedence value exceeds 10% (USEPA, 2003, and Catawba River Basinwide Plan, 2004). The selection of 10% of standard exceedence as a 'cut-off' value continues to be a common and appropriate method in categorizing waters as impaired.

As shown in Table 3, assessment of 1997-2004 turbidity data indicate less than 10% exceedence at six of the seven ambient stations and thus attainment of water quality standards at those locations. Based on the infrequent nature of the turbidity violations, the development of a TMDL in McAlpine Creek, Sugar Creek, Little Sugar Creek, Irwin Creek, Henry Fork, and Mud Creek is an inappropriate management response. Rather, data is supportive of removing these waters from Category 5 of the Water Quality Assessment and Impaired Waters List. A load duration curve analysis and brief discussion of the six waterbodies proposed to be removed from Category 5 are provided in Appendix D and below text. Long Creek does require a TMDL based on these standard violations, thus Sections 1.5.3 through 8 will focus on the analysis of Long Creek.

In McAlpine Creek, six of eighty-six measurements violate the 50 NTU turbidity standard. In all cases, violations occurred under high flow conditions in which the flow was less than or equal to 10% exceedence. In Sugar Creek five of the seven violations occurred under high flows exceeding 10% of flow duration, while two violations occurred under flows that occur between 35 and 65% of the time. In Little Sugar Creek, four of the 5 violations occurred under high flows that occur less than 10% of the time while 1 violation occurred under flow conditions that occur approximately 12% of the time. In Irwin Creek all six of the violations occur under flows that are equaled or exceeded 11% of the time. In Henry Fork, four violations occur at each of the two ambient stations. At ambient station C4360000, all four violations occur under flows that occur between 10 and 95% of the time. At ambient station C4300000, violations were widely spread from flow occurring 96% of the time to flows equal or exceeding 85% to 26% to 1% of the time. In Mud Creek, the two of the four violations occurred under flows that were equaled or exceeded 10% of the time, the other two violations occurred at flows equal or exceeding 46% and 67% of the time.

At the primary monitoring site along Long Creek, 86 daily observations were collected from January 1997 to March 2004 ranging from 2 to 220 NTU. Daily observations at this site are shown in Figure 15 along with the corresponding stream flow. The number of violations to the 50 NTU water quality standard has increased in recent years and appears to be associated with periods of elevated streamflow.

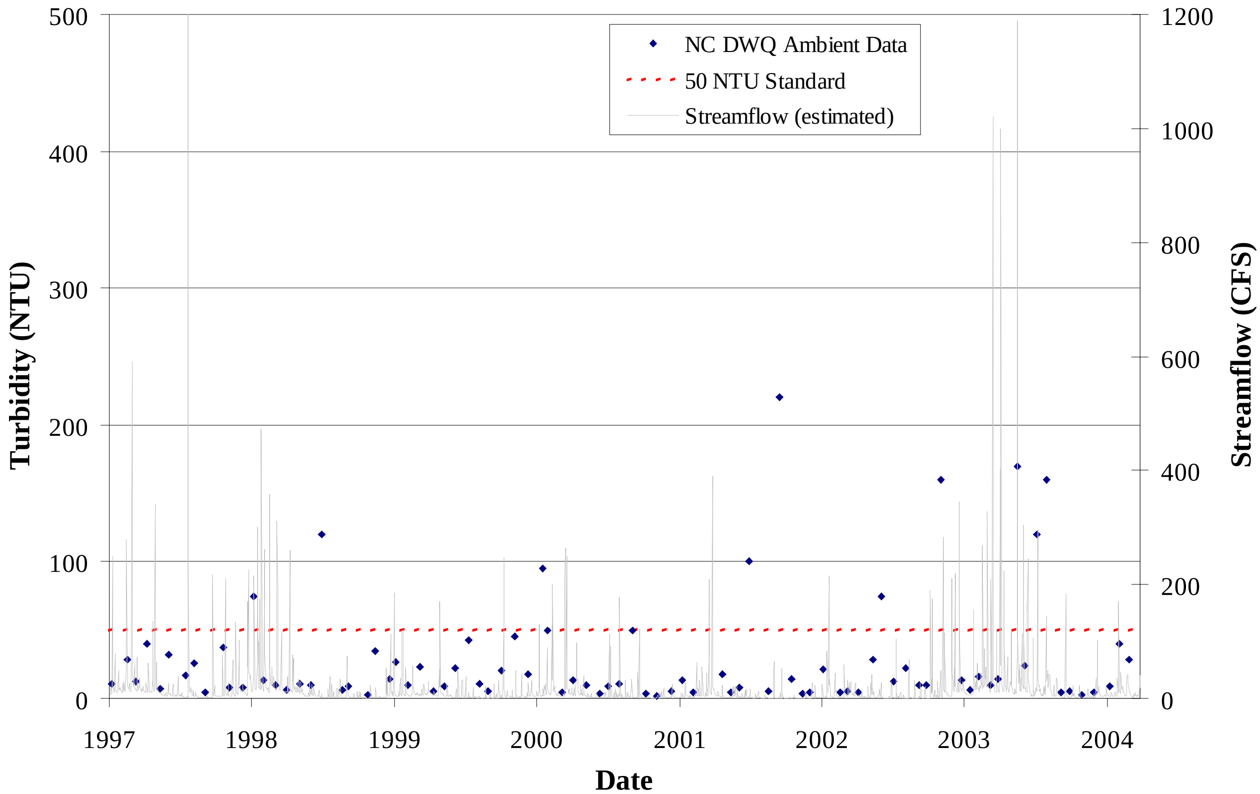
1.5.3 Flow Gaging

USGS has monitored stream flow at Station 02142900 (Long Creek near Paw Creek, NC) since 1965. The station is located in Mecklenburg County at latitude 35°19'43", longitude 80°54'35". Data were obtained from the USGS NWIS system, including provisional data updated through September 2004. Table 4 presents flow statistics for this station obtained from the USGS and load duration curve analysis to be discussed in Section 2.2.2.

Table 4 Flow statistics for Long Creek USGS gage station #02142900 during years 1965-2004.

Parameter	Value
Count	14,325
Drainage Area	16.4 mi^2
Average flow	18.1 cfs
Minimum flow	0.03 cfs
Maximum flow	1,600 cfs
High Flow Range (> 10% exceed)	31 cfs
Nonpoint Source Contributions from runoff (10-85%)	31- 2.2 cfs
Low Flow Range (95-100%)	< 1.2 cfs

Figure 15. Streamflow (USGS station 02142900) and turbidity monitoring in Long Creek at ambient station C4040000 (Long Creek at SR 2042 near Paw Creek) during 1/1997-4/2004.



2.0 Source Assessment

A source assessment is used to identify and characterize the known and suspected sources of turbidity in the Long Creek watershed. This section outlines the assessment completed for the purpose of developing this TMDL. The NCDENR's Geographic Information System (GIS) was used extensively to watershed characterization. Data sources used in assessing Long Creek are identified in Appendix E.

2.1 Assessment of Point Sources

Two categories are included under this discussion; NPDES-regulated municipal and industrial wastewater treatment facilities and NPDES general permitted facilities.

2.1.1 NPDES-Regulated Municipal and Industrial Wastewater Treatment Facilities

There are no NPDES regulated municipal or industrial wastewater treatment facilities in the Long Creek watershed and no continuous NPDES permitted facilities with turbidity or TSS limits.

2.1.2 NPDES General Permits

Nine minor individual permitted facilities and six general permitted facilities are located in the Long Creek watershed. A list of these facilities is presented in Appendix F.

General permitted facilities, while not subject to effluent TSS or turbidity limitations, are required to develop a stormwater pollution prevention plan, and conduct qualitative and/or quantitative measurements at each stormwater discharge outfall and vehicle maintenance area. Sampling methodology and constituents to be measured are characteristic of the volume and nature of the permitted discharge. For example, general permits for mining operations require the permitee to measure settleable solids, total suspended solids, turbidity, rainfall, event duration, and flow in stormwater discharge areas. Measurements of pH, oil and grease, total suspended solids, rainfall, and flow are required in on-site vehicle maintenance areas. Similarly, monitoring is required in mine dewatering areas, wastewater associated with sand/gravel mining, and in overflow from other process recycle wastewater systems.

Facilities submitting a notice of intent (NOI) for coverage under a general permit, prior to establishment or approval of a TMDL for a priority pollutant(s) for stormwater discharges (i.e. wet weather flows), may be covered under a general permit during its term. For such facilities continued coverage under the reissuance of a general permit is subject to the facility demonstrating that it does not have a reasonable potential to violate applicable water quality standards for such pollutants due to the stormwater discharge(s). In part, the decision to reissue is based on the submission of water quality measurements. For facilities that do have a reasonable potential for violation of applicable water quality standards due to the stormwater discharge(s) the facility shall apply for an individual permit 180 days prior to the expiration of their general permit. Once the individual permit is issued and becomes effective the facility will no longer have coverage under the general permit.

All construction activities in the Long Creek watershed that disturb one or more acres of land are subject to NC general permit NCG010000 and as such are required to not cause or contribute to violations of Water Quality Standards. As stated in Permit NCG010000, page 2, “The discharges allowed by this General Permit shall not cause or contribute to violations of Water Quality Standards. Discharges allowed by this permit must meet applicable wetland standards as outlined in 15A NCAC 2B .0230 and .0231 and water quality certification requirements as outlined in 15A NCAC 2H .0500”. Monitoring requirements for these construction activities are outlined in Section B (page 5) of NCG010000. As stated, “All erosion and sedimentation control facilities shall be inspected by or under the direction of the permittee at least once every seven calendar days (at least twice every seven days for those facilities discharging to waters of the State listed on the latest EPA approved 303(d) list for construction related indicators of impairment such as turbidity or sedimentation) and within 24 hours after any storm event of greater that 0.5 inches of rain per 24 hour period.” (NCG010000, Section B)

As per 40 CFR § 122.44(d)(1)(vii)(B), where a TMDL has been approved, NPDES permits must contain effluent limits and conditions consistent with the requirements and assumptions of the WLA in the TMDL. While effluent limitations are generally expressed numerically, EPA guidance on NPDES-regulated municipal and small construction storm water discharges is that these effluent limits be expressed as best management practices (BMPs) or other similar requirements, rather than numeric effluent limits (EPA, 2002). Compliance with the turbidity standard in Long Creek is expected to be met when construction and other land management activities in the Long Creek watershed employ adequate BMPs. Upon approval of this TMDL, DWQ will notify the NC Division of Land Resources (DLR) and other relevant agencies, including county and local offices in the Long Creek watershed (Mecklenburg County) responsible in overseeing construction activities, as to the impaired status of Long Creek and the need for a high degree of review in the construction permit review process.

2.2 Assessment of Nonpoint and Stormwater Sources

Nonpoint and stormwater sources include various erosional processes, including sheetwash, gully and rill erosion, wind, landslides, dry ravel, and human excavation that contribute sediment during storm or runoff events. Sediments are also often produced as a result of stream channel and bank erosion and channel disturbance (EPA, 1999).

Nonpoint sources account for the vast majority of sediment loading to surface waters. A few of these sources include:

- Natural erosion occurring from the weathering of soils, rocks, and uncultivated land; geological abrasion; and other natural phenomena.

- Erosion from agricultural activities. This erosion can be due to the large land area involved and the land-disturbing effects of cultivation. Grazing livestock can leave areas of ground with little vegetative cover. Unconfined animals with direct access to streams can cause streambank damage and erosion.

- Erosion from unpaved roadways can be a significant source of sediment to rivers and streams. Exposed soils, high runoff velocities and volumes and poor road compaction all increase the potential for erosion.

- Runoff from active or abandoned mines may be a significant source of solids loading. Mining activities typically involve removal of vegetation, displacement of soils and other significant land disturbing activities.

- Soil erosion from forested land that occurs during timber harvesting and reforestation activities. Timber harvesting includes the layout of access roads, log decks, and skid trails; the construction and stabilization of these areas; and the cutting of trees. Established forest areas produce very little erosion.

- Streambank and streambed erosion processes often contribute a significant portion of the overall sediment budget. The consequence of increased streambank erosion is both water quality degradation as well as increased stream channel instability and accelerated sediment yields. Streambank erosion can be traced to two major factors: stream bank characteristics (erodibility potential) and hydraulic/gravitational forces (Rosgen, online). The predominant processes of stream bank erosion include: surface erosion, mass failure (planar and rotational), fluvial entrainment (particle detachment by flowing water, generally at the bank toe), freeze-thaw, dry ravel, ice scour, liquifaction/collapse, positive pore water pressure, both saturated and unsaturated failures and soil piping.

2.2.1 Stormwater Discharges

Urban runoff can contribute significant amounts of turbidity to Long Creek. However, much of this runoff is regulated in compliance with the NPDES Storm Water Phase I and Phase II program (EPA, 2000). This rule applies to a unit of government such as a city or county, which owns or operates a municipal separate storm sewer system (MS4). The MS4 is required to obtain a National Point Source Discharge Elimination System (NPDES) permit for their stormwater discharges to surface waters. As such, stormwater runoff from areas within an MS4 is considered a point source. The cities of Charlotte and Huntersville, Mecklenburg County, and NCDOT fall under the NPDES stormwater rules and therefore maintain stormwater management programs. There are no continuous point sources in the watershed with NPDES permit limits for turbidity or TSS.

According to the 2000 US Census Urbanized Area, the Long Creek watershed includes portions of the Charlotte "urbanized area." The total Phase II area included as part of the Charlotte urbanized area within the Long Creek watershed is approximately 13,817 acres (21.5 mi^2), or approximately 59.5% of the total Long Creek watershed.

2.2.2 Water Quality Assessment

When streamflow gage information is available, a load duration curve (LDC) is useful in identifying and differentiating between storm-driven and steady-input sources (Stiles 2002, Cleland 2002, ASIWPCA, 2002). This method determines the relative ranking of a given flow based on the percent of time that historic flows exceed that value. Flow data have been collected by USGS at the primary site (USGS Gage 02142900) from June 1, 1965 to the present. Excursions that occur only during low-flow events (flows that are frequently exceeded) are likely caused by continuous or point source discharges, which are generally diluted during storm events. Excursions that occur during high-flow events (flows that are not frequently exceeded) are generally driven by storm-event runoff. A mixture of point and nonpoint sources may cause excursions during normal flows. Table 5 identifies the number of turbidity samples exceeding the 50 NTU criterion under a variety of flow conditions.

Table 5 Number of violations to the 50 NTU turbidity standard in Long Creek classified by flow range.

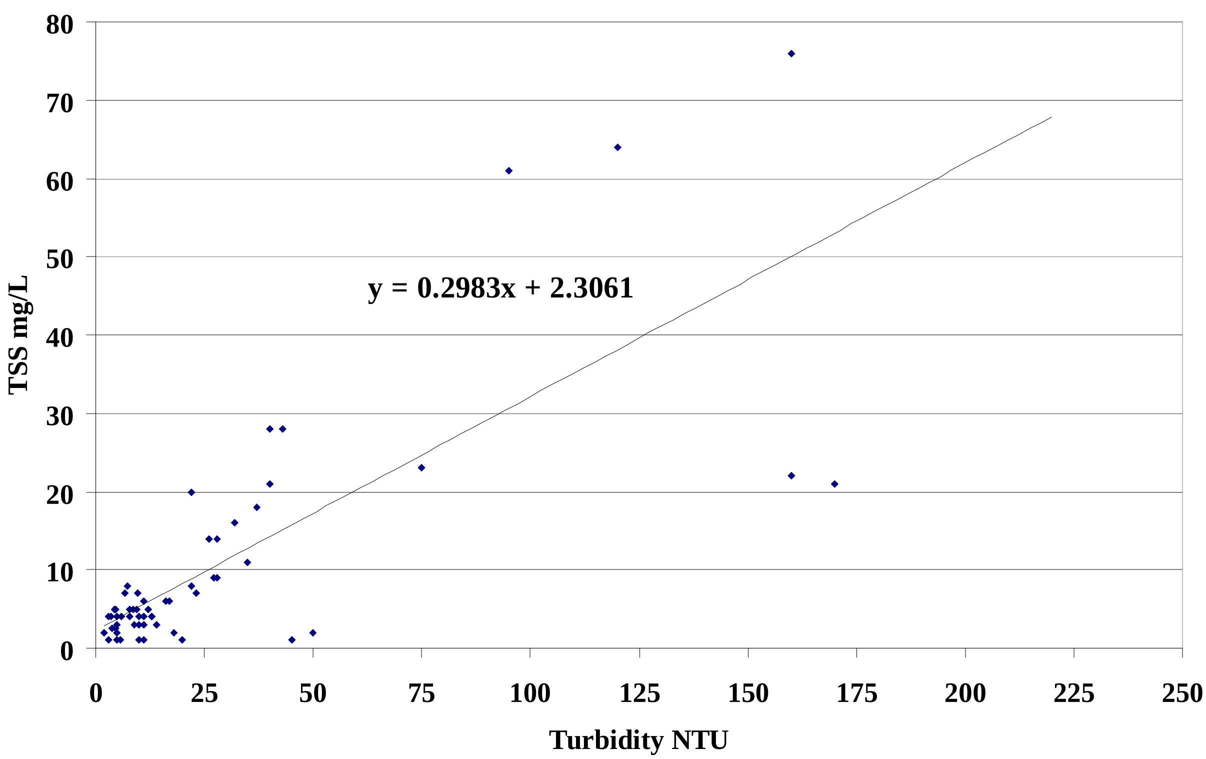
Percent of Time Flows are Equaled or Exceeded	Total number of samples	Number of samples > 50 NTU
0% - 10% (high flows)	4	4
10% - 40% (moist conditions)	21	3
40% - 60% (mid-range flows)	16	1
60% - 95% (dry conditions)	35	1
95% - 100% (low flows)	10	1
All flows	83	10

Because turbidity is measured as NTUs and not as a concentration, another parameter that is measured as a concentration must be used to represent turbidity loadings in the watershed. For this TMDL, total nonfilterable solids (or TSS, method 00530) was selected based on a 0.77 correlation value with turbidity. The correlation was determined using the below formula:

$$\rho_{xy} = \frac{\frac{1}{n}\sum_{i=1}^{n}(x_i - \mu_x)(y_i - \mu_y)}{\sigma_x \cdot \sigma_y} \qquad \text{where: } -1 \le \rho_{xy} \le 1$$

Given this, a linear regression was developed between turbidity and TSS to allow for the use of TSS values in developing a LDC. This regression is shown in Figure 16. Steps used to develop the LDC are presented in Appendix G.

Figure 16. Linear regression for TSS-Turbidity at Long Creek at C4040000 and USGS station 02142900, Long Creek near Paw Creek, NC using data collected during years 1997-2003.



Using the ambient data and USGS flow values, a load duration graph was developed for the Long Creek ambient station (see Section 3.2). Monitoring data was then matched up with the flow duration ranking based on the collection date. No flow estimation was necessary given that the USGS flow gage (02142900) used to develop the LDC is located adjacent to the ambient monitoring station. Figure 17 shows TSS data as a function of flow duration at the Long Creek ambient station. As shown in Figure 17, the surface water quality violations occur primarily under the 5%-40% range and thus are likely attributable to storm driven sources.

3.0 Technical Approach

A LDC and mass-balance approach was chosen to calculate this TMDL for turbidity in Long Creek. The load duration curve approach is advantageous because it is applicable in the initial phases of source identification, in water quality assessment to quantifying the magnitude of exceedence during critical conditions, and in implementation planning. Given this, the LDC/mass balance approach was used to identify source types, specify the assimilative capacity of the stream, and quantify the necessary load reduction needed to meet water quality standards

3.1 TMDL Endpoints

As previously discussed, to meet North Carolina Surface Water Quality Standards, instream turbidity values cannot exceed 50 NTU. Given that the turbidity standard is expressed as NTU, a correlation between TSS and turbidity was necessary in applying the LDC method. A discussion surrounding the selection of TSS as a surrogate for turbidity is presented in Section 2.2.2. A correlation coefficient of 0.77 exists between the TSS – turbidity data, and in using a linear regression, the following relationship is observed:

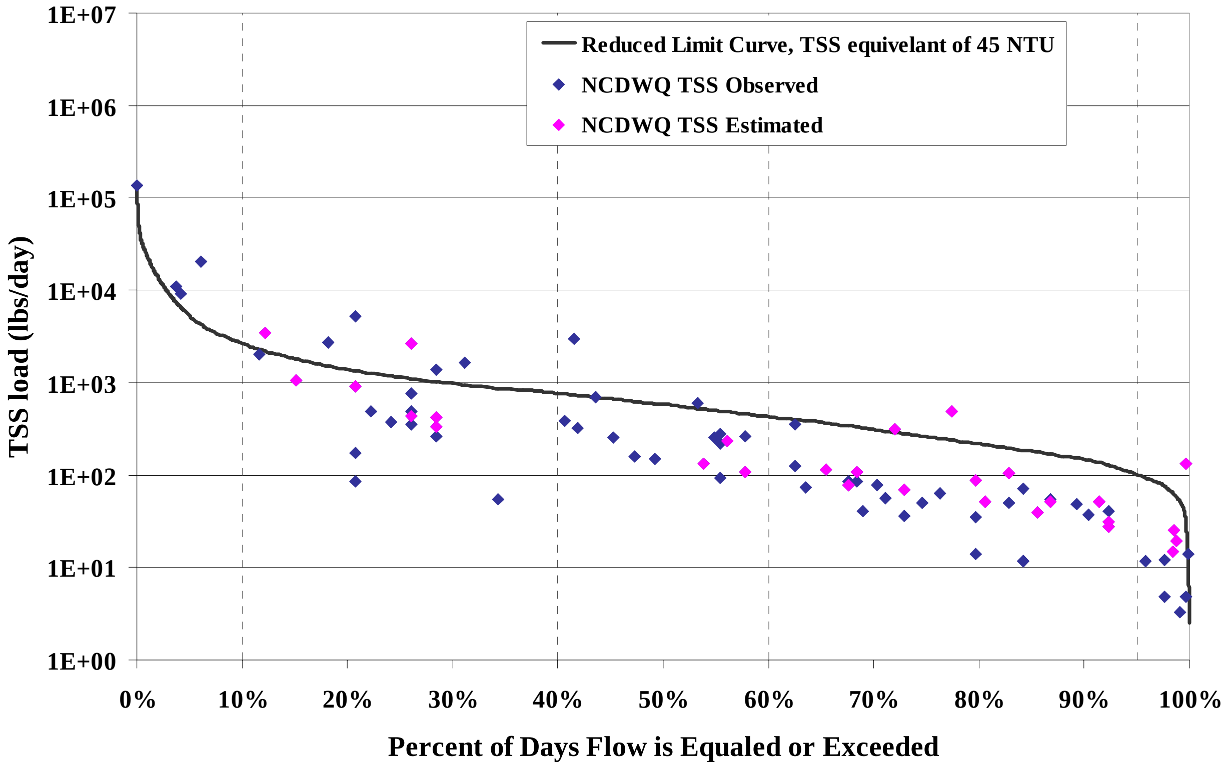
$$\mathbf{TSS = (0.2983 * Turbidity) - 2.3061}$$
$$\mathbf{R^2 = 0.60}$$

Thus, the Surface Water Quality Standard turbidity target of 50 NTU in Class C waters correlates to a TSS value of 17.2 mg/L.

3.2 Load Duration Curve for Total Suspended Solids

Values that plot below the LDC represent samples below the concentration threshold whereas values that plot above represent samples that exceed the concentration threshold. Loads that plot above the curve and in the region between 85 and 100 percent of days in which flow is exceeded indicate a steady-input source contribution. Loads that plot in the region between 10 and 70 percent suggest the presence of storm-driven source contributions. A combination of both storm-driven and steady-input sources occurs in the transition zone between 70 and 85 percent. Loads that plot above 95 percent or below 10 percent represent values occurring during either extreme low or high flows conditions and are thus considered to be outside the region of technically and economically feasible management.

Figure 17. Load duration curve using TSS at Long Creek station C4040000 (1997-2004) and flow at USGS 02142900, Long Creek near Paw Creek NC (1970-2004). "TSS estimated" values are based on turbidity values and applying the turbidity/TSS correlation.



The majority of excursions of the 50 NTU criterion occurred under moderate and higher flows. A variety of techniques have been used in applying the LDC method. Cleland (2003) has suggested separating the load duration results into different intervals characteristic of flow regimes. Using this methodology, Table 6 identifies the number of TSS measurements (both actual and estimated) that exceed 17 mg/L TSS, the TSS equivalent to 50 NTU, under five flow regimes.

Table 6 Number of measurements over 17 mg TSS/L (equivalent to 50 NTU turbidity standard) in Long Creek classified by flow range.

Percent of Time Flows are Equaled or Exceeded	Total number of samples	Number of TSS samples > 17 mg/L TSS
0% - 10% (high flows)	4	1
10% - 40% (moist conditions)	21	6
40% - 60% (mid-range flows)	16	2
60% - 95% (dry conditions)	35	1
95% - 100% (low flows)	10	2
All flows	**86**	**12**

3.3 Assimilative Capacity

The assimilative capacity is the maximum level of pollutant allowable while achieving the water quality goal. As discussed in section 2.2.2, TSS was selected as a surrogate for turbidity in this TMDL. To determine the TSS assimilative capacity, the TSS concentration equivalent to the turbidity standard of 50 NTU (17 mg TSS/L) was multiplied by the full range of measured flow values. The assimilative capacity is shown graphically in the form of a black line in Figure 17.

4.0 TMDL Calculation

A Total Maximum Daily Load (TMDL) represents the assimilative or carrying capacity of a waterbody, taking into consideration point and nonpoint sources of pollutants of concern, natural background and surface water withdrawals. A TMDL quantifies the amount of a pollutant a water body can assimilate without violating a state's water quality standards (in our case, Class C and WS-IV freshwaters) and allocates that load capacity to known point and nonpoint sources in the form of wasteload allocations (WLAs), load allocations (LAs). In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. This definition is expressed by the following equation:

TMDL = ΣWLAs + ΣLAs + MOS

A TMDL is developed as a mechanism for identifying all the contributors to surface water quality impacts and setting goals for load reductions for pollutants of concern as necessary to meet the SWQS. The Code of Federal Regulations (40 CFR §130.2(1)) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures. This TMDL will be expressed in terms of mass per time and a percent reduction that is calculated based on estimated stream flow and both estimated and measured instream TSS concentrations. At total of 86 TSS values were used in this TMDL analysis; 58 collected by the NC DWQ as part of routine monitoring between 1997 and 2004 and 28 values estimated based on instream turbidity measurements and the turbidity-TSS correlation identified in section 2.2.

4.1 TMDL Endpoints

TMDL endpoints represent the instream water quality targets used in quantifying TMDLs and their individual components. As discussed in Section 3, turbidity as a measure is not applicable to the estimation of loading to a stream. TSS was selected as a surrogate measure for turbidity. Based on the regression analysis, a TSS limit of 17 mg/L was determined to be equivalent to a turbidity measure of 50 NTU. As will be discussed in Section 4.4, a 10% explicit margin of safety was applied to the endpoint and resulted in a reduction of the target value from 50 NTU to 45 NTU (17 mg TSS/L to 15.7 mg TSS/L).

4.2 Critical Conditions and Seasonal Variation

In Long Creek, elevated turbidity concentrations occur under both low, moderate, and high flow conditions (Figure 17). The majority of turbidity violations during 1997-2004 occurred during the summer months between May and September with the most violations occurring in July. Table 7 shows the number of violations in each month during the 1997-2004 period. The TMDL has been set such that the turbidity standard is met under all seasons and flow conditions for the 1997-2004 period.

Table 7 Violations to the 50 NTU standard for each month during the 1997-2004 period.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Violations (#)	2	0	0	0	1	1	3	1	1	0	1	0

4.3 Margin of Safety

A Margin of Safety (MOS) is provided to account for "lack of knowledge concerning the relationship between effluent limitations and water quality" (40 CFR 130.7(c)). The MOS may be incorporated into a TMDL either implicitly, through the use of conservative assumptions to develop the allocations, or explicitly through a reduction in the TMDL target. For this TMDL, an explicit margin of safety was incorporated in the analysis by setting the TMDL target at 45 NTU, or equivalent 15.7 mg TSS/L, which is 10% lower than the water quality target of 50 NTU or equivalent 17 mg TSS/L.

4.4 Reserve Capacity

Reserve capacity is an optional means of reserving a portion of the loading capacity to allow for future growth. Reserve capacities are not included at this time. The loading capacity of each stream is expressed as a function of the current load (Section 4.0), and both WLAs and LAs are expressed as reductions for the entire Long Creek watershed. Therefore, the reductions from current levels, outlined in this TMDL, must be attained in consideration of any new sources that may accompany future development. Strategies for source reduction will apply equally to new development as to existing development.

4.5 TMDL Calculation

The LDC presented in Figure 17 for 1997-2004 data is used as the basis for estimating the TMDL. The LDC presents a maximum allowable concentration of 15.2 mg TSS/L (value includes a 10% MOS and is equivalent to 45 NTU) and identifies a maximum allowable load under any given flow experienced in Long Creek. The TMDL calculation focuses on measurements observed under a range of normal or expected flow conditions and excludes data collected under extremely high flows (occurring less than 10% of the time) and low flows (occurring more than 95% of the time). While data obtained under extreme flow conditions are not used to develop the TMDL, they may be appropriate for decision making during TMDL implementation.

For this report, the TMDL calculation is accomplished in a manner similar to previous TMDLs in which reductions are based on a confidence interval on a regression line (NCDWQ, 2004c). The analysis is accomplished by using the LDC to establish a regression model to predict load as a function of flow percentage. A confidence interval on the regression line is then developed with the interval reflecting the allowable level of exceedence to the water quality criterion. The confidence interval is a prediction interval about the regression line. For turbidity, a waterbody is considered 'not-impaired' by NCDWQ if ten-percent or less of the measurements do not exceed 50 NTU. Thus, for turbidity, the upper 80^{th} percentile confidence interval is sufficient to meet the ten percent or less assessment criteria since ten percent of the observations are expected to fall in both the upper and lower tails of the distribution. Additional detail on the methodology can be found in Appendix H.

The regression equation and upper 80th percentile is shown in Figure 18. The exponential regression line and confidence interval were fit to the values between 10% and 95% percent flow exceedence. Allowable loading was then calculated at each percentage between 10% and 95% based on the MOS-adjusted target concentration and the 80th percentile confidence interval to the regression line. A load reduction was determined by calculating the difference between the assimilative capacity (i.e. Reduced Limit Curve) and corresponding 80th percentile confidence interval based on corresponding flow. The existing and target loadings were estimated within each of the five flow range intervals and are summarized in Table 8. The Long Creek TMDL analysis proposes a 58.4%-reduction, specifically targeted toward conditions in which the flow recurrence interval is 40% or less (approximately 8.9 cfs or higher).

Figure 18. Load duration curve using TSS at Long Creek station C4040000 (1997-2004) and flow at USGS 02142900, Long Creek near Paw Creek NC (1970-2004).

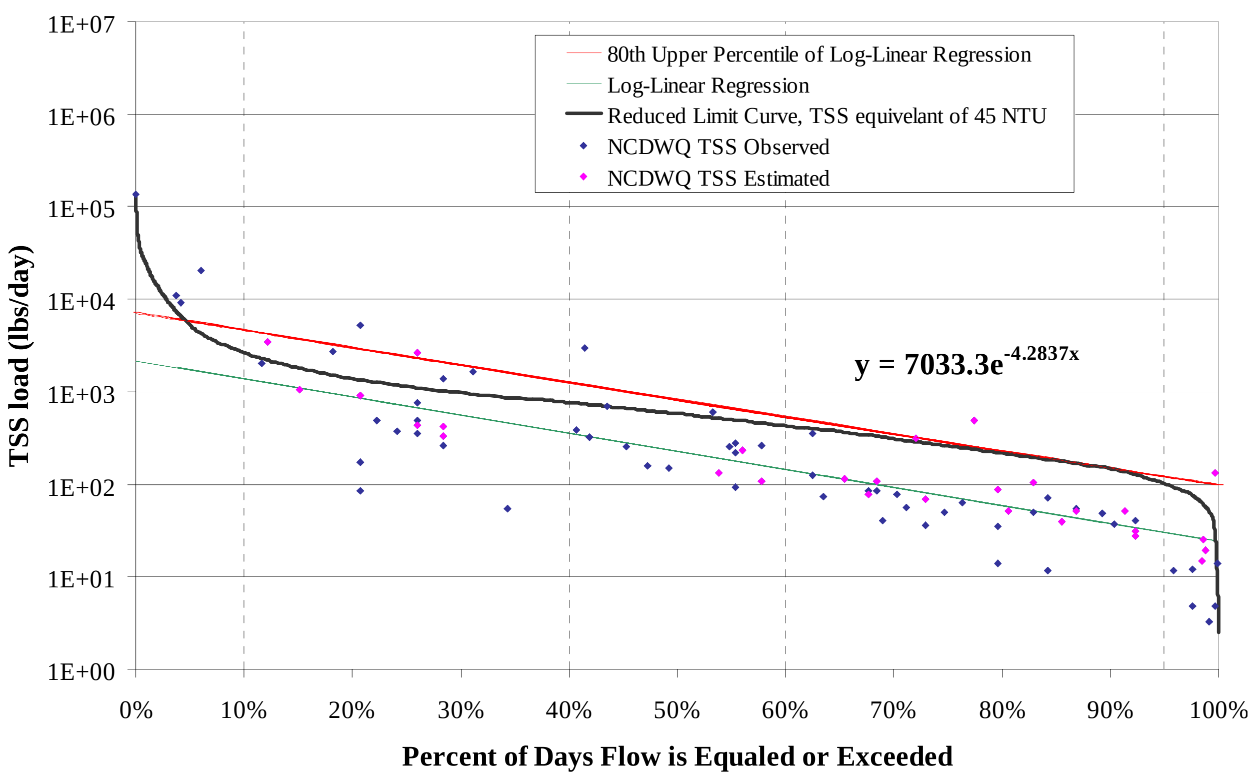


Table 8 TSS Target Load and Reduction Requirements Calculated using the Load-Duration Curve Analysis.

Flow Range	Critical Percentile	Flow (cfs)	Target Load (lbs/day)	80th Prediction Limit (lbs/day)	Reduction Required (Percent)
0% - 10% (high flows)	10.0%	31	2,286	4,583	50.1%
10% - 40% (moist conditions)	19.4%	17	1,296	3,117	58.4%
40% - 60% (mid-range flows)	41.2%	8.8	663	1,215	45.4%
60% - 90% (dry conditions)	61.1%	4.9	373	516	27.6%
90% - 95% (low flows)	94.9%	1.2	91	120	23.9%

The critical percentile is the value within the flow range in which the ratio of the 80th percentile limit to the target load is greatest.
Flow (cfs) is the corresponding value to each critical percentile.
Target Load is the value of the adjusted (lowered by 10) instantaneous criterion limit curve at the specified critical percentile and flow.
Reduction required is the calculated as (80th percentile prediction limit – target load)/(80th percentile prediction limit)

4.6 Background Turbidity

As discussed in Section 1.4.3, the Long Creek watershed contains a variety of soils classified as having a high or severe hazard of water erosion. The natural transport of sediment, as erosion and resuspension, is an important driver in maintaining aquatic health and quality. For the purposes of this TMDL, natural background levels of turbidity were estimated for flows within the 10%-95% recurrence interval range. Using the LDC method, an exponential regression line was fit to the data (1997-2004) within the 10%-90% flow interval and below the TSS equivalent of the turbidity surface water quality threshold of 50 NTU. As shown in Appendix I, background conditions are estimated from the regression line to be approximately 5.0 mg TSS/L or 9.0 NTUs under lower flows (occur approximately 95% of the time) and approximately 5.3 mg TSS/L or 10.1 NTUs under higher flows (occur approximately 10% of the time). Using estimates obtained under each percent flow between 10 and 90, on average, the background TSS concentration in Long Creek is 4.7 mg/L and the background turbidity is 8.3 NTU.

4.7 Allocations

As identified in Table 8, a 58.4% reduction in TSS loading is necessary to meet the turbidity standard of 50 NTU under all flow conditions. Additional analysis is required to address the TMDL reduction by identifying point and nonpoint contributors of turbidity and calculating wasteload and load allocations. The wasteload allocation and load allocations are estimated by similar methods and combined into one table below (Table 9). Activities not receiving an allocation in this TMDL are assumed to have an implicit zero allocation for turbidity and TSS.

4.7.1 Wasteload Allocations

There are currently no permitted point sources in the watershed. However, the entire county of Mecklenburg is authorized to discharge stormwater from its Municipal Separate Storm Sewer System (MS4) under EPA's NPDES Phase I stormwater permit program. The MS4 designation, pursuant to 40 CFR § 122.26(b)(8), refers to a conveyance or system of conveyances that are owned by a public entity and designed or used for collecting or conveying stormwater. Within the Long Creek watershed, the MS4 designation is assumed to apply to the land area in the watershed that is within the corporate limits of Charlotte and Huntersville, or which falls within the "high intensity developed" land use category and is outside these cities but within Mecklenburg County. For the purposes of this report, the total MS4 area in the Long Creek watershed is approximated at 13,817 acres or 59.5% of the watershed area.

A wasteload allocation is assigned to these land areas consistent with the NPDES Phase I Stormwater program. The assignment of the wasteload allocation is made on an areal basis by the same methods used to develop load allocations in Section 4.7.2. The total MS4 wasteload allocation is 1,000 lbs/day at 15.3 cfs critical flow (refer to Table 9). Future urban/suburban development within the watershed will also fall under the MS4 NPDES permit, and any associated WLA with the new development will be determined by shifting a portion of the LA to the WLA.

The WLA associated with construction and other land management activities, as discussed in Section 2.1.2, is equivalent to the surface water quality standard for turbidity in that any construction activity cannot cause or contribute to a violation of the water quality standard. As discussed, these WLAs will continue to be expressed as BMPs in general or individual construction permits rather than as numeric effluent limits.

4.7.2 Load Allocations

Load allocations account for the portion of the TMDL assigned to nonpoint sources. According to 40 CFR § 130.2(g), load allocations are "best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loads should be distinguished." The total of the wasteload allocation and load allocations for Long Creek is equivalent to the target load of 1290 lbs/day at the critical flow condition of 15.3 cfs.

For this TMDL, generalized landuse load allocations have been estimated based on the proportionate area in the watershed. Natural background loading rates are applied equally to all land areas and are also assigned based on the percentage of land in the watershed in each land use. The natural background loading, as explained in Section 4.6, is estimated from the LDC and an exponential regression line through values that meet the 50 NTU criteria. The remainder of the load allocation is assigned to those land uses that are likely to contribute TSS load at rates above natural background; primarily agriculture and residential land and the portion of forest area estimated to have been cut within the past year. The acreage of forest area contributing above background conditions was estimated at 566 acres. The MS4 WLA and LAs are summarized below in Table 9.

Table 9 Total Suspended Solids Wasteload Allocation and Load Allocations for Long Creek.

Source	Percent of Total Land Area	Estimated Percent of the Non-background TSS Load	Allocations (lbs/day at 15.3 cfs flow)		
			Natural Background	Additional Allocation	Total
Wasteload Allocation (WLA)					
MS4 area	59.45%	90.07%	324.6	675.4	1000.0
NCG010000 (Construction Activities)					50 NTU
Load Allocation (LA)					
Forest	36.40%	3.69%	198.6	27.7	226.2
Residential	3.90%	5.92%	21.3	44.4	65.7
Agriculture	0.20%	0.26%	0.9	2.0	2.9
Other	0.10%	0.06%	0.7	0.4	1.1
Total LAs	40.60%	9.93%	222	74.4	296.0
Margin of Safety (MOS)					10%
Grand Total	**100%**	**100%**	**546**	**750**	**1296**

Notes: The WLA associated with construction and other land management activities, as discussed in Section 2.1.2, is equivalent to the surface water quality standard for turbidity in that any construction activity cannot cause or contribute to a violation of the water quality standard. As discussed, these WLAs are and will be expressed as BMPs in the general or individual construction permits rather than as numeric effluent limits.

“Other” includes water and unconsolidated sediment outside the MS4 area.

5.0 Follow – up Monitoring

Turbidity monitoring will continue on a monthly interval at the Long Creek ambient monitoring station C4040000 at SR 2042 near Paw Creek and will allow for the evaluation of progress towards the goal of reaching the turbidity water quality standard. Additional monitoring could focus on identifying critical areas of streambank erosion and turbidity source assessment in the watershed. This would further aid in the evaluation of the progress towards meeting the water quality standard.

6.0 Implementation

Recent intensive construction and other land disturbing activities are the primary source of suspended sediment in Long Creek and its tributaries. Erosion problems associated with land-disturbing activities are compounded by increased flows, which result from an increase in impervious area after development. Enforcement of stormwater BMP requirements for construction sites and urban stormwater controls for sediment are potential management options for improving turbidity levels. Among these measures are construction entrances, diversion ditches and berms, sediment basins, and silt fences, which, to be effective, must be installed and maintained from the initiation of land disturbing activities until the establishment of permanent soil stabilization measures. While stormwater controls are required on construction sites, significant loadings can occur due to initial periods of land disturbance before controls are in place or during high rainfall periods during which the controls are inadequate. North Carolina Phase II rules require development, implementation, and enforcement of an erosion and sediment control program for construction activities that disturb one or more acres of land. In addition, Phase II rules require the development, implementation, and enforcement of a program to address discharges of post-construction storm water runoff from new development and redevelopment areas.

Implementation of conservation management plans and best management practices are the best means of controlling agricultural sources of suspended solids. Several programs are available to assist farmers in the development and implementation of conservation management plans and best management practices. The Natural Resource Conservation Service is the primary source of assistance for landowners in the development of resource management pertaining to soil conservation, water quality improvement, wildlife habitat enhancement, and irrigation water management. The USDA Farm Services Agency performs most of the funding assistance. All agricultural technical assistance is coordinated through the locally led Naturally Resource Conservation Service offices (Soil Conservation Districts). The funding programs include: The Environmental Quality Incentive Program (EQIP), The Conservation Reserve Program (CRP), and Soil & Water Conservation Cost-Sharing Program practices

Management Strategies

Management measures are “economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint and stormwater sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint and stormwater source pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives” (USEPA, 1993). The City of Charlotte has a variety of mechanisms already in place to protect and enhance water quality in Long Creek. Two means by which the City of Charlotte is already addressing sediment in the Long Creek watershed are discussed below.

The City of Charlotte is the agency responsible and active in preventing the discharge of sediment to the surface waters and maintaining and restoring water quality conditions in the streams and lakes in the cities jurisdiction. This jurisdiction encompasses 70% of Mecklenburg County and includes the City’s Extra-Territorial Jurisdiction (ETJ). One of the goals of the City of Charlotte is to achieve a 25% reduction in total suspended solid (TSS) loads in streams that have established in-stream storm water monitoring sites. For those streams in the County where in-stream monitoring sites have not been established, the goal is to prevent turbidity levels from increasing in excess of 25% downstream of construction sites as measured by portable, automated monitoring units. The Mecklenburg County Soil Erosion and Sedimentation Control Ordinance (MCSESCO) outlines the measures in which Mecklenburg County will regulate the installation and maintenance of stormwater control devices (City of Charlotte Mecklenburg, 2004).

A second mechanism by which the City of Charlotte is addressing sediment in Long Creek is the Surface Water Improvement and Management (S.W.I.M.) Program. The S.W.I.M. approach has prioritized Mecklenburg’s creek basins and focus on preventing further degradation, preserving the best waters, improve the good waters, and remediating the worst waters. The program has been successful in improving water quality conditions, enhancing efforts to enforce erosion control ordinances, reducing sediment levels in some streams by as much as 79 percent, establishing vegetative stream buffers county wide through the adoption of ordinances, and in the development of automated water quality monitoring techniques. The automated monitoring technique was employed in cooperation with NCDOT to ensure the protection of Long Creek from sediment discharges from I-485 construction activities and is being expanded to other locations around the county (City of Charlotte Mecklenburg, 2004).

S.W.I.M. Phase II was implemented in 2002 and started a four-year process aimed at maintaining and/or restoring water quality conditions in identified special interest watersheds to fulfill Mecklenburg County's goal of "swimmable/fishable" waters. During its first year of implementation, S.W.I.M. Phase II made significant progress toward achieving this goal. In general, S.W.I.M. Phase II utilizes the tools developed in S.W.I.M. Phase I, such as water quality monitoring and modeling. Phase III is planned for implementation in 2006 for the purpose of applying the techniques developed in Phases I and II to the remaining waters county wide with the ultimate goal of achieving the Board's "swimmable/fishable" goal by 2015. The S.W.I.M. Program is being used to fulfill the Phase II Storm Water Permit requirements for Mecklenburg County and the six towns in the county including Cornelius, Davidson, Huntersville, Matthews, Mint Hill and Pineville. Under the S.W.I.M. Program, a Storm Water Management Program Plan was developed and a joint permit application submitted to the state in February 2003. Implementation of the plan began on July 1, 2003 (City of Charlotte Mecklenburg, 2004).

The NC Department of Transportation is also actively involved in managing and reducing sediment erosion through the Sediment and Erosion control program as part of their NPDES Highway Stormwater Program. The below paragraphs were obtained from NCDOT to elaborate on their work in the Catawba Basin (full letter found in Appendix K).

Presently, the NCDOT program is evaluating the water quality impact of road construction in the Catawba River Basin through three related projects. The first project involves detailed water quality monitoring of the Long Creek Watershed, the second is evaluating various methods to reduce erosion and off-site sediment movement, and the third addresses sediment loading from secondary road construction activities. The first two projects are being conducted in Mecklenburg County and the third project noted is located in Burke County.

In conjunction with Mecklenburg County's S.W.I.M Program, the first project is collecting detailed water quality data at 15 locations along a portion of Long Creek. These data are being collected in 15 minutes intervals to determine in "real time" if selected water quality parameters, with an emphasis on turbidity, are being violated. If a problem is detected, the monitoring system includes the capability to send alerts to Mecklenburg County's Water Quality Program and the NCDOT, such that staff can quickly respond to determine and correct the source of the water quality violation. The project has been in place for almost two years with onsite management provided by Mecklenburg County.

The second project is comparing the effectiveness of various innovative erosion control systems which include the use of polyacrylamides, rolled erosion control products, and bonded fiber matrix hydromulching. Testing of these BMPs is taking place on a segment of the Charlotte I-485 Outer Loop. These systems are being installed, evaluated, and modified if needed to improve their effectiveness. The project has been active for over a year and is directed by Drs. Richard McLaughlin and Greg Jennings of North Carolina State University.

The third project is on a secondary road bridge construction project in Burke County. Single stage samplers have been installed up and downstream to monitor pre, during, and post construction TSS and turbidity (NTU) levels. A crest gage has been installed to monitor stream stage levels to develop a stage/discharge relationship. Sediment loading values have been developed thus far for the pre-construction phase. Dr. Garry Grabow with North Carolina State University has provided general project oversight. The NCDOT has approximately 30 other sites across the state also under similar investigation.

7.0 Public Participation

The TMDL was publicly noticed in *The Charlotte Observer* on November 17, 2004, the *Asheville Citizen-Times* on November 24, 2004, and comments on the TMDL were accepted over a period of thirty days.

8.0 Additional Information

Further information concerning North Carolina's TMDL program can be found on the Internet at the Division of Water Quality website:
http://h2o.enr.state.nc.us/tmdl/index.htm

Technical questions regarding this TMDL should be directed to the following members of the DWQ Modeling/TMDL Unit:

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Appendix A. Burke, Mecklenburg, Catawba and Henderson Counties - soils greater than 1% of county area (NRCS, 1991)

Map symbol	Map unit name	Description	Acres	Percent
Burke	FaC2	Fairview sandy clay loam, 8 to 15 percent slopes, moderately eroded	59,443	18
Burke	FaD2	Fairview sandy clay loam, 15 to 25 percent slopes, moderately eroded	36,573	11.1
Burke	RhE	Rhodhiss sandy loam, 25 to 45 percent slopes	29,021	8.8
Burke	EvE	Evard-Cowee complex, 30 to 50 percent slopes, stony	20,802	6.3
Burke	FaB2	Fairview sandy clay loam, 2 to 8 percent slopes, moderately eroded	17,988	5.5
Burke	MoE	Meadowfield-Rhodhiss complex, 25 to 60 percent slopes, very stony	9,294	2.8
Burke	CpF	Cliffield-Pigeonroost complex, 50 to 80 percent slopes, very stony	9,331	2.8
Burke	WoC2	Woolwine-Fairview complex, 8 to 15 percent slopes, moderately eroded	9,365	2.8
Burke	CpE	Cliffield-Pigeonroost complex, 30 to 50 percent slopes, very stony	8,791	2.7
Burke	AcF	Ashe-Chestnut-Buladean complex, 50 to 95 percent slopes, extremely stony	8,810	2.7
Burke	CvA	Colvard sandy loam, 0 to 3 percent slopes, occasionally flooded	9,046	2.7
Burke	EvD	Evard-Cowee complex, 15 to 30 percent slopes, stony	8,634	2.6
Burke	WoD2	Woolwine-Fairview complex, 15 to 25 percent slopes, moderately eroded	6,682	2
Burke	W	Water	6,244	1.9
Burke	RhD	Rhodhiss sandy loam, 15 to 25 percent slopes	6,291	1.9
Burke	SoE	Soco-Ditney complex, 30 to 50 percent slopes, very stony	5,899	1.8
Burke	AsF	Ashe-Cleveland-Rock outcrop complex, 30 to 95 percent slopes, extremely bouldery	5,444	1.7
Burke	EdE	Edneytown-Pigeonroost complex, 30 to 50 percent slopes, stony	4,622	1.4
Burke	AaA	Arkaqua loam, 0 to 2 percent slopes, occasionally flooded	4,624	1.4
Burke	DrF	Ditney-Unicoi-Rock outcrop complex, 25 to 95 percent slopes	4,719	1.4
Burke	EuF	Evard-Cowee complex, 50 to 85 percent slopes, rocky	3,898	1.2
Burke	CpD	Cliffield-Pigeonroost complex, 15 to 30 percent slopes, very stony	3,241	1
Burke	CkF	Chestnut-Buladean complex, 50 to 95 percent slopes, stony	3,366	1
Mecklenburg	CeB2	Cecil sandy clay loam, 2 to 8 percent slopes, eroded	101,192	28.8
Mecklenburg	CuB	Cecil-Urban land complex, 2 to 8 percent slopes	33,078	9.4
Mecklenburg	CeD2	Cecil sandy clay loam, 8 to 15 percent slopes, eroded	29,078	8.3
Mecklenburg	MO	Monacan loam	21,003	6
Mecklenburg	EnB	Enon sandy loam, 2 to 8 percent slopes	16,950	4.8
Mecklenburg	MeB	Mecklenburg fine sandy loam, 2 to 8 percent slopes	15,714	4.5
Mecklenburg	IrB	Iredell fine sandy loam, 1 to 8 percent slopes	13,656	3.9
Mecklenburg	Ur	Urban land	12,767	3.6
Mecklenburg	PaE	Pacolet sandy loam, 15 to 25 percent slopes	10,812	3.1
Mecklenburg	HeB	Helena sandy loam, 2 to 8 percent slopes	10,451	3
Mecklenburg	WkE	Wilkes loam, 15 to 25 percent slopes	10,538	3
Mecklenburg	WkD	Wilkes loam, 8 to 15 percent slopes	10,370	2.9
Mecklenburg	EnD	Enon sandy loam, 8 to 15 percent slopes	9,532	2.7
Mecklenburg	WkB	Wilkes loam, 4 to 8 percent slopes	6,881	2
Mecklenburg	MeD	Mecklenburg fine sandy loam, 8 to 15 percent slopes	4,885	1.4
Mecklenburg	MkB	Mecklenburg-Urban land complex, 2 to 8 percent slopes	4,482	1.3
Mecklenburg	VaB	Vance sandy loam, 2 to 8 percent slopes	3,909	1.1
Catawba	CmB2	Cecil sandy loam, 2 to 6 percent slopes, eroded	37,745	14.3
Catawba	CmC2	Cecil sandy loam, 6 to 10 percent slopes, eroded	36,560	13.8
Catawba	HsB2	Hiwassee loam, 2 to 6 percent slopes, eroded	23,287	8.8
Catawba	PeE	Pacolet soils, 10 to 25 percent slopes	21,258	8

Map symbol	Map unit name	Description	Acres	Percent
Catawba	CnE3	Cecil clay loam, 10 to 25 percent slopes, severely eroded	16,121	6.1
Catawba	W	Water	12,262	4.6
Catawba	CmD2	Cecil sandy loam, 10 to 15 percent slopes, eroded	11,838	4.5
Catawba	HsC2	Hiwassee loam, 6 to 10 percent slopes, eroded	11,764	4.4
Catawba	Cw	Chewacla loam	11,170	4.2
Catawba	MgE2	Madison gravelly sandy loam, 10 to 25 percent slopes, eroded	10,137	3.8
Catawba	HwC2	Hiwassee clay loam, 6 to 10 percent slopes, eroded	9,831	3.7
Catawba	MgC2	Madison gravelly sandy loam, 6 to 10 percent slopes, eroded	7,471	2.8
Catawba	CnC2	Cecil clay loam, 6 to 10 percent slopes, eroded	6,278	2.4
Catawba	PcC	Pacolet gravelly fine sandy loam, 6 to 10 percent slopes	6,180	2.3
Catawba	Cy	Congaree complex	5,622	2.1
Catawba	AsB	Appling sandy loam, 2 to 6 percent slopes	4,992	1.9
Catawba	PaF	Pacolet gravelly sandy loam, 25 to 45 percent slopes	4,902	1.9
Catawba	MgB2	Madison gravelly sandy loam, 2 to 6 percent slopes, eroded	4,789	1.8
Catawba	HsD2	Hiwassee loam, 10 to 15 percent slopes, eroded	3,607	1.4
Catawba	HsE	Hiwassee loam, 15 to 25 percent slopes	3,208	1.2
Catawba	AsC2	Appling sandy loam, 6 to 10 percent slopes, eroded	2,791	1.1
Henderson	AhG	Ashe stony sandy loam, 45 to 70 percent slopes	17,734	7.4
Henderson	EwF	Evard soils, 25 to 45 percent slopes	17,874	7.4
Henderson	EdE	Edneyville (Edneytown) fine sandy loam, 15 to 25 percent slopes	17,328	7.2
Henderson	HyC	Hayesville loam, 7 to 15 percent slopes	16,946	7.1
Henderson	EdF	Edneyville (Edneytown) fine sandy loam, 25 to 45 percent slopes	16,269	6.8
Henderson	EwE	Evard soils, 15 to 25 percent slopes	15,818	6.6
Henderson	AhF	Ashe stony sandy loam, 25 to 45 percent slopes	15,548	6.5
Henderson	EvC	Evard fine sandy loam, 7 to 15 percent slopes	9,500	4
Henderson	Co	Codorus loam	9,376	3.9
Henderson	TuE	Tusquitee stony loam, 15 to 25 percent slopes	7,294	3
Henderson	HyB	Hayesville loam, 2 to 7 percent slopes	6,903	2.9
Henderson	HyE	Hayesville loam, 15 to 25 percent slopes	6,345	2.6
Henderson	TeC	Tate fine sandy loam, 7 to 15 percent slopes	5,611	2.3
Henderson	BaB	Bradson gravelly loam, 2 to 7 percent slopes	5,192	2.2
Henderson	EwG	Evard soils, 45 to 70 percent slopes	4,862	2
Henderson	EdC	Edneyville (Edneytown) fine sandy loam, 7 to 15 percent slopes	4,176	1.7
Henderson	PoG	Porters stony loam, 45 to 70 percent slopes	3,782	1.6
Henderson	AhE	Ashe stony sandy loam, 15 to 25 percent slopes	3,642	1.5
Henderson	BrE	Brevard loam, 15 to 25 percent slopes	3,518	1.5
Henderson	DeB	Delanco (Dillard) loam, 2 to 7 percent slopes	3,257	1.4
Henderson	BrC	Brevard loam, 7 to 15 percent slopes	3,007	1.3
Henderson	FaE	Fannin silt loam, 15 to 25 percent slopes	3,116	1.3
Henderson	To	Toxaway silt loam	3,216	1.3
Henderson	BaC	Bradson gravelly loam, 7 to 15 percent slopes	2,882	1.2
Henderson	PoF	Porters stony loam, 25 to 45 percent slopes	2,839	1.2
Henderson	TsE	Tusquitee loam, 15 to 25 percent slopes	2,750	1.1
Henderson	FaC	Fannin silt loam, 7 to 15 percent slopes	2,393	1
Henderson	Ro	Rosman loam	2,375	1
Henderson	TeB	Tate fine sandy loam, 2 to 7 percent slopes	2,463	1

Appendix B. Benthic macroinvertebrate results in Long Creek, McAlpine Creek, Sugar Creek, Little Sugar Creek, Irwin Creek, Henry Fork, and Mud Creek watersheds

Results for fish monitoring in all watersheds:

Basin	Watershed	Waterbody	Station	Date	IBI Score	IBI Rating
Catawba	Henry Fork	Henry Fork	SR 1916	5/6/1997	46	Good-Fair
Catawba	Henry Fork	Henry Fork	SR 1922	9/28/1998	52	Good
Catawba	Little Sugar	Little Sugar Cr	NC 51	6/30/1997	40	Fair
Catawba	Little Sugar	Little Sugar Cr	NC 51	4/15/1999	42	Good-Fair
Catawba	Sugar Cr	Sugar Cr	SR 1156	6/30/1993	18	Poor
Catawba	Sugar Cr	Sugar Cr	SR 1156	6/30/1997	32	Poor
Catawba	Sugar Cr	Sugar Cr	SR 1156	4/15/1999	28	Poor
French Broad	Mud Creek	Bat Fork	SR 1779	9/16/1997	24	Poor
French Broad	Mud Creek	Mud Cr	SR 1647	9/16/1997	20	Poor
French Broad	Mud Creek	Clear Cr	SR 1513	10/2/2001	44	Good-Fair
French Broad	Mud Creek	Clear Cr	SR 1586	10/2/2001	36	Fair
French Broad	Mud Creek	Clear Cr	SR 1587	10/2/2001	44	Good-Fair
French Broad	Mud Creek	Bat Fork	SR 1779	6/4/2002	14	Poor
French Broad	Mud Creek	Mud Cr	SR 1647	6/4/2002	22	Poor

Results for benthos monitoring in all watersheds:

Basin	Watershed	Waterbody	Location	Date	Bioclass
Catawba	Henry Fork	Henry Fork	SR 1144	11/16/1983	Fair
Catawba	Henry Fork	Ut Henry Fork	BE Pantasote	6/19/1985	Poor
Catawba	Henry Fork	Ut Henry Fork	AB Pantasote	6/20/1985	Poor
Catawba	Henry Fork	Henry Fork	SR 1124	7/21/1986	Good-Fair
Catawba	Henry Fork	Ut Henry Fork	bel Neuville	2/9/1987	Poor
Catawba	Henry Fork	Ut Henry Fork	I-40	2/9/1987	Good-Fair
Catawba	Henry Fork	Ut Henry Fork	SR 1148	2/9/1987	Good
Catawba	Henry Fork	Ut Henry Fork	US 64 Bypass,	2/9/1987	Not Rated
Catawba	Henry Fork	Henry Fork	SR 1124	7/22/1987	Good-Fair
Catawba	Henry Fork	HE CR	AB Water Intake	4/18/1988	Excellent
Catawba	Henry Fork	Henry Fork	BE HE CR	4/18/1988	Excellent
Catawba	Henry Fork	Black Fox Ck		4/19/1988	Excellent
Catawba	Henry Fork	Carswell Br		4/19/1988	Good
Catawba	Henry Fork	Henry Fork	SR 1922	4/19/1988	Excellent
Catawba	Henry Fork	Ivy Creek	SR 1919	4/19/1988	Good
Catawba	Henry Fork	Rock Creek	SR 1915	4/19/1988	Good
Catawba	Henry Fork	Henry Fork	NC 18	4/20/1988	Excellent
Catawba	Henry Fork	Henry Fork	SR 1124	7/10/1989	Good
Catawba	Henry Fork	Henry Fork	SR 1124	8/22/1992	Good
Catawba	Henry Fork	Henry Fork	SR 1124	8/18/1997	Good
Catawba	Henry Fork	Henry Fork	SR 1803	9/12/2001	Good-Fair
Catawba	Henry Fork	Henry Fork	be dam	9/13/2001	Fair
Catawba	Henry Fork	Henry Fork	SR 1124	8/22/2002	Good
Catawba	Henry Fork	Henry Fork	end of SR 1854	4/1/2003	Good-Fair
Catawba	Irwin Creek	Irwin Creek	AB WWTP	11/9/1983	Poor
Catawba	Irwin Creek	Irwin Creek	AB Landfill	10/17/1984	Fair
Catawba	Irwin Creek	Irwin Creek	BE Landfill	10/17/1984	Fair
Catawba	Irwin Creek	Stewart Creek	SR 2050	2/27/1990	Not Rated
Catawba	Irwin Creek	Irwin Creek	SR 2523	2/28/1990	Good-Fair

Basin	Watershed	Waterbody	Location	Date	Bioclass
Catawba	Irwin Creek	Irwin Creek	I-77 (West Blvd)	8/18/1992	Poor
Catawba	Little Sugar	Little Sugar Cr	Archdale RD	11/9/1983	Poor
Catawba	Little Sugar	Little Sugar Cr	NC 51	9/19/1992	Poor
Catawba	Little Sugar	Little Sugar Cr	NC 51	8/21/1997	Fair
Catawba	Little Sugar	Worm Creek	SR 1393A	6/24/2002	Not Impaired
Catawba	Little Sugar	Little Sugar Cr	Polk St.	8/19/2002	Poor
Catawba	Long Creek	Long Creek	SR 2042	7/12/1989	Good-Fair
Catawba	McAlpine Ck	McAlpine Ck	NC 521	11/9/1983	Poor
Catawba	McAlpine Ck	McAlpine Ck	SARDIS RD	11/9/1983	Fair
Catawba	McAlpine Ck	McAlpine Ck	AB WWTP	3/26/1987	Poor
Catawba	McAlpine Ck	McAlpine Ck	SARDIS RD	3/26/1987	Fair
Catawba	McAlpine Ck	McAlpine Ck	NC 51	8/19/1992	Fair
Catawba	McAlpine Ck	McAlpine Ck	NC 51	8/21/1997	Fair
Catawba	McAlpine Ck	McAlpine Ck	NC 51	8/19/2002	Fair
Catawba	Sugar Cr	McCullough Br	NC 51	2/27/1990	Poor
Catawba	Sugar Cr	Sugar Cr	SR 1156, BE WWTP	8/18/1992	Poor
Catawba	Sugar Cr	Sugar Cr	SR 1156	8/21/1997	Fair
Catawba	Sugar Cr	Sugar Cr	SR 1156	8/20/2002	Poor
French Broad	Mud Creek	Mud Creek	SR 1508, ab WWTP	9/12/1985	Poor
French Broad	Mud Creek	Mud Creek	SR 1508, be WWTP	9/12/1985	Poor
French Broad	Mud Creek	Bat Fork	nr SR 1809	4/11/1989	Poor
French Broad	Mud Creek	Bat Fork	SR 1779	4/11/1989	Poor
French Broad	Mud Creek	Bat Fork	SR 1807	4/11/1989	Not Rated
French Broad	Mud Creek	Bat Fork	US 176	4/11/1989	Not Rated
French Broad	Mud Creek	Bat Fork	SR 1803	4/12/1989	Poor
French Broad	Mud Creek	Clear Creek	SR 1513	7/7/1992	Poor
French Broad	Mud Creek	Mud Creek	SR 1508, ab WWTP	7/7/1992	Poor
French Broad	Mud Creek	Mud Creek	SR 1508, be WWTP	7/7/1992	Poor
French Broad	Mud Creek	Clear Creek	SR 1586	6/15/1993	Fair
French Broad	Mud Creek	Clear Creek	SR 1587	6/15/1993	Fair
French Broad	Mud Creek	Clear Creek	SR 1591	6/15/1993	Not Rated
French Broad	Mud Creek	Laurel Fork	Wash Freeman Rd	6/15/1993	Good
French Broad	Mud Creek	Cox Creek	SR 1587	6/16/1993	Poor
French Broad	Mud Creek	Puncheon Camp Cr	SR 1591	6/16/1993	Not Impaired
French Broad	Mud Creek	Clear Creek	SR 1513	7/8/1997	Poor
French Broad	Mud Creek	Mud Creek	SR 1126	9/8/1997	Not Rated
French Broad	Mud Creek	Mud Creek	SR 1508	9/8/1997	Poor
French Broad	Mud Creek	Mud Creek	SR 1508	9/8/1997	Poor
French Broad	Mud Creek	Mud Creek	SR 1647, 7th Ave	9/8/1997	Poor
French Broad	Mud Creek	Bat Fork	SR 1779	9/9/1997	Fair
French Broad	Mud Creek	Mud Creek	US 25	9/9/1997	Fair
French Broad	Mud Creek	Bat Fork	SR 1779	7/10/2000	Fair
French Broad	Mud Creek	Bat Fork	SR 1809	7/10/2000	Not Rated
French Broad	Mud Creek	Mud Creek	SR 1126	7/11/2000	Not Rated
French Broad	Mud Creek	Mud Creek	SR 1508, ab WWTP	7/11/2000	Fair
French Broad	Mud Creek	Mud Creek	SR 1647, 7th Ave	7/11/2000	Fair
French Broad	Mud Creek	Clear Creek	SR 1513	7/12/2000	Fair
French Broad	Mud Creek	Clear Creek	SR 1586	7/12/2000	Poor
French Broad	Mud Creek	Mud Creek	SR 1508	7/12/2000	Fair
French Broad	Mud Creek	Devils Fork	SR 1006	7/13/2000	Not Rated
French Broad	Mud Creek	Devils Fork	US 64	7/13/2000	Poor
French Broad	Mud Creek	Mud Creek	US 25	7/13/2000	Poor

Basin	Watershed	Waterbody	Location	Date	Bioclass
French Broad	Mud Creek	Clear Creek	SR 1591	10/23/2000	Not Rated
French Broad	Mud Creek	Cox Creek	Off SR 1569	10/23/2000	Not Impaired
French Broad	Mud Creek	Cox Creek	SR 1587	10/23/2000	Not Rated
French Broad	Mud Creek	Mill Creek	SR 1586	10/23/2000	Not Rated
French Broad	Mud Creek	Clear Creek	SR 1587	10/24/2000	Good-Fair
French Broad	Mud Creek	Harper Creek	SR 1582 (Clear Ck Rd)	10/24/2000	Excellent
French Broad	Mud Creek	Laurel Fork	Wash Freeman Rd	10/24/2000	Excellent
French Broad	Mud Creek	Devils Fork	SR 1006	10/25/2000	Not Rated
French Broad	Mud Creek	King Creek	US HWY 25	10/25/2000	Not Rated
French Broad	Mud Creek	Mud Creek	SR 1125	10/25/2000	Not Impaired
French Broad	Mud Creek	Mud Creek	SR 1126	10/25/2000	Not Rated
French Broad	Mud Creek	Clear Creek	SR 1513	10/26/2000	Poor
French Broad	Mud Creek	Devils Fork	SR 1006	3/3/2001	Not Rated
French Broad	Mud Creek	Clear Creek	SR 1513	3/13/2001	Fair
French Broad	Mud Creek	Clear Creek	SR 1586	3/14/2001	Poor
French Broad	Mud Creek	Cox Creek	SR 1587	3/14/2001	Not Rated
French Broad	Mud Creek	Kyle Creek	SR 1579	3/14/2001	Not Impaired
French Broad	Mud Creek	Mill Creek	SR 1586	3/14/2001	Not Rated
French Broad	Mud Creek	Bat Fork	be Dunn Cr	7/23/2001	Not Rated
French Broad	Mud Creek	Bat Fork	SR 1779	7/23/2001	Not Rated
French Broad	Mud Creek	Clear Creek	SR 1513	10/3/2001	Fair
French Broad	Mud Creek	Clear Creek	SR 1586	10/3/2001	Poor
French Broad	Mud Creek	Cox Creek	SR 1587	10/3/2001	Not Rated
French Broad	Mud Creek	Kyle Creek	SR 1579	10/3/2001	Not Rated
French Broad	Mud Creek	Laurel Fork	Wash Freeman Rd	10/3/2001	Not Impaired
French Broad	Mud Creek	Mill Creek	SR 1586	10/3/2001	Not Rated
French Broad	Mud Creek	Mud Creek	SR 1125	10/3/2001	Not Impaired
French Broad	Mud Creek	Mud Creek	SR 1126	10/3/2001	Not Rated
French Broad	Mud Creek	Mud Creek	SR 1647, 7th Ave	10/3/2001	Poor
French Broad	Mud Creek	Devils Fork	SR 1006	10/4/2001	Not Rated
French Broad	Mud Creek	Mud Creek	SR 1164	10/4/2001	Fair

Appendix C. NC DWQ Ambient Monitoring Results for TSS and Turbidity in Long Creek, McAlpine Creek, Sugar Creek, Little Sugar Creek, Irwin Creek, Henry Fork, and Mud Creek watersheds

Ambient Chemical Data Station C4040000, LONG CRK AT SR 2042 NR PAW CREEK.

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
01/08/97	6	11
02/17/97	14	28
03/12/97	5	12
04/07/97	28	40
05/13/97	8	7.3
06/04/97	16	32
07/16/97	6	17
08/06/97	14	26
09/04/97	5	4.2
10/21/97	18	37
11/06/97	4	7.9
12/09/97	5	7.7
01/07/98	23	75
02/02/98	4	13
03/04/98	1	10
04/01/98	7	6.6
05/04/98	1	11
06/03/98	7	9.6
07/01/98	64	120
08/24/98	4	5.8
09/08/98	3	8.8
10/28/98	1	2.9
11/16/98	11	35
12/21/98	3	14
01/06/99	9	27
02/08/99	3	10
03/10/99	7	23
04/12/99	4	4.9
05/12/99	5	9.3
06/10/99	8	22
07/13/99	28	43
08/10/99	3	11
09/01/99	1	5.6
10/06/99	1	20
11/08/99	1	45
12/13/99	2	18
01/20/00	61	95
02/02/00	2	50
03/09/00	2	4.7
04/05/00	4	13
05/09/00	4	10
06/14/00	4	3.6

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
07/06/00	5	8.5
08/03/00	4	11
09/06/00		50
10/09/00		3.8
11/08/00	2	2
12/13/00		5.2
01/11/01		13
02/08/01	1	4.7
04/26/01		18
05/16/01	5	4.6
06/07/01		8.3
07/02/01		100
08/21/01	3	4.9
09/17/01		220
10/18/01		14
11/15/01	2.5	3.8
12/05/01		4.5
01/09/02		21
02/20/02	2.5	4.5
03/11/02		5.2
04/10/02		4.8
05/16/02	9	28
06/06/02		75
07/09/02		12
08/08/02	20	22
09/11/02		9.5
10/01/02		9.8
11/06/02	76	160
12/30/02		13
01/22/03		5.8
02/11/03	6	16
03/13/03		9.6
04/03/03		14
05/22/03	21	170
06/10/03		24
07/10/03		120
08/05/03	22	160
09/11/03		4.5
10/02/03		5.2
11/04/03	4	2.9
12/04/03		4
01/14/04		9
02/09/04	21	40
03/03/04		28

Ambient Chemical Data Station C9370000, McAlpine Crk at SR 3356 Sardis Rd near Charlotte

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
02/18/97	6	16
03/17/97	6	11
04/16/97	11	9.4
05/20/97	5	3.6
06/23/97		14
07/30/97	44	80
08/26/97	7	8.1
09/24/97	4	190
10/28/97	26	40
11/20/97	1	5.3
12/30/97	8	25
01/20/98	10	38
02/18/98	17	50
03/12/98	1	15
04/27/98	5	8.6
05/05/98	11	6.6
06/15/98	5	7.3
07/21/98	98	110
08/06/98	4	5
09/15/98	3	6.7
10/13/98	5	16
11/05/98	3	8.3
12/08/98	1	5.7
01/05/99	6	23
02/04/99	12	28
03/04/99	3	12
04/06/99	2	7.8
05/11/99	4	5.8
06/15/99	19	16
07/21/99	2	4.7
08/19/99	3	4.8
09/07/99	4	16
10/18/99	1	4.6
11/18/99	1	2.4
12/14/99	30	80
01/19/00	1	6
02/03/00	3	29
03/06/00	2	7.6
04/04/00	8	5.5
05/10/00	5	5.5
06/22/00	6	4.1
07/25/00	14	23
08/14/00	8	12
09/11/00	9	14
10/17/00		4.1
11/20/00		18

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
12/12/00	4	4.7
01/04/01		3.8
02/07/01		3.2
04/05/01	2	
05/03/01		4.4
06/12/01	4	7.6
07/10/01		12
08/06/01		4.9
09/06/01	12	27
10/02/01		7.2
11/07/01		8.8
12/10/01	4	7.6
01/07/02		37
02/12/02		10
03/06/02	5	16
04/09/02		6.3
05/09/02		5.8
06/04/02	3	8.6
07/10/02		12
08/05/02		8.5
09/03/02	6	22
10/03/02		4.1
11/05/02		7.4
12/03/02	2.5	3.9
01/21/03		7.3
02/06/03		8.6
03/10/03	5	14
04/01/03		19
05/22/03		100
06/12/03	8	14
07/17/03		160
08/04/03		23
09/24/03	9	14
10/20/03		5.3
11/13/03		5
12/22/03		8.1
01/08/04		3.9
02/11/04		11
03/04/04	6	15

Ambient Chemical Data Station C9050000, Sugar Creek at NC 51 at Pineville.

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
1/29/97	84	22
2/11/97	44	29
3/17/97	14	14
4/8/97	10	7.6
5/14/97	1	5.5

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
6/12/97	85	36
7/21/97	25	14
8/13/97		24
9/18/97	1	3.8
10/28/97	26	37
11/20/97	3	6.9
12/8/97	3	6.7
1/6/98	6	6.2
2/3/98	29	16
3/5/98	4	6.2
4/2/98		27
5/5/98	5	7.6
6/10/98	2000	1100
7/15/98	5	3.7
8/4/98	8	7.4
9/2/98	1	1.9
10/1/98	6	3.9
11/5/98	7	
12/2/98	4	2.2
1/4/99	24	50
2/3/99	18	36
3/3/99	4	5.6
4/5/99	9	5.8
5/4/99	7	15
6/3/99	1	4.7
7/1/99	25	19
8/5/99	3	3
9/7/99	6	5.2
10/7/99	1	3
11/3/99	7	11
12/1/99	1	4.2
1/3/00	4	3
2/1/00	22	38
3/1/00	4	7
4/3/00	110	40
5/8/00	8	5.2
6/8/00	5	3.4
7/25/00	5	8.9
8/17/00		2.3
9/20/00	11	17
10/30/00		2.4
11/27/00		15
12/19/00	14	11
1/10/01		7.8
2/6/01		2.3
4/4/01	7	
5/2/01		3.6
6/13/01	5	3.6

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
7/10/01		5.1
8/7/01		6.4
9/5/01	33	33
10/1/01		3.7
11/7/01		4.1
12/3/01	2.5	6.7
1/7/02		80
2/11/02		23
3/5/02	10	22
4/1/02		200
5/8/02		6.9
6/3/02	7	11
7/2/02		160
8/1/02		6.2
9/4/02	6	19
10/2/02		3.3
11/4/02		4.3
12/2/02	2.5	4.1
1/2/03		16
2/5/03		55
3/11/03	12	13
4/1/03		19
5/28/03		24
6/18/03	68	60
7/23/03		15
8/19/03		24
9/25/03	12	13
10/23/03		3.8
11/19/03		30
12/22/03		6.4
1/15/04		5.1
2/12/04		130
3/18/04	5	7.3

Ambient Chemical Data Station C9210000, Little Sugar Creek at NC 51.

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
1/29/97	10	11
2/11/97	19	21
3/17/97	62	26
4/8/97	8	4.9
5/14/97	7	5.3
6/12/97	81	24
7/21/97	6	2.6
8/13/97	3	3.5
9/18/97	9	3.8
10/28/97	11	17
11/20/97	2	4.3

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
12/8/97	3	3.4
1/6/98	50	33
2/3/98	44	16
3/5/98	1	2.4
4/2/98		9
5/5/98	8	3.8
6/10/98	410	200
7/15/98	1	2.5
8/4/98	2	2.4
9/2/98	6	1.9
10/1/98	21	2.7
11/5/98	8	3.5
12/2/98	2	1.4
1/4/99	13	28
2/3/99	8	15
3/3/99	4	3.2
4/5/99	10	3.5
5/4/99	1	5.7
6/3/99	2	4.1
7/1/99	15	6.7
8/5/99	4	3.2
9/7/99	4	3.5
10/7/99	3	3
11/3/99	6	8
12/1/99	3	3.3
1/3/00	3	2
2/1/00	15	21
3/1/00	1	5.1
4/3/00	45	12
5/8/00	29	3.3
6/8/00	1	3.1
7/25/00	5	6.5
8/17/00	6	2.4
9/20/00	3	5.6
10/30/00		2.2
11/27/00		30
12/19/00	2	6.1
1/10/01		4.1
2/6/01		1.6
4/4/01	4	
5/2/01		2.6
6/13/01	4	3
7/10/01		2.9
8/7/01		3.8
9/5/01	11	13
10/1/01		2
11/7/01		4
12/3/01	2.5	7.7

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
1/7/02		36
2/11/02		9.1
3/5/02	4	11
4/1/02		80
5/8/02		3.8
6/3/02	6	6
7/2/02		23
8/1/02		4
9/4/02	9	9.6
10/2/02		1.7
11/4/02		2.1
12/2/02	2.5	2.9
1/2/03		6.3
2/5/03		14
3/11/03	7	11
4/1/03		24
5/28/03		29
6/18/03	200	140
7/23/03		27
8/19/03		13
9/25/03	6	6.4
10/23/03		5.7
11/19/03		100
12/22/03		4.7
1/15/04		4.2
2/12/04		95
3/18/04	17	35

Ambient Chemical Data Station C8896500, Irwin Creek at Irwin Creek WWTP near Charlotte.

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
01/22/97	6	7.1
02/20/97	1	6.6
03/19/97	5	5.5
04/17/97	1	3.7
05/19/97	2	1.6
07/22/97	2	1.9
08/14/97		2.3
09/16/97	1	1.6
10/21/97	5	7.9
11/13/97	30	35
12/10/97	110	120
01/08/98	60	150
02/16/98	13	13
03/11/98	22	18
04/29/98	2	3.2
05/20/98	2	2.2

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
06/23/98	130	6.4
07/22/98	2	5.3
08/10/98	34	40
09/21/98	1	1.9
10/29/98	3	4.4
11/23/98	6	5.9
12/30/98	2	5.8
01/27/99	6	12
02/23/99	2	7.1
03/18/99	4	4.5
04/28/99	42	70
05/24/99	1	2.6
06/28/99	8	17
08/03/99	1	1.2
08/19/99	2	1.7
09/13/99	1	6
10/19/99	1	1.1
11/03/99	1	8.6
12/06/99	1	1.2
01/05/00	4	21
02/21/00	1	4.5
03/16/00	1	1.7
04/18/00	11	26
05/17/00	4	1.6
06/20/00	2	3.9
07/27/00	3	2.2
08/25/00	3	1.3
09/13/00		1.3
10/19/00		3.6
11/29/00	2	4.8
12/28/00		5.8
01/29/01		5.6
02/13/01	5	8
04/23/01		1.7
05/29/01	32	28
06/13/01		45
07/23/01		4
08/23/01	2	1.2
09/18/01		1.2
10/22/01		1.5
11/29/01	2.5	
12/17/01		2.6
01/16/02		3.7
02/14/02	3	5.5
03/18/02		45
04/25/02		8.6
05/22/02	7	4.9
06/13/02		1.5

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
07/01/02		2
08/13/02	4	1.7
09/09/02		1
10/24/02		5.7
11/20/02	3	8.6
01/06/03		4.2
02/13/03	20	5.2
03/04/03		6.8
04/02/03		4.5
05/22/03	270	200
06/12/03		10
07/23/03		17
08/04/03	8	24
09/24/03		20
10/21/03		1.6
11/13/03	2.5	2
12/10/03		200
01/15/04		2.3
02/12/04	190	100
03/04/04		6.8

Ambient Chemical Data Station C4360000, Henry Fork River at SR 1143 Near Brookford.

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
03/13/97	5	5.6
04/03/97	21	4.1
05/01/97	22	12
06/26/97	24	18
07/29/97	40	32
08/21/97		8
09/23/97	8	6.1
10/29/97	10	13
11/24/97	1	5
01/05/98	5	3.5
02/24/98	14	15
03/18/98	12	7
04/23/98	14	9.6
05/19/98	8	6.2
06/09/98	17	13
07/08/98	1	8
08/27/98	2	6.5
09/24/98	32	6.6
10/07/98	36	26
11/09/98	2	2.3
12/17/98	4	3.9
01/14/99	1	3.2
02/16/99	2	3.1
03/24/99	24	13

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
04/22/99	14	8.4
05/17/99	56	35
06/17/99	31	23
07/19/99	140	70
08/12/99	5	8.6
09/09/99	7	6.5
10/13/99	16	20
11/02/99	42	38
12/02/99	1	2.4
01/04/00	7	4.4
02/09/00	21	16
03/02/00	5	3.2
04/05/00	42	33
05/11/00	4	3.8
06/13/00	40	18
07/06/00	8	16
08/07/00	13	17
09/07/00		22
10/12/00		2.3
11/02/00	3	2.8
12/05/00		2.9
01/09/01		4.7
02/14/01	5	6.8
04/11/01		
05/08/01	8	3.6
06/04/01		9.9
07/05/01		190
08/20/01	4	6.2
09/12/01		7.1
10/08/01		27
11/08/01	2.5	5.3
12/04/01		4.1
01/08/02		8.4
02/13/02	7	9.7
03/12/02		5.3
04/08/02		6.3
05/14/02	14	15
06/12/02		12
07/15/02		300
08/06/02		6.1
09/05/02		7.7
10/15/02		45
11/07/02	8	9.6
12/18/02		12
01/08/03		4.4
02/12/03	3	4.1
03/05/03		11
04/03/03		5.4

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
05/20/03	22	15
06/05/03		36
07/08/03		13
08/13/03	75	65
09/10/03		8.6
10/16/03		9.6
11/10/03	13	7.2
12/08/03		3.4
01/13/04		5.6
02/10/04	24	23
03/02/04		2.4

Ambient Chemical Data Station C4300000, Henry Fork Riv at SR 1124 Nr Henry River.

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
01/07/97	6	17
03/13/97	2	4.1
04/03/97	1	2.7
05/01/97	2	5.2
06/26/97	14	13
07/29/97	17	17
08/21/97		6.9
09/23/97	8	7.4
10/29/97	3	7.2
11/24/97	1	3.1
01/05/98	3	3.2
01/27/98	94	65
02/24/98	6	13
03/18/98	2	2.2
04/23/98	14	5.1
05/19/98	4	6.1
06/09/98	6	9
07/08/98	12	10
08/27/98	3	7.9
09/24/98	1	5.6
10/07/98	9	8
11/09/98	4	2.5
12/17/98	2	2.8
01/14/99	3	1.8
02/16/99	1	3.5
03/24/99	3	3.6
04/22/99	5	5.5
05/17/99	7	7.6
06/17/99	15	20
07/19/99	48	70
08/12/99	10	5.6
09/09/99	5	6.4
10/13/99	10	11

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
11/02/99	12	17
12/02/99	3	1.6
01/04/00	1	2.2
02/09/00	2	1.1
03/02/00	1	2.5
04/05/00	8	9.4
05/11/00	1	5
06/13/00	4	5.2
07/06/00	2	4.1
08/07/00	6	8
09/07/00		8.9
10/12/00		2.2
11/02/00	1	1.7
12/05/00		1.4
01/09/01		2.5
02/14/01	3	1.8
05/08/01	5	2.6
06/04/01		4.5
07/05/01		150
08/20/01	71	80
09/12/01		10
10/08/01		3.5
11/08/01	3	7
12/04/01		4.4
01/08/02		6.6
02/13/02	8	8.7
03/12/02		4.4
04/08/02		4.8
05/14/02	4	8
06/12/02		6.7
07/15/02		17
08/06/02		6.9
09/05/02		9.8
10/15/02		18
11/07/02	6	8.5
12/18/02		20
01/08/03		4.2
02/12/03	3	3.3
03/05/03		9.5
04/03/03		8.4
05/20/03	16	12
06/05/03		20
07/08/03		6.4
08/07/03	23	18
09/10/03		6.1
10/16/03		7.5
11/10/03	3	2.3
12/08/03		4.3

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
01/13/04		4
02/10/04	17	10.3
03/02/04		3.1

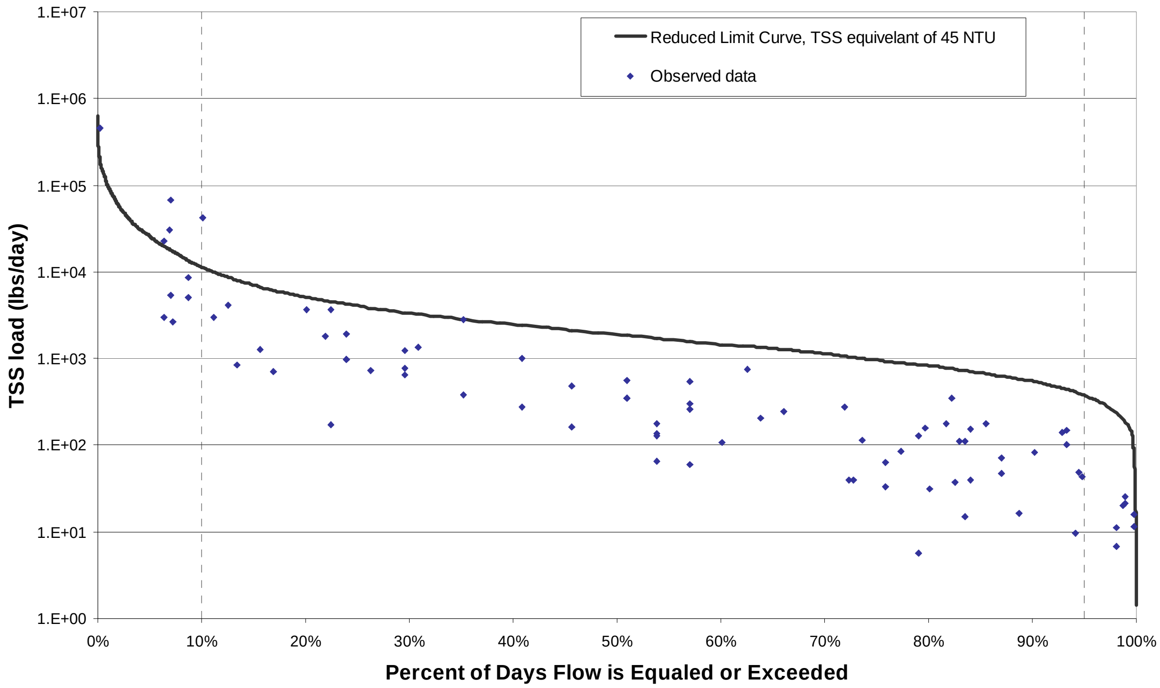
Ambient Chemical Data Station E2120000, Mud Crk at SR 1508 Nr Balfour.

DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
1/2/97	6	4.9
2/26/97	9	6.2
3/13/97	13	5.8
4/24/97	26	14
5/29/97	9	6.3
6/16/97	45	31
7/23/97	12	8.5
8/7/97	10	9.4
9/18/97	9	7.9
10/22/97	4	4.5
11/25/97	2	4.2
12/11/97	3	7
1/14/98	10	13
2/25/98	25	9.8
3/12/98	10	9.9
4/7/98	19	6.8
5/14/98	15	8.4
6/4/98	11	11
7/22/98	30	33
8/26/98	5	7.2
11/30/98	3	2.6
12/14/98	6	7.9
1/7/99	4	5.4
2/25/99	4	5.9
3/18/99	6	6.5
4/8/99	8	6.8
5/26/99	8	9.4
6/17/99	15	14
7/15/99	11	3.9
8/5/99	6	4.3
9/23/99	6	5.8
10/14/99	4	7.4
11/23/99	2	6.3
12/16/99	7	9.1
1/20/00	5	6.2
2/17/00	9	9
3/23/00	21	15
4/13/00	33	24
5/16/00	8	5.2
6/21/00		20
7/11/00	9	6.3

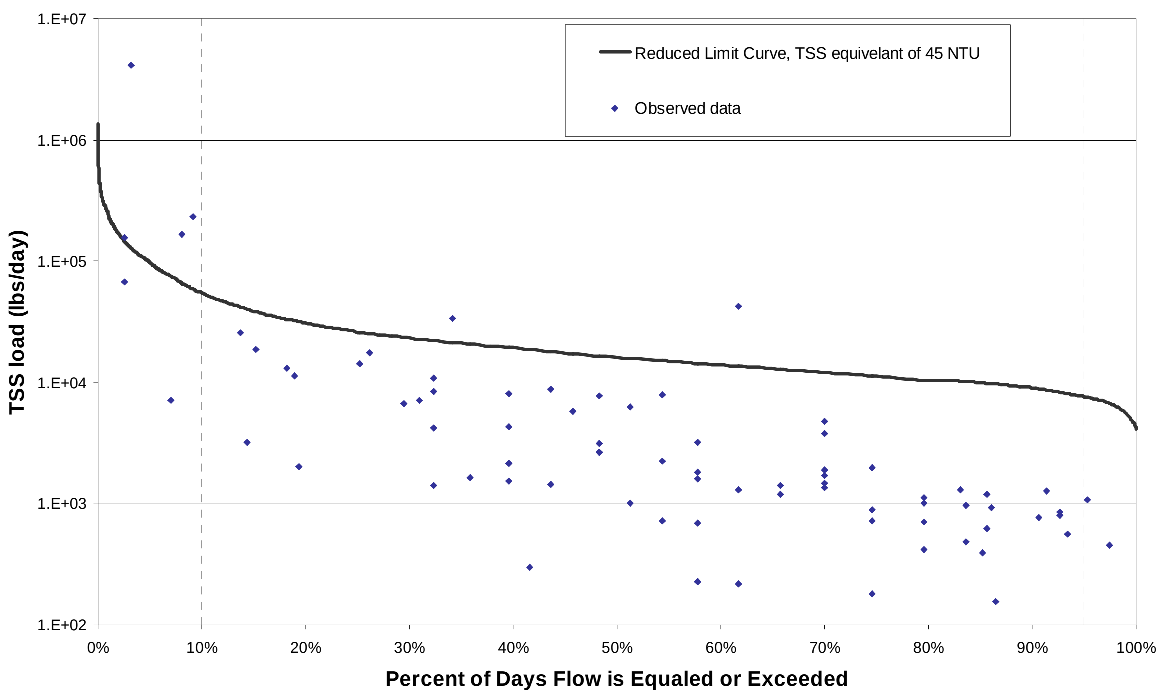
DATE	TOTAL NONFILTRABLE RESIDUE MG/L (method 00530)	TURBIDITY, NEPHELOMETRIC TURBIDITY UNITS NTU (method 82079)
8/16/00		5.3
9/14/00		6.4
10/24/00		2.3
11/8/00		7
12/29/00		7
1/17/01		3.9
4/11/01	11	9.4
5/29/01		19
6/20/01		18
7/2/01	41	50
8/8/01		49
9/20/01		8.3
10/9/01	2	2.5
11/7/01		4
12/19/01	4	4.1
1/29/02	8	7.4
3/21/02		43
4/9/02	8	5.1
5/1/02		79
6/5/02		83
7/10/02	5	7
8/21/02		13
9/4/02		8
10/17/02	16	14
11/6/02		17
12/5/02		36
1/15/03	12	13
2/12/03		3.9
3/18/03		14
4/30/03	20	17
5/28/03		13
6/16/03		50
7/22/03	19	19
8/6/03		70
9/24/03		26
10/8/03	4.6	4.3
11/5/03		12
12/10/03		90
1/21/04	3.2	4
2/11/04		14
3/10/04		4.18

Appendix D Load Duration Curves for waters in which TMDLs will not be developed.

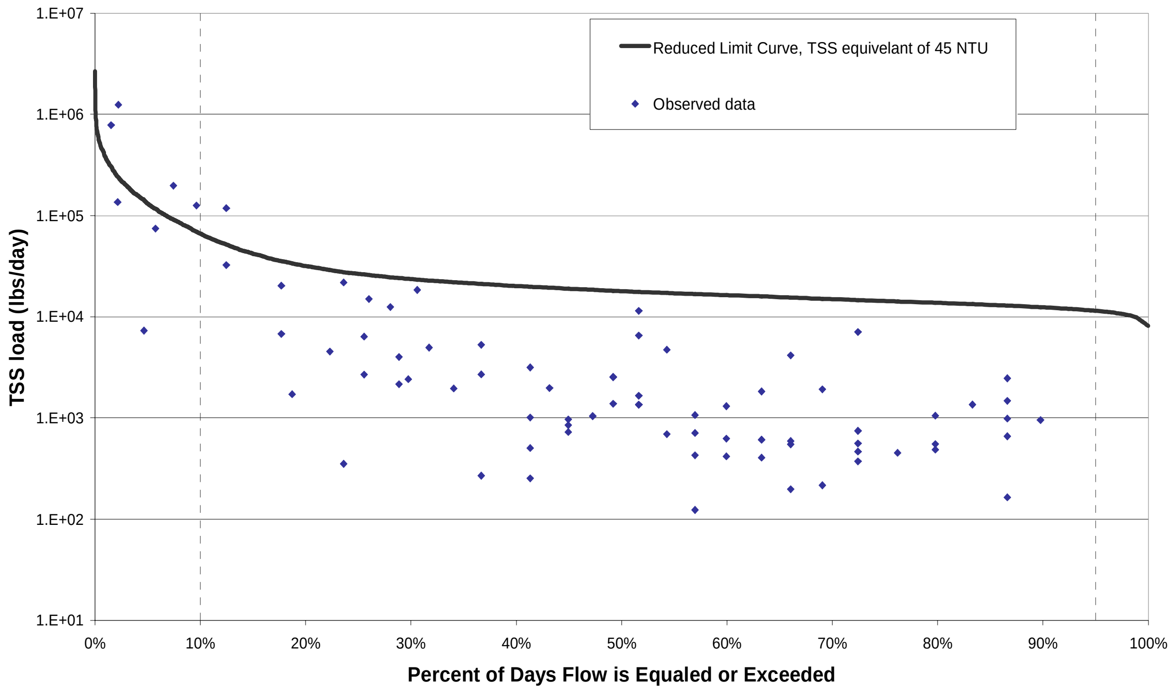
McAlpine Creek at Ambient Station C9370000 (1997-2004), and flow at USGS gage # 02146600 (1970-2004).



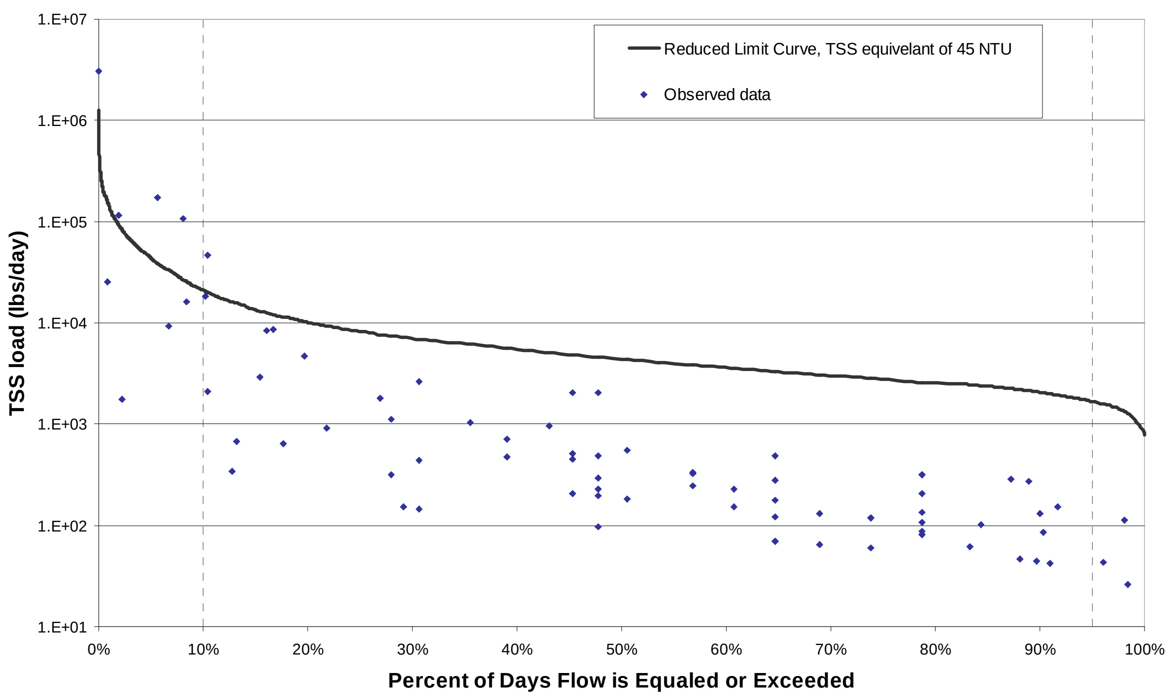
Sugar Creek at Ambient Station C9050000 (1997-2004), and estimated flow at 02146381using USGS gage #02146300 (1970-2004).



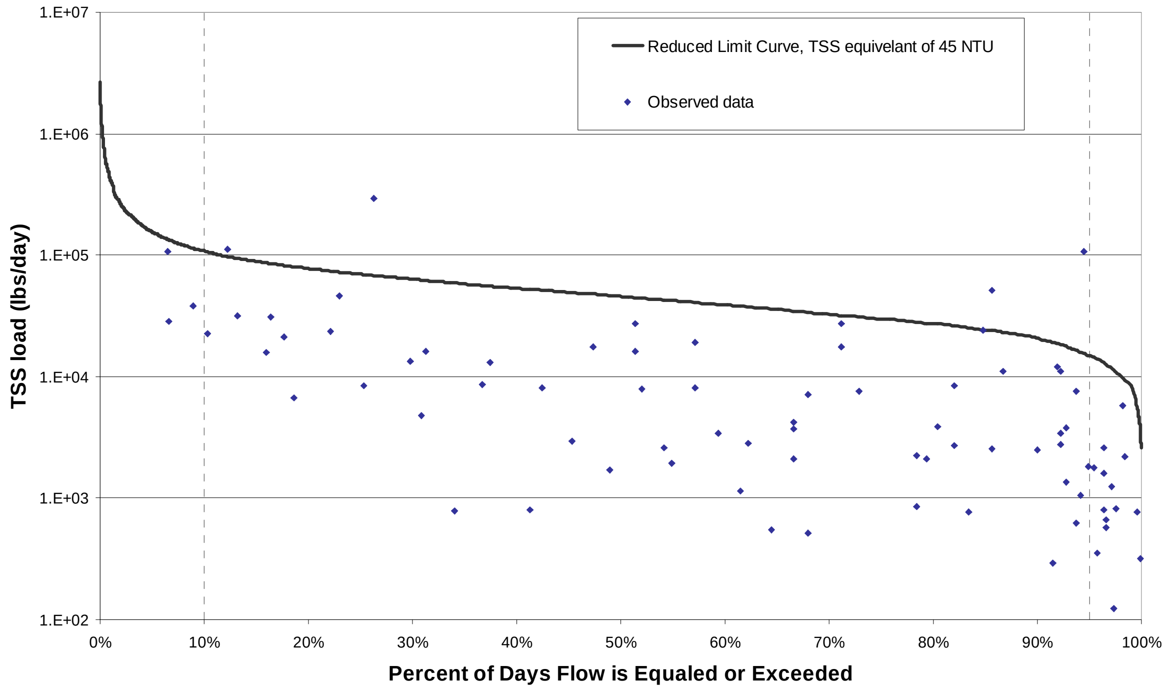
Little Sugar Creek at Ambient Station C9210000 (1997-2004), and estimated flow at 02146530 using USGS gage #02146507 (1970-2004).



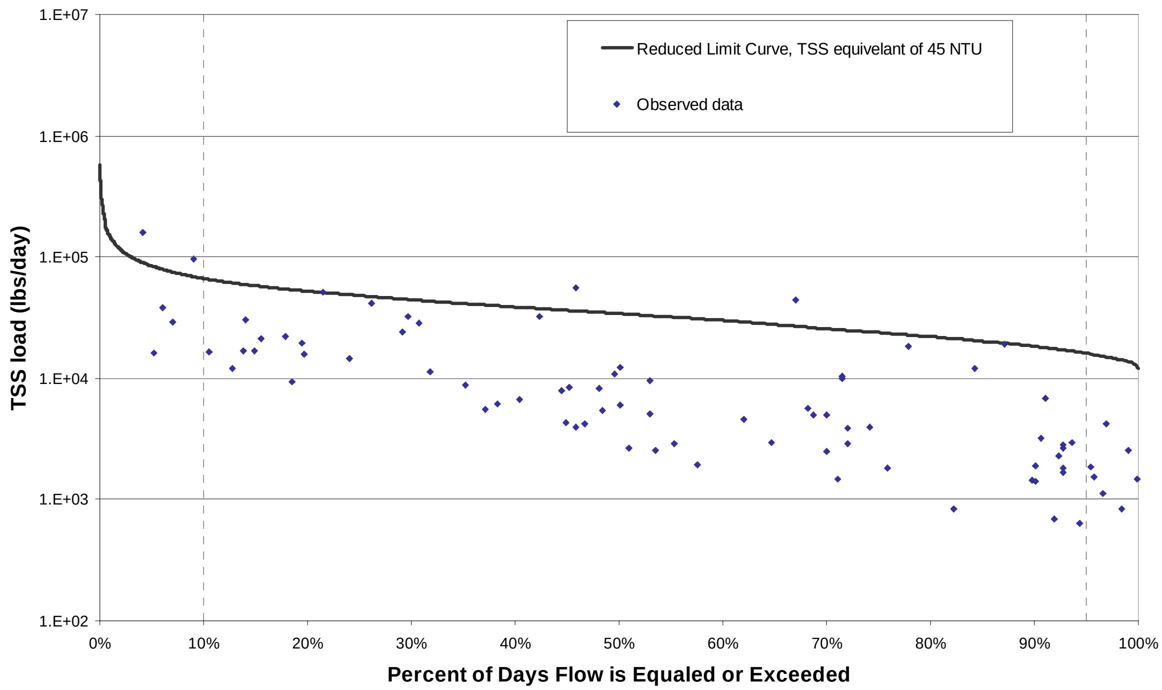
Irwin Creek at Ambient Station C8896500 (1997-2004), and flow using USGS gage #02146300 (1975-2004).



Henry Fork at Ambient Station C4360000 (1997-2004), and estimated flow at the ambient station (weighted by watershed size) using USGS gage # 02143000 (1970-2004).



Mud Creek at Ambient Station E2120000 (1997-2004), and using USGS gage # 03446000 (1970-2004).



Appendix E Data Sources used to develop the Long Creek TMDL.

The NCDENR's Geographic Information System (GIS) was used extensively to watershed characterization. The following is general information regarding the data used to describe the watershed:

- **Ambient chemical monitoring locations**: NC DENR Div of Water Quality, Water Quality Section, 9/30/2000, Ambient Water Quality Monitoring Sites: NC DENR Div of Water Quality, Water Quality Section, Raleigh, North Carolina.
- **Biological monitoring locations**: NC DENR Clean Water Management Trust Fund, NC DENR - Div. of Water Quality, Biological Assessment Unit, 11/15/2000, Benthic monitoring results: NC DENR - Div. of Water Quality, Biological Assessment Unit, Raleigh, North Carolina.
- **Urban area boundary**: NC Department of Transportation-GIS Unit, 2002, Municipal Boundaries - Powell Bill 1999: NC Department of Transportation, Raleigh, North Carolina.
- **County boundaries**: information NC Center for Geographic Information & Analysis, 12/01/1998, Boundaries - County (1:100,000): NC Center for Geographic Information & Analysis, Raleigh, North Carolina.
- **Detailed stream coverage**: North Carolina Center for Geographic Information and Analysis, 4/19/2001, Hydrography (1:24,000): North Carolina Center for Geographic Information and Analysis, Raleigh, NC.
- **Hydrologic Units**: USDA, Natural Resources Conservation Service, 12/01/1998, Hydrologic Units - North Carolina River Basins: USDA, Natural Resources Conservation Service, Raleigh, North Carolina.
- **Land use/Land cover information**: Earth Satellite Corporation (EarthSat), 6/12/1998, Statewide Land Cover - 1996: EarthSat, Raleigh, North Carolina.
- **NPDES Permitted Facilities**: NC DENR Division of Water Quality, Planning Branch, 10/11/2000, National Pollutant Discharge Elimination System Sites: NC DENR Division of Water Quality, Planning Branch, Raleigh, North Carolina.
- **Roads**: NC Department of Transportation - GIS Unit, 9/21/1999, Transportation - NCDOT Roads (1:24,000): NC Department of Transportation, Raleigh, NC.
- **Stream Gaging Stations**: NC DENR-Division of Water Resources, 12/01/1998, Stream Gaging Stations: NC DENR-Division of Water Resources, Raleigh, North Carolina.
- **Streamflow gage data** was obtained online from the United States Geological Survey (USGS) at: http://nc.water.usgs.gov/.

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Appendix F. NPDES permitted facilities within the Long Creek watershed.

Permit Number	Owner Name	Facility Description	Waterbody	Stream Index
NC0004839	ExxonMobil Refining and Supply Company	Kinder Morgan Southeast Terminals - Charlotte Terminal 2	Long Creek	11-120-(0.5)
NC0005185	Magellan Terminals Holdings L P	Charlotte II Terminal	Long Creek	11-120-(0.5)
NC0046213	Marathon Ashland Petroleum LLC	Charlotte Terminal	Long Creek	11-120-(0.5)
NC0046892	Motiva Enterprises LLC	Charlotte South Terminal	Long Creek	11-120-(0.5)
NC0086002	Livingstone Coating Corporation	Livingstone Coating Corporation	Long Creek	11-120-(2.5)
NCG080584	McKenzie Tank Lines Inc	McKenzie Tank Lines Inc - Charlotte	Long Creek	11-120-(0.5)
NCG080652	USF Holland Inc	USF Holland Inc - Charlotte	Long Creek	11-120-(0.5)
NCG140053	Concrete Supply Co	Concrete Supply Co-Croft Plt	Long Creek	11-120-(0.5)
NCS000037	Clariant Corporation	Mount Holly East (MHE) Facility	Long Creek	11-120-(0.5)
NCG020089	Ogelbay Norton Specialty Minerals	Oglebay Norton Spcty Minerals	Dixon Br	11-120-1
NCG030434	Torque Traction Int Tech Inc	Torque Traction Int Tech Inc	Dixon Br	11-120-1
NCG160169	Rea Contracting LLC	Rea Contracting LLC - North Mecklenburg Plant 078	Dixon Br	11-120-1
NC0021962	CITGO Petroleum Corporation	Paw Creek Terminal	Gum Br	11-120-5
NC0022187	Motiva Enterprises LLC	Paw Creek Terminal	Gum Br	11-120-5
NC0031038	Colonial Pipeline Company	Paw Creek Terminal	Gum Br	11-120-5
NC0032891	Kinder Morgan Southeast Terminals LLC	KMST Charlotte Terminal	Gum Br	11-120-5

List of individual permitted facilities including permit limits for TSS or turbidity in Long Creek watershed.

Permit Number	Facility Name	Flow Limit	Turbidity Limit (NTU)	Daily Max (TSS mg/L)
NC0004839	Kinder Morgan Southeast Terminals - Charlotte Terminal 2			45
NC0005185	Charlotte II Terminal			
NC0046213	Charlotte Terminal			45
NC0046892	Charlotte South Terminal			45
NC0086002	Livingstone Coating Corporation	0.0216		
NC0021962	CITGO Petroleum Corporation/ Paw Creek Terminal			45
NC0022187	Motiva Enterprises LLC/ Paw Creek Terminal			45
NC0031038	Colonial Pipeline Company/ Paw Creek Terminal			45
NC0032891	Kinder Morgan Southeast Terminals LLC/ KMST Charlotte Terminal		50	45

List of facilities with General Permits including permit limits for TSS or turbidity in Long Creek watershed.

Permit Number	Facility Name	Turbidity Limit (NTU)	TSS Daily Max (TSS mg/L)	Annual Max Measurement
NCG020089	Ogelbay Norton Specialty Minerals	50		100
NCG030434	Torque Traction Int Tech Inc			100
NCG160169	Rea Contracting LLC- North Mecklenburg Plant 078			100
NCG080584	McKenzie Tank Lines Inc - Charlotte			100
NCG080652	USF Holland Inc - Charlotte			100
NCG140053	Concrete Supply Co-Croft Plt		30	

Appendix G. Methodology for developing the Load Duration Curve

The load duration curve method is based on comparison of the frequency of a given flow event with its associated water quality load. In the case of applying the NTU criteria, a correlation is necessary between NTU and TSS to allow for calculation of a load in mass per time units. Data from the Long Creek ambient station (Station C4040000) was used in this TMDL resulted in the below equation:

TSS concentration (mg/L) = (0.2986* Turbidity (NTU) + 2.3061)
$R^2 = 0.60$

A LDC can be developed using the following steps:

1. Plot the Flow Duration Curve, Flow vs. % of days flow exceeded.
2. Develop TSS-turbidity correlation.
3. Translate turbidity values to equivalent TSS values using the linear regression equation from the correlation.
4. Translate the flow-duration curve into a LDC by multiplying the water quality standard (as equivalent TSS concentration), the flow and a units conversion factor; the result of this multiplication is the maximum allowable load associated with each flow.
5. Graph the LDC, maximum allowable load vs. percent of time flow is equaled or exceeded.
6. Water quality samples, expressed as estimated TSS values, are converted to loads (sample water quality data multiplied by daily flow on the date of sample).
7. Plot the measured loads on the LDC

Appendix H. Development of Regression Equation

Results of the regression analysis of total suspended solids load on flow frequency, Long Creek TSS and turbidity data, 1997-2004 are summarized below.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.794845
R Square	0.631778
Adjusted R Square	0.626199
Standard Error	0.861016
Observations	68

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	83.95031	83.95031	113.2399	5.86E-16
Residual	66	48.92905	0.741349		
Total	67	132.8794			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	7.671917	0.262339	29.24431	1.69E-39	7.148141	8.195693
X Variable 1	-4.54411	0.427021	-10.6414	5.86E-16	-5.39668	-3.69154

The method requires the estimation of a prediction interval about the regression line. In addition, because the regression is in log space, the bias inherent in conversion from log space to arithmetic space must be addressed.

The regression equation yields a minimum variance unbiased estimate of the local mean value, μ_0 of the natural logarithms of load, conditional on a corresponding value of the independent variable, x_0, (expressed as the deviation from the mean of all observed x values), in this case representing the flow fraction:

$$\mu_0 = \beta_0 + \beta_1 \cdot x_0 + \varepsilon \,,$$

where ε is a random disturbance term. The desired confidence limit (in log space) is given by the prediction interval estimate for an individual realization y_0 with mean μ_0. This interval addresses both the uncertainty in estimating the mean and the variability of individual observations about the mean and is given by

$$y_0 = \mu_0 \pm t_{\alpha, n-2} \cdot s_y \cdot \sqrt{\frac{1}{n} + \frac{x_0^{\;2}}{\sum x_i^{\;2}} + 1} \,,$$

where s_y is the sample standard deviation of the *y* values, and $t_{\alpha,\ n\text{-}2}$ is the Student's *t* statistic with tail area α and *n*-2 degrees of freedom. For a two-tailed 90 percent confidence interval, α = 0.05.

Conversion from logarithmic to arithmetic space introduces a bias, as the transform is not symmetrical. The exact minimum variance unbiased estimator of the arithmetic mean from the logarithmic mean does not have a closed-form solution, but, for large samples, is closely approximated by (Gilbert, 1987):

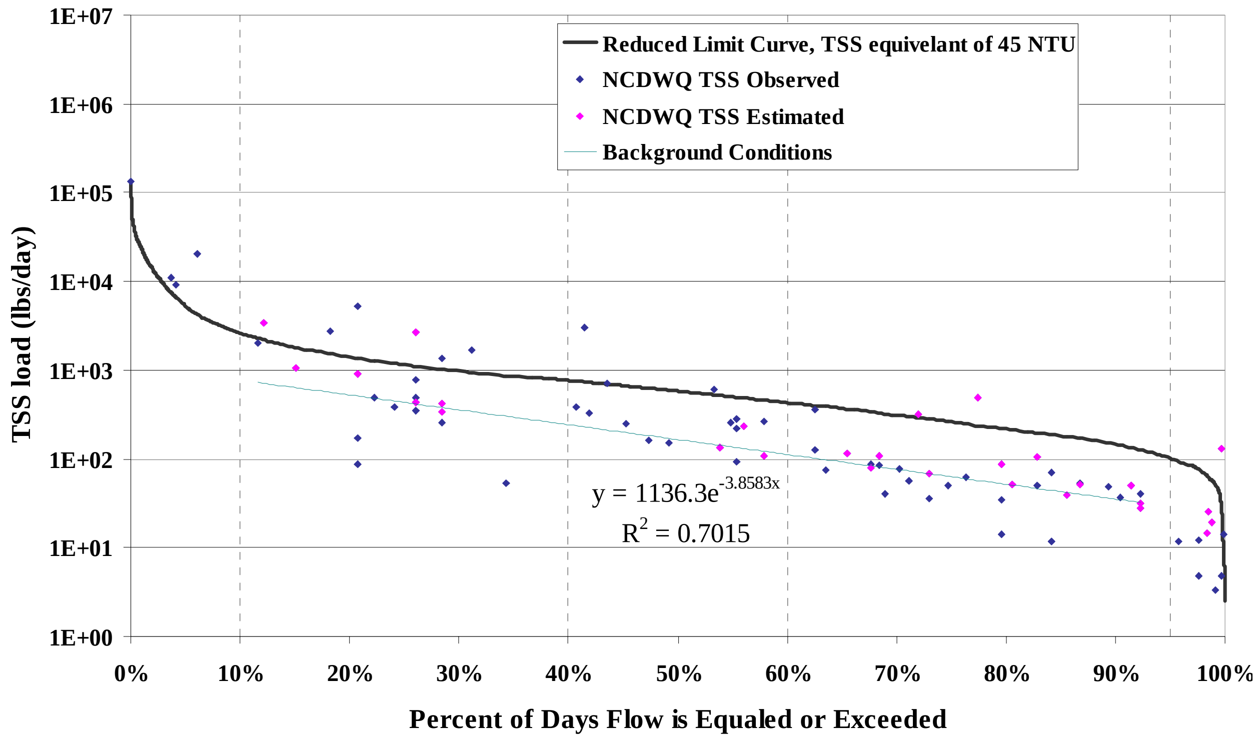
$$w_0 = e^{\left(y_0 + {s_{y0}}^2 / 2\right)},$$

where w_0 is the estimator in arithmetic space and ${s_{y0}}^2$ is the local variance about the mean line, or

$$s_{y0} = s_y \cdot \sqrt{\frac{1}{n} + \frac{{x_0}^2}{\sum {x_i}^2}}\ .$$

Explanation taken from NCDENR, 2004c.

Appendix I. Background TSS conditions in Long Creek as a function of percent of flow exceedence.



Appendix J. Public Notification of Public Review Draft of Long Creek Turbidity TMDL.

Long Creek, Catawba River Basin

Now Available Upon Request

Long Creek Turbidity Total Maximum Daily Load

Is now available upon request from the North Carolina Division of Water Quality. This TMDL study was prepared as a requirement of the Federal Water Pollution Control Act, Section 303(d). The study identifies the sources of pollution, determines allowable loads to the surface waters, and suggests allocations for turbidity.

TO OBTAIN A FREE COPY OF THE TMDL REPORT:

Please contact Mr. Brian Jacobson (919) 733-5083, extension 552 or write to:

Mr. Brian Jacobson
Water Quality Planning Branch
NC Division of Water Quality
1617 Mail Service Center
Raleigh, NC 27699-1617

Interested parties are invited to comment on the draft TMDL study by **December 17, 2004**. Comments concerning the reports should be directed to Mr. Brian Jacobson at the above address. The draft TMDL is also located on the following website: http://h2o.enr.state.nc.us/tmdl

PUBLIC NOTICE
State of North Carolina
Division of Water Quality

Availability of Total Maximum Daily Loads (TMDLs) for Turbidity in Long Creek, McAlpine Creek, Sugar Creek, Little Sugar Creek, Irwin Creek, Henry Fork, and Mud Creek in North Carolina.

Copies of the TMDL may be obtained by calling Mr. Brian Jacobson at (919) 733-5083, ext. 552, or on the internet at http://h2o.enr.state.nc.us/tmdl/. Written comments regarding the TMDL will be accepted until December 17, 2004. Please mail comments to Mrs. Brian Jacobson, Water Quality Planning Branch, NC Division of Water Quality, 1617 Mail Service Center, Raleigh, NC 27699-1617.

November 24, 2004
(0420)

AFFIDAVIT OF PUBLICATION

BUNCOMBE COUNTY
SS.
NORTH CAROLINA

Before the undersigned, a Notary Public of said County and State, duly commissioned, qualified and authorized by law to administer oaths, personally appeared **Darryl Rhymes,** who, being first duly sworn, deposes and says: that he is the **Legal Billing Clerk** of **The Asheville Citizen-Times,** engaged in publication of a newspaper known as **The Asheville Citizen-Times**, published, issued, and entered as second class mail in the City of Asheville, in said County and State; that he is authorized to make this affidavit and sworn statement; that the notice or other legal advertisement, a true copy of which is attached hereto, was published in **The Asheville Citizen-Times** on the following date: November 24th 2004 said newspaper in which said notice, paper, document or legal advertisement were published were, at the time of each and every publication, a newspaper meeting all of the requirements and qualifications of Section 1-597 of the General Statues of North Carolina and was a qualified newspaper within the meaning of Section 1-597 of the General Statues of North Carolina.

Signed this 26th day of November 2004

(Signature of person making affidavit)

Sworn to and subscribed before me the 26th day of November 2004

(Notary Public)
My Commission expires the 3rd day of September 2008.

KATRINA JOYE PETREY
NOTARY
PUBLIC
BUNCOMBE CO., N.C.

The Knight Publishing Co., Inc.
Charlotte, NC
Affidavit of Publication

North Carolina } ss
Mecklenburg County}

THE CHARLOTTE OBSERVER

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REFERENCE: 30045571
5296668 Public Notice

Before the undersigned, a Notary Public of said County and State, duly authorized to administer oaths affirmations, etc., personally appeared, being duly sworn or affirmed according to law, doth depose and say that he/she is a representative of the Knight Publishing Company a corporation organized and doing business under the laws of the State of Delaware, and publishing a newspaper known as The Charlotte Observer in the city of Charlotte, County of Mecklenburg and State of North Carolina and that as such he/she is familiar with the books, records, files and business of said Corporation and by reference to the files of said publication the attached advertisement was inserted. The following is correctly copied from the books and files of the aforesaid Corporation and Publication.

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Division of Water Quality

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NAME: Kendra J. McCorkle TITLE: Accounting Specialist
DATE: NOV 2 3 2004

In Testimony Whereof I have hereunto set my hand and affixed my seal, the day and year aforesaid.

Notary: Judith M. Sears My Commission Expires: __/__/__

My Commission Expires May 17, 2006

Appendix K. Responsiveness Summary to TMDL Report Comments.

Responsiveness Summary for "Total Maximum Daily Loads (TMDLs) for Turbidity in Long Creek, McAlpine Creek, Sugar Creek, Little Sugar Creek, Irwin Creek, Henry Fork, and Mud Creek in North Carolina"

NC Division of Water Quality
January 6, 2005

Comments from specified organizations are in italics as they appear in the delivered documents. DWQ's response follows in plain text.

COMMENT: *Will there be a public meeting for the Draft Catawba French Broad Basin TMDL report after the comment period? (Bob Holman, Environmental Operations Engineer, North Carolina Department of Transportation, Division of Highways, Environmental Operations Section)*

RESPONSE: No. The Division of Water Quality is not conducting public meetings in TMDL watersheds of the size and scope of Long Creek.

COMMENT: *The NC Department of Transportation appreciates the opportunity to review and comment on the draft Turbidity TMDLs for the subject streams in the Catawba and French Broad River basins. The protection of surface water quality is a very important component of our department's mission to provide our citizens with safe transportation facilities in an environmentally responsible manner.*

Since 1974 the Department has implemented a delegated Erosion and Sediment Control Program. We continually strive to improve this program through comprehensive water quality monitoring and the implementation of proven erosion control BMPs. The Department invests in an ongoing research program to develop innovative erosion control BMPs in partnership with local governments, such as Mecklenburg County, and leading university researchers.

Attached is a brief summary of some of the innovative erosion control activities we are implementing within the Long Creek TMDL watershed and in other locations across the state. We respectively request that this summary be included within Section 6.0 Implementation of the TMDL report.

The NCDOT began implementation of a delegated Erosion and Sediment Control Program in 1974. The program continually strives to improve its effectiveness through water quality monitoring, research, and the development of innovative erosion control BMPs. Presently, the program is evaluating the water quality impact of road construction in the Catawba River Basin through three related projects. The first project involves detailed water quality monitoring of the Long Creek Watershed, the second is evaluating various methods to reduce erosion and off-site sediment movement, and the *third addresses sediment loading from secondary road construction activities. The first two projects are being conducted in Mecklenburg County and the third project noted is located in Burke County.*

In conjunction with Mecklenburg County's S.W.I.M Program, the first project is collecting detailed water quality data at 15 locations along a portion of Long Creek. These data are being collected in 15 minutes intervals to determine in "real time" if selected water quality parameters, with an emphasis on turbidity, are being violated. If a problem is detected, the monitoring system includes the capability to send alerts to Mecklenburg County's Water Quality Program and the NCDOT, such that staff can quickly respond to determine and correct the source of the water quality violation. The project has been in place for almost two years with onsite management provided by Mecklenburg County.

The second project is comparing the effectiveness of various innovative erosion control systems which include the use of polyacrylamides, rolled erosion control products, and bonded fiber matrix hydromulching. Testing of these BMPs is taking place on a segment of the Charlotte I-485 Outer Loop. These systems are being installed, evaluated, and modified if needed to improve their effectiveness. The project has been active for over a year and is directed by Drs. Richard McLaughlin and Greg Jennings of North Carolina State University.

The third project is on a secondary road bridge construction project in Burke County. Single stage samplers have been installed up and downstream to monitor pre, during, and post construction TSS and turbidity (NTU) levels. A crest gage has been installed to monitor stream stage levels to develop a stage/discharge relationship. Sediment loading values have been developed thus far for the pre-construction phase. Dr. Garry Grabow with North Carolina State University has provided general project oversight. The NCDOT has approximately 30 other sites across the state also under similar investigation. (Don Lee, Chief, Roadside Environmental Unit, North Carolina Department of Transportation)

RESPONSE: DWQ appreciates the additional information on water quality improvement projects and BMP implementation. This information will be included in Section 6.0 as requested.

COMMENT: *The City of Charlotte, Storm Water Services Division has obtained and reviewed the draft Turbidity TMDL dated November 2004 for creeks in Charlotte and Mecklenburg County. We have the following comments on the draft report.*

Pages 33 and 34 of the report reference the responsible agency and jurisdiction regarding addressing water quality impairments in Mecklenburg County.

- *The City of Charlotte is the responsible jurisdiction for streams within the City's jurisdiction. This jurisdiction encompasses 70% of Mecklenburg County and* *includes the City's Extra-Territorial Jurisdiction (ETJ). Certain programs to address water quality impairments are conducted in partnership with Mecklenburg County. However, the City's water quality program, roles, initiatives, and responsibility level is separate from that of Mecklenburg County.*

- *The City of Charlotte, not Mecklenburg County, is the responsible agency for the sediment and erosion control program throughout the City and its ETJ. Although the City and County programs are similar, questions about the City's sediment and erosion control program and related initiatives should be directed to Dave Weekly of the Charlotte Land Development Services Division.*

- *The draft report states that the City of Charlotte was contacted regarding the Long Creek Turbidity TMDL. No staff person of the City has been coordinated-with or contacted regarding this report or of the development of this TMDL. It is important that every effort be made by the Division of Water Quality to notify and coordinate with the appropriate City of Charlotte staff member regarding the development of any TMDL or other related regulatory activities affecting streams in the City's jurisdiction and ETJ. (Daryl Hammock, PE, Water Quality Program Manager, City of Charlotte, Storm Water Services)*

RESPONSE: Pages 34 and 35 have been changed to reflect the comments outlined by the City of Charlotte. It is the desire of the Division of Water Quality to work closely with all local and state agencies responsible in managing water quality to address such issues as outlined in the TMDL Report. The City of Charlotte is correct; future efforts to coordinate will be improved.

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