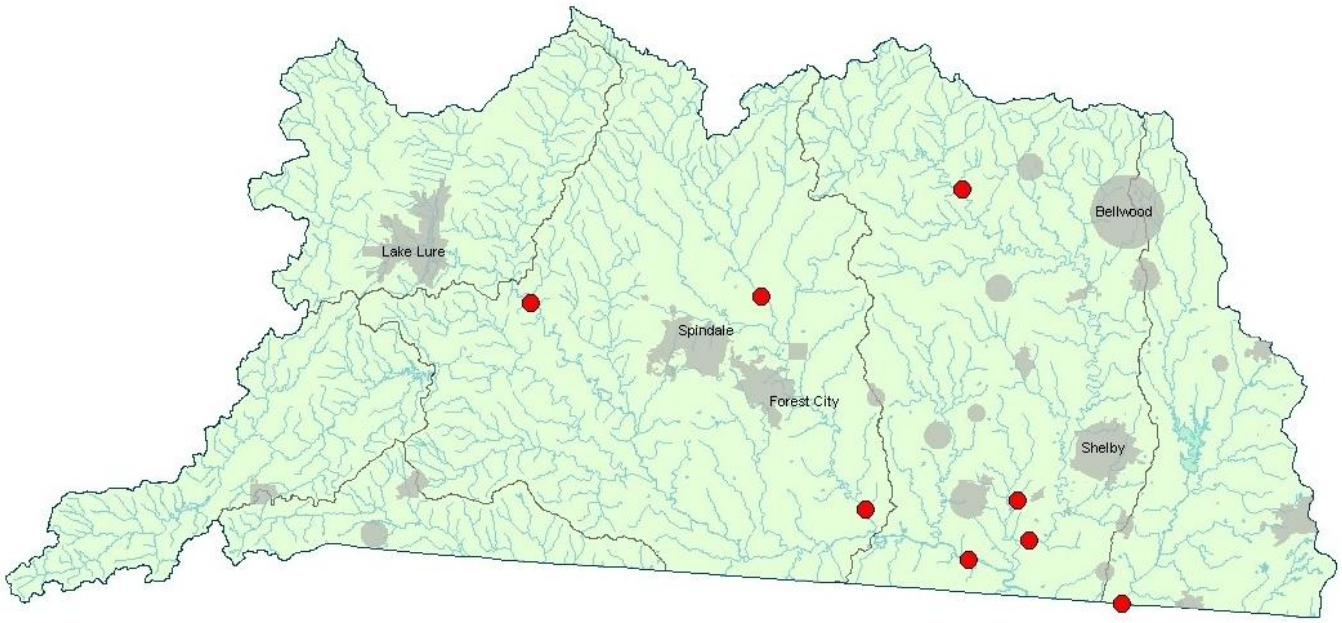
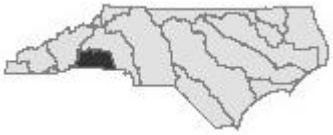


Broad River Basin
Ambient Monitoring System Report

January 1, 2006 through December 31, 2010



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Evaluation Levels

In order to assist the reader in developing a rapid understanding of the summary statistics provided throughout this data review, concentrations of water quality variables may be compared to an Evaluation Level (EL). Evaluation levels may be a water quality standard, an action level, an ecological threshold, or simply an arbitrary threshold that facilitates a rapid data review. Evaluation levels are further examined for frequency to determine if they have been exceeded in more than 10 percent of the observed samples. This summary approach facilitates a rapid and straightforward presentation of the data but may not be appropriate for making specific use support decisions necessary for identification of impaired waters under the Clean Water Act's requirements for 303(d) listings. The reader is advised to review the state's 303(d) listing methodology for this purpose (http://portal.ncdenr.org/web/wq/ps/mtu/assessment).

TABLES

FIGURES

APPENDICES

ACRONYMS

°C – degrees Celsius
colonies/100 mL – colonies [of bacteria] per 100 milliliters
AMS – Ambient Monitoring System
DO – dissolved oxygen
DWQ – Division of Water Quality
EL – evaluation level
EPA – Environmental Protection Agency
HUC – hydrologic unit code
mg/L – milligrams per liter
N – nitrogen
NC – North Carolina
NCAC – North Carolina Administrative Code
NCRWQP – North Carolina Recreational Water Quality Program
NTU – nephelometric turbidity units
RAMS – Random Ambient Monitoring System
SOP – standard operating procedure
SR – State Road
SSE – statistically significant exceedance
SU – standard units
TMDL – total maximum daily load
µg/L – micrograms per liter
µmhos/cm – micro-ohms per centimeter (equivalent to µS/cm, microsiemens per centimeter)
US – United States
µS/cm – microsiemens per centimeter (equivalent to µmhos/cm, micro-ohms per centimeter)
USGS – United States Geological Survey

EXECUTIVE SUMMARY

A general understanding of human activities and natural forces that affect pollution loads and their potential impacts on water quality can be obtained through routine sampling from fixed water quality monitoring stations. During this assessment period (January 1, 2006 through December 31, 2010) chemical and physical measurements were obtained by the NC Division of Water Quality (DWQ) from eight stations located throughout the Broad River Basin.

The DWQ uses a ten percent criterion to determine whether a water body is meeting applicable water quality standards (NC Division of Water Quality, 2010). The water quality evaluation level (EL) for a given parameter may be an ecological evaluation level, a narrative or numeric standard, or an action level as specified in 15A NCAC 2B .0200. If more than 10% of the monitoring results exceed the EL in question then the water body is not meeting the standard. In order to evaluate water quality results, a minimum of 10 observations is desired.

For this report, if at least 10 results per parameter were collected for a given site, the results were compared to water quality evaluation levels. If less than 10 results were collected, then no comparison to evaluation levels was made. When more than 10 percent of the results exceeded the EL, a binomial statistical test was employed to determine the level of statistical confidence associated with the conclusion that the results truly exceeded the 10% criterion. If at least 95% confidence was found that a 10% exceedance occurred, then that was termed a statistically significant exceedance (SSE). This criterion was applied to all parameters with an evaluation level, except for fecal coliform bacteria. The criteria for fecal coliform varied based on the classification of the water body. See the Parameters section for an explanation of fecal coliform methods. The results of the data analysis are displayed in tables and maps. For complete summaries on each station, reference the AMS Station Summary Sheets located in Appendix A.

All data were collected between January 1, 2006 and December 31, 2010. Stations with SSEs were found for pH < 6 SU (two sites). Ten percent exceedances that were not statistically significant also occurred for dissolved oxygen (< 4 mg/L), dissolved oxygen (< 5 mg/L), and temperature (> 29 °C in mountain and upper piedmont waters) at one station each. Fecal coliform screening values exceeded target levels (> 400 colonies/100 mL in > 20% of results, or geometric mean > 200 colonies/100 mL) at one station. Among the eight stations in the basin, A6450000 on Sugar Branch had the most exceedances and parameters of concern.

The following table gives a summary of the problem areas identified by using these criteria (Table 1). While reading the table, please note the following: The majority of the parameters listed are compared directly to water quality standards. There are two exceptions, however. The fecal coliform standard requires that 5 samples be taken in the span of 30 days, which was not done for this data. Therefore any fecal coliform violations should be taken as a recommendation to collect the data required by the standard. The second exception is the dissolved oxygen (< 5 mg/l) standard which applies to all waters, but specifically to fresh waters as a daily average. The 4 mg/L standard applies to fresh waters only as an instantaneous minimum value.

Table 1. Areas of Concern in the Broad River Basin

8-Digit HUC/ Station ID	Location	Class	Parameter/Evaluation Level	% Exceedance	% Confidence
03050105	**Upper Broad River Hydrologic Unit (part of the Santee River Basin of North and South Carolina)**				
A4700000	Broad River at NC 150 near Boiling Springs	WS-IV	Temperature (>29°C)	16.7	92.7
A4800000	First Broad River at SR 1530 near Casar	WS-V Tr	pH (<6 SU)	20.0	98.5
A6450000	Sugar Branch at NC 150 near Boiling Springs	C	Dissolved Oxygen (<4 mg/L)	10.7	50.7
			Dissolved Oxygen (<5 mg/L)	14.3	80.7
			pH (<6 SU)	22.0	99.5
			Fecal coliform (>400 colonies/100 mL)[1]	32.2	98.2
			Fecal coliform (geomean >200/100 mL)[1]	geomean = 222.4	

Notes:

[1]Fecal coliform results presented here are screening values, rather than EL exceedances, which may warrant further monitoring. See Parameters section for details on bacteriological standards and analyses.

INTRODUCTION

The DWQ's Ambient Monitoring System is a network of stream, lake, and estuarine stations strategically located for the collection of physical and chemical water quality data. The stations are located at convenient access points (e.g. bridge crossings) that are sampled on a monthly basis. These locations were chosen to characterize the effects of point source dischargers and nonpoint sources such as agriculture, animal operations and urbanization within watersheds.

The data are used to identify long term trends within watersheds, to develop Total Maximum Daily Loads (TMDLs) and to compare measured values with water quality standards to identify possible areas of impairment. Parameters of interest are determined by freshwater or saltwater waterbody classification and corresponding water quality standards. Under this arrangement, core parameters are based on Class C waters with additional parameters added when justified (Table 2).

Within this document, an analysis of how monitoring results compare with water quality standards and evaluation levels is presented. An educational and conceptual overview of water quality standards is provided at: http://www.epa.gov/waterscience/standards. Specific information on North Carolina water quality standards is provided at: http://portal.ncdenr.org/web/wq/ps/csu. A summary of selected water quality standards are listed in Table 3.

Water quality data are evaluated in five year periods. Some stations have little or no data for one or more parameters over the period. However, for the purpose of standardization, data summaries for each station are included in this report. The DWQ monitored water quality and collected samples at eight stations throughout the basin. The locations of the sampling sites are illustrated in Figure 1 and listed in Table 4.

In January 2007 the DWQ began collection of samples from a series of randomly determined sites. A description of the Random Ambient Monitoring System (RAMS) can be found here: http://portal.ncdenr.org/web/wq/ess/eco/rams. There is currently one RAMS site in the Broad River Basin which is being sampled during 2011 and 2012. Because the basinwide reports assess in five-year windows and RAMS stations will only have two years of data, they are not included in the ambient reports. Once a sufficient number of samples have been collected statewide, RAMS data will be discussed in a separate report.

Table 2. Parameters collected for the Ambient Monitoring System

Parameter
Dissolved oxygen (s)
pH (s)
Specific conductance
Temperature (s)
Total suspended solids
Turbidity (s)
Fecal coliform bacteria (s)
Nutrients (phosphorus and nitrogen species):
- Total phosphorus
- Ammonia as N
- Total Kjeldahl as N
- Nitrate+nitrite as N (s)
Chlorophyll *a* (s)

Notes:
An 's' indicates the parameter has a numeric standard.
Chlorophyll *a* and nutrient sampling are only done in areas of concern, such as NSW, estuaries, lakes, and areas with known enrichment issues.

Table 3. Selected Water Quality Standards[1]

	Standards for All Freshwater			Standards to Support Additional Uses		
Parameter	Aquatic Life	Human Health	Water Supply Classifications	Trout Water	HQW	Swamp Waters
Chloride (mg/L)	230		250			
Chlorophyll *a* (µg/L)	40[2]			15[2]		
Coliform, total (MFTCC/100 mL)[3]			50[2] (WS-I only)			
Coliform, fecal (MFFCC/100 mL)[4]		200[2]				
Dissolved oxygen (mg/L)	4.0[5,6]			6.0		[2, 6]
Hardness, total (mg/L)			100			
Nitrate nitrogen (mg/L)			10			
pH (standard units)	6.0 - 9.0[2, 6]					[2, 6]
Solids, total suspended (mg/L)					10 Trout, 20 other[7]	
Turbidity (NTU)	50, 25[2]			10[2]		

Notes:
[1]Standards apply to all classifications. For the protection of water supply and supplemental classifications, standards listed under Standards to Support Additional Uses should be used unless standards for aquatic life or human health are listed and are more stringent. Standards are the same for all water supply classifications (Administrative Code 15A NCAC 2B 0200, eff. May 1, 2007).
[2]Refer to 2B.0211 for narrative description of limits.
[3]Membrane filter total coliform count per 100 ml of sample.
[4]Membrane filter fecal coliform count per 100 ml of sample.
[5]An instantaneous reading may be as low as 4.0 mg/L, but the daily average must be 5.0 mg/L or more.
[6]Designated swamp waters may have a dissolved oxygen less than 5.0 mg/L and a pH as low as 4.3, if due to natural conditions.
[7]For effluent limits only, refer to 2B.0224(1)(b)(ii).

Table 4. DWQ Monitoring stations in the Broad River Basin, 2006 - 2010

8-Digit HUC/ Station ID	Location	Class	Latitude	Longitude
03050105	**Upper Broad River Hydrologic Unit (part of the Santee River Basin of North and South Carolina)**			
A1520000	Broad River at SR 1181 near Rock Springs	C	35.39366	-82.09476
A2700000	Second Broad River at SR 1538 near Logan	WS-IV	35.40424	-81.87201
A4400000	Second Broad River at US 221 Alt at Cliffside	WS-IV	35.23872	-81.76667
A4700000	Broad River at NC 150 near Boiling Springs	WS-IV	35.20131	-81.66553
A4800000	First Broad River at SR 1530 near Casar	WS-V Tr	35.49331	-81.68133
A6400000	First Broad River at SR 1140 near Earl	C	35.21776	-81.60773
A6450000	Sugar Branch at NC 150 near Boiling Springs	C	35.24938	-81.62025
A8600000	Buffalo Creek at NC 198 near Grover	C	35.17076	-81.51679

Notes:

Primary Water Use Classifications

C: Aquatic Life

B: Primary Recreation

WS-I, WS-II, WS-III, WS-IV, WS-V: Water Supply

SA: Saltwater Shellfish Harvesting

SB: Saltwater Primary Recreation

SC: Saltwater Aquatic Life

Secondary Water Use Classifications

Sw: Swamp Water

HQW: High Quality Water

ORW: Outstanding Resource Water

Tr: Trout Waters

CA, +: Critical Area

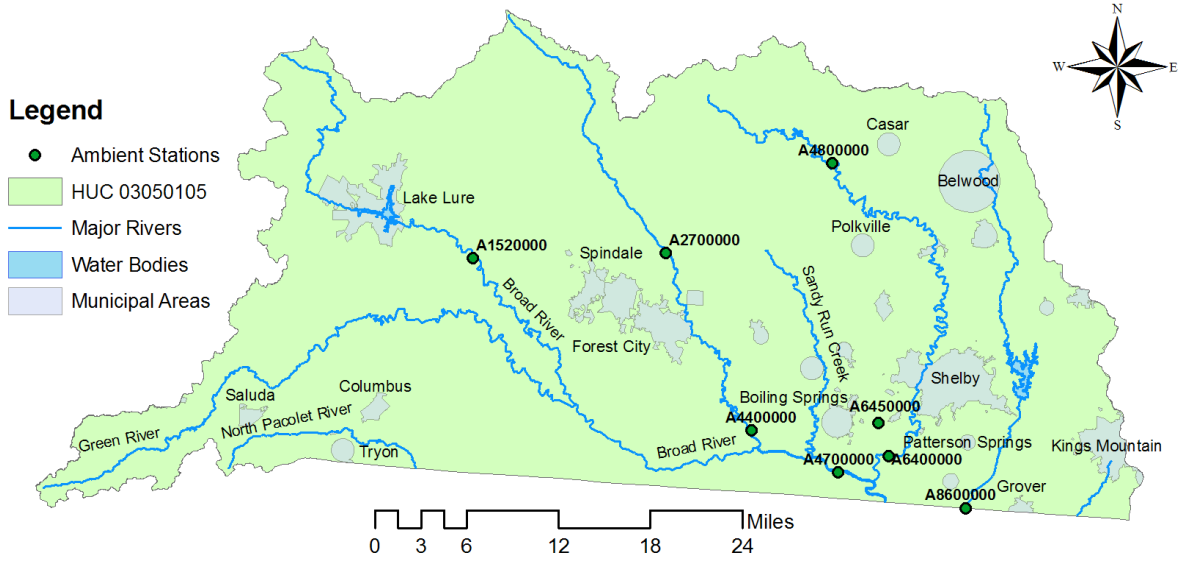

Figure 1. DWQ's Ambient Monitoring System in the Broad River Basin

DATA ASSESSMENT AND INTERPRETATION

Monitoring and sampling results considered in this report represent samples collected or measurements taken at less than one-meter depth. The AMS raw data are available online from the US Environmental Protection Agency's Storage and Retrieval (STORET) Data Warehouse. Links to STORET and instructions for accessing STORET data are provided on the AMS website at http://portal.ncdenr.org/web/wq/ess/eco/ams.

Percentile statistics were calculated for most of the data using JMP statistical software (version 8.0.2; SAS Institute, Cary, NC). Values less than the minimum reporting level (non-detects) were evaluated as equal to the reporting level.

Providing Confidence in the Exceedances of Water Quality Standards

Historically, the DWQ has used guidance provided by the US Environmental Protection Agency (EPA) for determining when the number of results that exceed a water quality standard indicate potential water quality issues (US Environmental Protection Agency, 1997). The EPA has suggested that management actions be implemented when 10 percent of the results exceeded a water quality standard. This interpretation is the same whether 1 out of 10, 5 out of 50, or 25 out of 250 results exceed a standard. Evaluating exceedances in this manner is termed the "raw-score" approach. Although this "10 percent exceedance criterion" defines a point where potential water quality issues may be present, it does not consider uncertainty. Some results are subject to chance or other factors such as calibration errors or sample mishandling. Uncertainty levels change with sample size: the smaller the sample size, the greater the uncertainty. Therefore, applying the raw-score approach to small sample sizes could result in an impairment listing of a stream that is not really impaired.

This document uses a nonparametric procedure (Lin *et al.,* 2000) to identify when a sufficient number of exceedances have occurred that indicate a true exceedance probability of 10 percent. Calculating the minimum number of exceedances needed for a particular sample size was done using the BINOMDIST function in Microsoft Excel®. This statistical function suggests that at least three exceedances need to be observed in a sample of 10 in order to be [about] 95 percent confident that the results statistically exceed the water quality standard more than 10% of the time. For example, there is less statistical confidence associated with 1 exceedance out of 10 (35 percent confidence) than when there are 3 exceedances out of 10 (93 percent confidence) (Table 5).

Table 5. Exceedance Confidence

Number of Samples	Number of Exceedances																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
10	35%	74%	93%	99%	100%	100%	100%	100%	100%	100%	100%							
12	28%	66%	89%	97%	100%	100%	100%	100%	100%	100%	100%	100%						
14	23%	58%	84%	96%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%				
16	19%	51%	79%	93%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
18	15%	45%	73%	90%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20	12%	39%	68%	87%	96%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22	10%	34%	62%	83%	94%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24	8%	29%	56%	79%	91%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26	6%	25%	51%	74%	89%	96%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
28	5%	22%	46%	69%	86%	94%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
30	4%	18%	41%	65%	82%	93%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
32	3%	16%	37%	60%	79%	91%	96%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
34	3%	13%	33%	55%	75%	88%	95%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%
36	2%	11%	29%	51%	71%	85%	94%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%
38	2%	10%	25%	46%	67%	83%	92%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%
40	1%	8%	22%	42%	63%	79%	90%	96%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%
42	1%	7%	20%	38%	59%	76%	88%	95%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%
44	1%	6%	17%	35%	55%	73%	85%	93%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%
46	1%	5%	15%	31%	51%	69%	83%	92%	96%	99%	100%	100%	100%	100%	100%	100%	100%	100%
48	1%	4%	13%	28%	47%	65%	80%	90%	95%	98%	99%	100%	100%	100%	100%	100%	100%	100%
50	1%	3%	11%	25%	43%	62%	77%	88%	94%	98%	99%	100%	100%	100%	100%	100%	100%	100%
52	0%	3%	10%	22%	40%	58%	74%	86%	93%	97%	99%	100%	100%	100%	100%	100%	100%	100%
54	0%	2%	8%	20%	36%	54%	71%	83%	91%	96%	98%	99%	100%	100%	100%	100%	100%	100%
56	0%	2%	7%	18%	33%	51%	67%	81%	90%	95%	98%	99%	100%	100%	100%	100%	100%	100%
58	0%	2%	6%	16%	30%	47%	64%	78%	88%	94%	97%	99%	100%	100%	100%	100%	100%	100%
60	0%	1%	5%	14%	27%	44%	61%	75%	86%	93%	97%	99%	99%	100%	100%	100%	100%	100%
62	0%	1%	5%	12%	24%	40%	57%	72%	84%	91%	96%	98%	99%	100%	100%	100%	100%	100%
64	0%	1%	4%	11%	22%	37%	54%	69%	81%	90%	95%	98%	99%	100%	100%	100%	100%	100%
66	0%	1%	3%	9%	20%	34%	51%	66%	79%	88%	94%	97%	99%	99%	100%	100%	100%	100%
68	0%	1%	3%	8%	18%	31%	47%	63%	76%	86%	93%	96%	98%	99%	100%	100%	100%	100%
70	0%	1%	2%	7%	16%	29%	44%	60%	74%	84%	91%	96%	98%	99%	100%	100%	100%	100%
72	0%	0%	2%	6%	14%	26%	41%	57%	71%	82%	90%	95%	97%	99%	100%	100%	100%	100%
74	0%	0%	2%	5%	13%	24%	38%	54%	68%	80%	88%	94%	97%	99%	99%	100%	100%	100%
76	0%	0%	1%	5%	11%	22%	35%	51%	65%	77%	86%	93%	96%	98%	99%	100%	100%	100%
78	0%	0%	1%	4%	10%	20%	33%	48%	62%	75%	85%	91%	95%	98%	99%	100%	100%	100%
80	0%	0%	1%	4%	9%	18%	30%	45%	59%	72%	83%	90%	95%	97%	99%	99%	100%	100%
82	0%	0%	1%	3%	8%	16%	28%	42%	56%	70%	81%	88%	94%	97%	98%	99%	100%	100%
84	0%	0%	1%	3%	7%	14%	25%	39%	53%	67%	78%	87%	93%	96%	98%	99%	100%	100%
86	0%	0%	1%	2%	6%	13%	23%	36%	51%	64%	76%	85%	91%	95%	98%	99%	100%	100%
88	0%	0%	1%	2%	5%	12%	21%	34%	48%	62%	74%	83%	90%	95%	97%	99%	99%	100%
90	0%	0%	0%	2%	5%	10%	19%	31%	45%	59%	71%	81%	89%	94%	97%	98%	99%	100%
92	0%	0%	0%	1%	4%	9%	17%	29%	42%	56%	69%	79%	87%	93%	96%	98%	99%	100%
94	0%	0%	0%	1%	4%	8%	16%	27%	39%	53%	66%	77%	86%	92%	95%	98%	99%	99%
96	0%	0%	0%	1%	3%	7%	14%	24%	37%	50%	64%	75%	84%	90%	95%	97%	99%	99%
98	0%	0%	0%	1%	3%	6%	13%	22%	34%	48%	61%	73%	82%	89%	94%	97%	98%	99%
100	0%	0%	0%	1%	2%	6%	12%	21%	32%	45%	58%	70%	80%	88%	93%	96%	98%	99%

Note: Shaded entries indicate at least 95% confidence that at least 10% of the possible samples exceed the standard/evaluation level.

Methods Used to Summarize Results

Methods used to summarize the results in this report encompass both tabular and spatial formats. Individual summary sheets for each station provide details on station location, stream classification, along with specifics on what parameters were measured, the number of samples taken (i.e. sample size), the number of results below reporting levels, the number of results exceeding a water quality standard or evaluation level, statistical confidence that 10% of results exceeded the evaluation level, and a general overview of the distribution of the results using percentiles. These station summary sheets provide the greatest details on a station-by-station basis. They are included as Appendix A to this report.

Use Support Assessment Considerations

1) The freshwater dissolved oxygen concentrations of 5.0 mg/L and 4.0 mg/L (6.0 mg/L in Tr waters) are presented as evaluation levels. Instantaneous concentrations of 4.0 mg/L or less (5.0 mg/L in salt water) are in violation of the standard unless caused by natural (e.g. swampy) conditions. The 5.0 mg/L evaluation level is based upon a freshwater standard which specifies "not less than a daily average of 5.0 mg/L" (15A NCAC 2B.0200).
2) The geometric mean and percentage of results greater than evaluation level threshold values were calculated for fecal coliform results for each station as appropriate for stream class.

Specific information on water quality standards and action levels can be found in 15A NCAC 2B.0200 (May 1, 2007).

PARAMETERS

Dissolved Oxygen

Dissolved oxygen is one of the most important of all the chemical measurements. Dissolved oxygen provides valuable information about the ability of the water to support aquatic life and the capacity of water to assimilate point and nonpoint discharges. Water quality standards for dissolved oxygen vary depending on the classification of the body of water. For freshwaters, 15A NCAC 02B .0211 (3)(b) specifies:

Dissolved oxygen: not less than 6.0 mg/l for trout waters; for non-trout waters, not less than a daily average of 5.0 mg/l with a minimum instantaneous value of not less than 4.0 mg/l; swamp waters, lake coves or backwaters, and lake bottom waters may have lower values if caused by natural conditions.

The only monitoring station on a trout water, A4800000 on the First Broad River, in the Broad basin exceeded the 6.0 mg/L evaluation level only once during the current assessment period. Station A6450000 on Sugar Branch exceeded the 4.0 mg/L and 5.0 mg/L evaluation levels in more than ten percent of the samples collected during the assessment period, with 51% and 81% levels of statistical confidence, respectively.

pH

The scale for measuring pH is logarithmic (i.e. a pH of 8.0 is ten times less concentrated in hydrogen ions than a pH of 7.0). A pH value of 7.0 Standard Units (SU) is neutral, while lower values are more acidic and higher values are more basic. The pH of ambient waters varies naturally depending upon interaction with soils and in-stream constituents, upstream inputs, and conditions in the surrounding environment. Point source discharges can also influence the pH of a stream. Values much lower than 7.0 SU may be found in waters rich in dissolved organic matter (e.g. swamp lands). Values much greater than 7.0 SU may be observed during algal blooms. The accuracy of field measurements is limited by the abilities of field equipment, which is generally accurate to within 0.2 SU, and by natural variation within a site.

The water quality standards for pH in freshwaters consider values less than 6.0 SU or greater than 9.0 SU to warrant attention. In swamp waters, a pH below 4.3 SU is of concern. For saltwaters, the acceptable range is narrower: 6.8 SU to 8.5 SU.

The pH evaluation level (< 6.0 SU) was exceeded more than ten percent of the time at two stations (A4800000 and A6450000) in the Broad basin during the assessment timeframe. See Figure 4 in the maps section below for location information.

Specific Conductance

Specific conductance is a measure of the ability of water to conduct an electric current. It is reported in microsiemens per centimeter (µS/cm) at 25°C. The presence of ions and temperature are major factors in the ability of water to conduct a current. Clean freshwater has a low specific conductance, whereas high specific conductance values may indicate polluted water or saline conditions. Measurements reported are corrected for temperature, thus the range of values reported over a period of time indicate the relative presence of ions in water.

Specific conductance can be used to evaluate variations in dissolved mineral concentrations (ions) among sites with varying degrees of impact resulting from point source discharges. Generally, impacted sites show elevated and widely ranging values for specific conductance. Water bodies that contain saltwater will also have high specific conductance values. Therefore those wishing to use specific conductance as an indicator for problems must first account for salinity.

Turbidity

Turbidity data may denote episodic high values on particular dates or within narrow time periods. These can often be the result of intense or sustained rainfall events; however elevated values can occur at other times. In coastal areas, tidal surges can also disturb shallow estuarine sediments and naturally increase turbidity.

Turbidity evaluation levels (> 50 NTU in freshwater, > 10 NTU in trout waters) were not exceeded more than 10% of the time at any station in the Broad basin during the assessment timeframe. All but one station exceeded the EL's at least once during the assessment period.

Metals

A number of metals are essential micronutrients for the support of aquatic life. However, there are threshold concentrations over which metals can be harmful. Traditionally, the DWQ has considered total metals concentrations in surface waters to evaluate potential adverse effects on human and aquatic life. However, metals can exist in many forms within the water column. Scientific investigation has revealed that different forms present different levels of risk to aquatic organisms (US Environmental Protection Agency, 2007). Therefore, as of May 2007, the DWQ suspended routine collection of total metals at AMS stations, and is currently reviewing water quality standards for metals.

The stations in the Broad basin had less than ten total metals results from quarterly sampling during 2006 and 2007 before the suspension. In July 2006, station A6450000 returned high (outlier) values for total aluminum (7,000 µg/L), iron (14,000 µg/L), manganese (380 µg/L) and zinc (43 µg/L). The remaining total metals results at that station during 2006 – 2007 were much lower. During the next sampling event in October 2006, most metals were non-detects, except for iron (520 µg/L) and aluminum (410 µg/L).

Because of the small number of total metals samples collected during the 2006 through 2010 timeframe, the total metals results are not considered in the tables and figures in this report. The results are summarized in Appendix A on the Station Summary Sheets.

Nutrients

Compounds of nitrogen and phosphorus are major components of living organisms and thus are essential to maintain life. These compounds are collectively referred to as "nutrients." Nitrogen compounds include ammonia-nitrogen (NH_3-N), total Kjeldahl nitrogen (TKN) and nitrite+nitrate nitrogen (NO_2+NO_3-N). Phosphorus is measured as total phosphorus. When nutrients are introduced to an aquatic ecosystem from municipal and industrial treatment processes, or runoff from urban or agricultural land, the excessive growth of algae and other plants may occur.

At neutral pH in water, ammonia normally forms an ionized solution of ammonium hydroxide, with only a small amount of ammonia. However, as pH increases, more ammonia is left unionized. Unionized ammonia is toxic to fish and other aquatic organisms.

None of the monitoring stations in the Broad basin are on waters classified as nutrient sensitive waters (NSW).

Bacteria

Concentrations of fecal coliform bacteria can vary greatly. The descriptive statistics used to evaluate fecal coliform bacteria data include the percentage of results above evaluation level threshold values, as well as either the geometric mean or the median colony count per 100 mL, depending upon the classification of the waterbody. For all of the sites in the Broad River Basin, the fresh surface water quality standards specified in Administrative Code 15A NCAC 02B.0211 (3)(e) (May 1, 2007) are applicable:

Organisms of the coliform group: fecal coliforms shall not exceed a geometric mean of 200/100ml (MF count) based upon at least five consecutive samples examined during any 30 day period, nor exceed 400/100ml in more than 20 percent of the samples examined during such period; violations of the fecal coliform standard are expected during rainfall events and, in some cases, this violation is expected to be caused by uncontrollable nonpoint source pollution; all coliform concentrations are to be analyzed using the membrane filter technique unless high turbidity or other adverse conditions necessitate the tube dilution method; in case of controversy over results, the MPN 5-tube dilution technique shall be used as the reference method.

For waters where commercial shellfishing is done (Class SA), an additional water quality standard is applied (15A NCAC 02B .0221 (3)(d) (May 1, 2007):

Organisms of coliform group: fecal coliform group not to exceed a median MF of 14/100 ml and not more than 10 percent of the samples shall exceed an MF count of 43/100 ml in those areas most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions.

Fecal coliform problems are screened using annual summaries of ambient sampling results. If the screening indicates that the station may be in violation of the standard, the standard is assessed using the method required by law. All class B (and class SB/SA in coastal basins) waters are assessed, and other waters as resources permit. The required assessment method is known as "5 in 30", collecting a minimum five samples within a span of 30 days. If a water body exceeds the standard more than the specified percentage of the time during the 30-day period, or if the median or geometric mean for the 30-day period is greater than the threshold values described in the relevant standard(s), then that water body is considered impaired and is added to the impaired water list, the 303(d) list. Details regarding the analysis of fecal coliform bacteria are available in the DWQ's Standard Operating Procedure (SOP) for analyzing Fecal Coliform using Standard Methods, 20th Edition, 9222 D (NC Division of Water Quality Laboratory Section, 2007).

During the current assessment period, one site (A6450000 on Sugar Branch) yielded a geometric mean greater than 200 colonies/100mL and exceeded 400 colonies/100 mL greater than 20 percent of the time. Two other stations (A2700000 and A8600000) exceeded 400 colonies/100 ml exactly 20 percent of the

time, but did not yield a geometric mean greater than 200 colonies/100 mL. Geometric means and evaluation level exceedance percentages for individual sites are indicated on the respective station summary sheets.

Temperature

Water temperature plays an important role in the chemistry of surface waters and the biological functioning, including growth and reproduction, of aquatic life. For NC freshwaters, 15A NCAC 02B .0211 (3)(j) specifies:

Temperature: not to exceed 2.8 degrees C (5.04 degrees F) above the natural water temperature and in no case to exceed 29 degrees C (84.2 degrees F) for mountain and upper piedmont waters and 32 degrees C (89.6 degrees F) for lower piedmont and coastal plain Waters; the temperature for trout waters shall not be increased by more than 0.5 degrees C (0.9 degrees F) due to the discharge of heated liquids, but in no case to exceed 20 degrees C (68 degrees F).

One station, A4700000, in the Broad basin exceeded the 29°C standard more than ten percent of the time during the current assessment period. Results from this station exceeded the same standard five percent of the time during the previous assessment period of September 2000 – August 2005. In both cases, this was the only Broad basin station to exceed the mountain and upper piedmont waters temperature standard. The Broad river basin experienced "severe" to "exceptional" drought conditions during the summers of 2007 and 2008 (NC Division of Water Resources, 2011) which may have contributed to higher than normal surface water temperatures. Graphing of temperature results from station A4700000 showed a seasonal trend (Figure 2). Exceedances occurred between May 31 and August 29 during each year of the 2006 – 2010 assessment period, and were most frequent in 2006, 2007 and 2008.

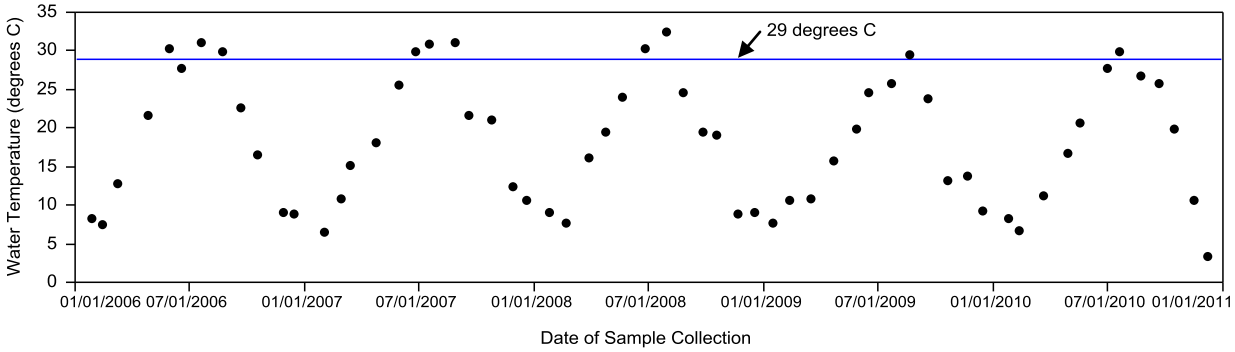

Figure 2. Temperature results at station A4700000, 2006 – 2010 (blue reference line represents the 29 °C water quality standard for mountain and upper piedmont waters)

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Table 6. Frequency of Evaluation Level Exceedances, 2006-2010

Station ID	Stream Class	Percentage of Results that Exceeded the Evaluation Limit (by Parameter, Water Type)								
		Temperature (°C)	Dissolved Oxygen (mg/L)			pH (SU)		Turbidity (NTU)		Fecal Coliform (colonies/100mL)
		(>29)	(<4)	(<5)	(<6)	(<6)	(>9)	(>50)	(>10)	(>400)
		Fresh	Fresh	Fresh	Trout	Fresh	Fresh	Fresh	Trout	Fresh
HUC 03050105: Upper Broad River Hydrologic Unit										
A1520000	C	0.0	0.0	0.0	NA	4.5	0.0	0.0	NA	4.3
A2700000	WS-IV	0.0	0.0	0.0	NA	2.1	0.0	2.0	NA	20.0
A4400000	WS-IV	0.0	0.0	0.0	NA	2.1	0.0	4.0	NA	8.0
A4700000	WS-IV	16.7	0.0	0.0	NA	5.0	0.0	5.0	NA	8.3
A4800000	WS-V Tr	0.0	0.0	0.0	1.7	20.0	0.0	1.7	8.3	5.0
A6400000	C	0.0	0.0	0.0	NA	3.3	0.0	10.0	NA	16.7
A6450000	C	0.0	10.7	14.3	NA	22.0	0.0	5.1	NA	32.2*
A8600000	C	0.0	0.0	0.0	NA	6.7	0.0	8.3	NA	20.0

Notes:

NA: This evaluation level is Not Applicable for this parameter in this stream class.

If there are no exceedances for a given combination of evaluation level, stream class, and parameter during the assessment period, then that column is not included in the table.

1. There were no exceedances for nitrate during the assessment period.

2. No samples were collected for chlorophyll *a* during the assessment period.

* Station A6450000 also exceeded the screening level for fecal coliform geometric mean, with a value of 222.4 colonies/100 mL.

WATER QUALITY PATTERNS IN THE BROAD RIVER BASIN

Maps were used to depict data for a variety of water quality parameters throughout the basin so that the relationship of stations to each other could be seen and regional patterns could become clear. While figures portray information visually, specific and accurate details can only be conveyed in tables. Individual station summary sheets should be consulted when exact information is needed.

Maps were utilized specifically to display the geographic distribution of evaluation level exceedances for dissolved oxygen, pH, turbidity, fecal coliform and water temperature (Figures 3 through 7 below). Station symbol colors signified the degree of water quality evaluation level exceedance at each location.

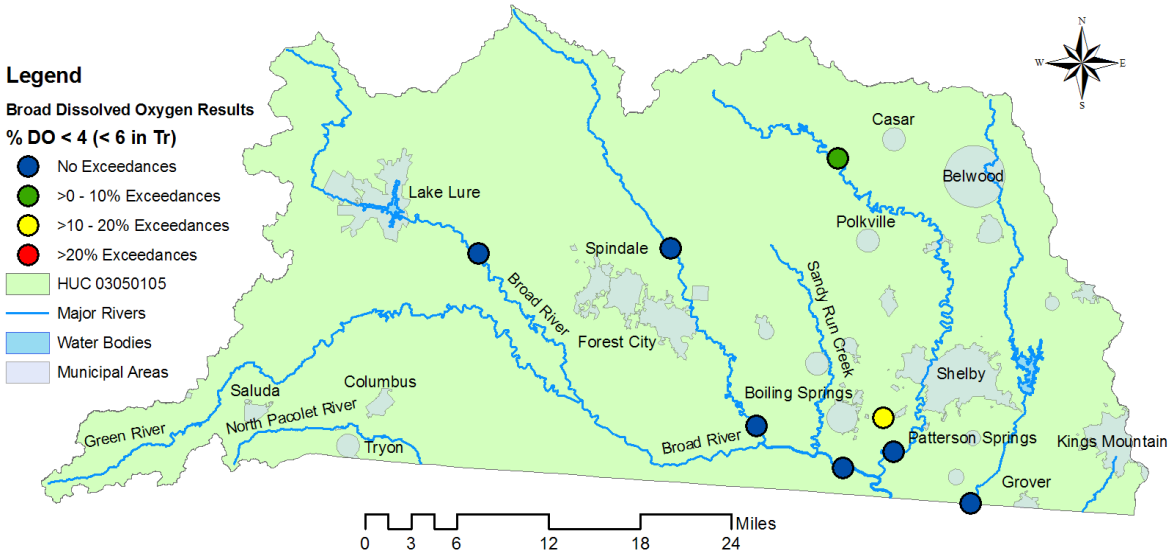

Figure 3. Geographic Distribution and Percentage of Dissolved Oxygen Exceedances (less than 4.0 mg/L in freshwater; less than 6.0 mg/L in trout waters)

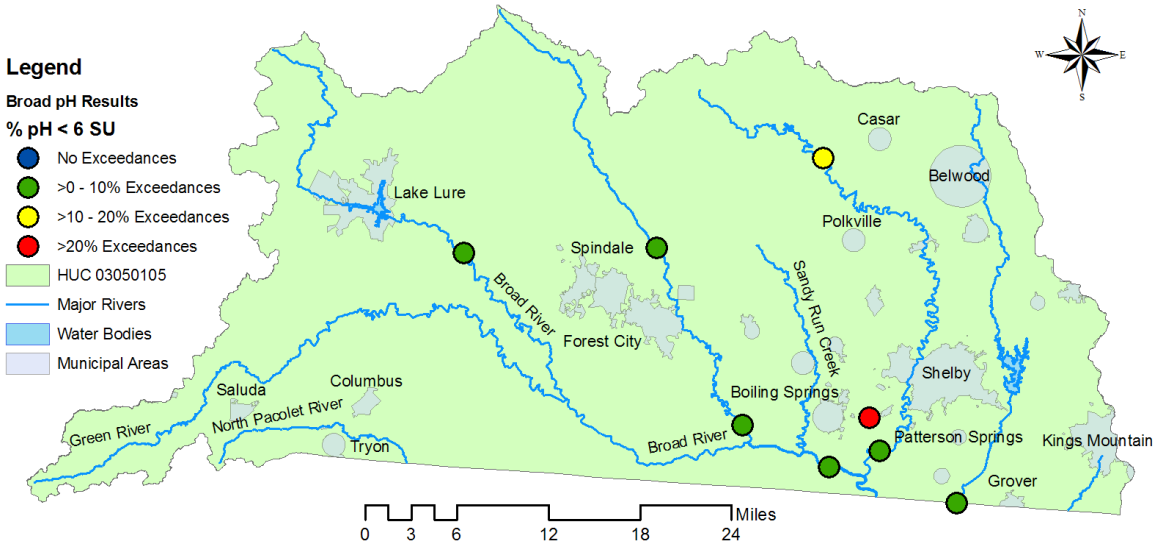

Figure 4. Geographic Distribution and Percentage of pH Exceedances (less than 6.0 in freshwater)

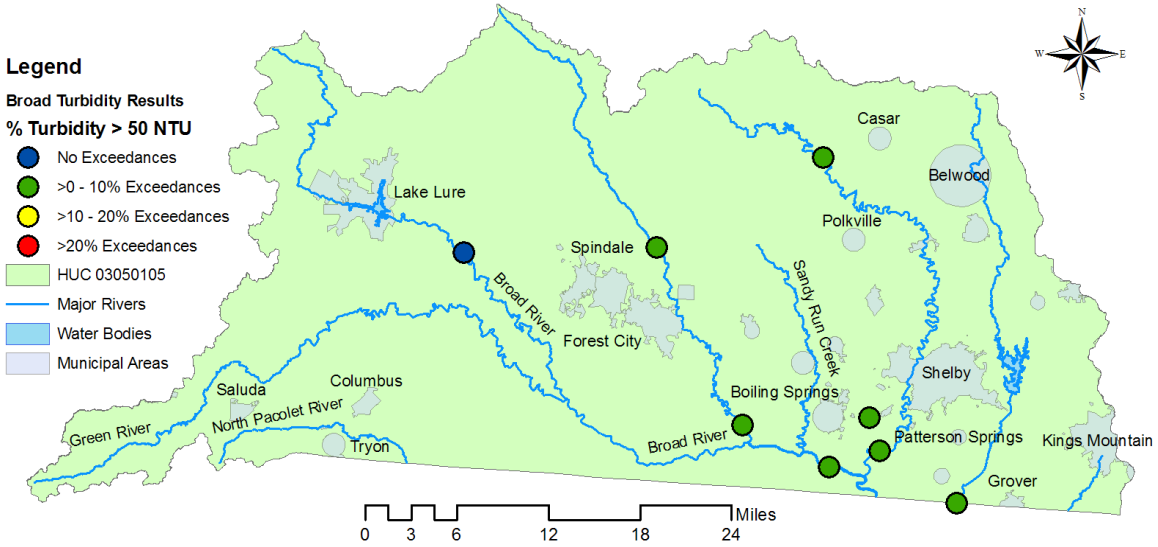

Figure 5. Geographic Distribution and Percentage of Turbidity Exceedances (greater than 50 NTU in freshwater, greater than 10 NTU in trout waters)

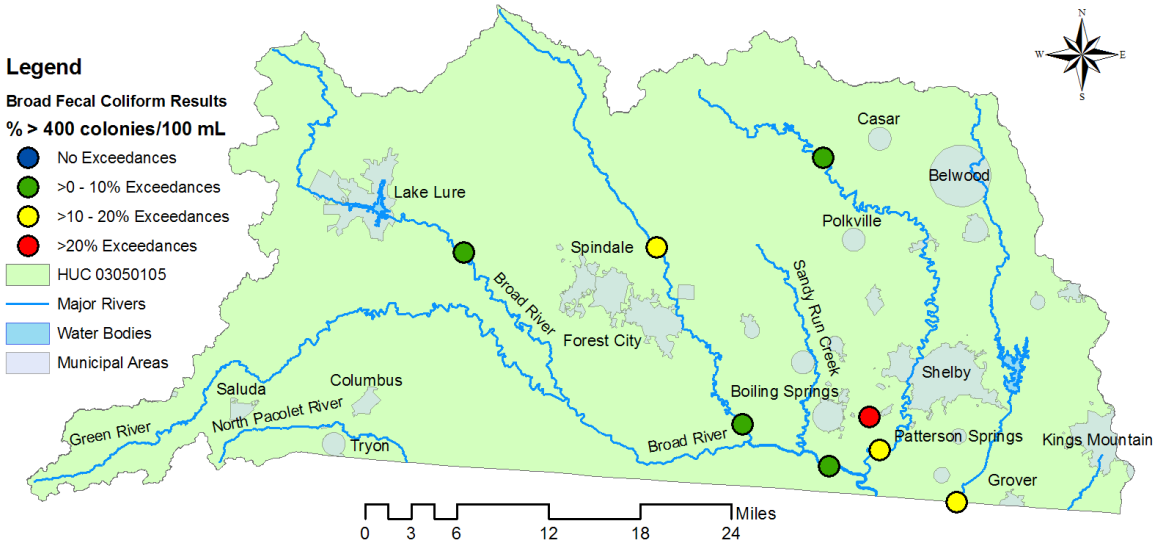

Figure 6. Geographic Distribution and Percentage of Fecal Coliform Exceedances (greater than 400 colonies/100 mL by membrane filter fecal coliform count)

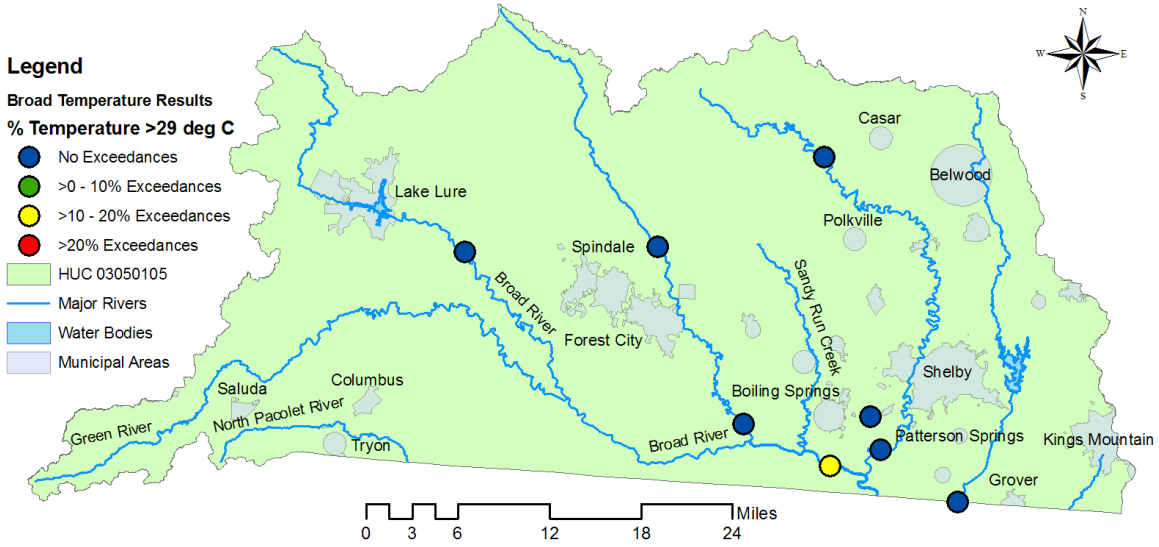

Figure 7. Geographic Distribution and Percentage of Temperature Exceedances (greater than 29°C)

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Appendix A: Station Summary Sheets

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: BROAD RIV AT SR 1181 NR ROCK SPRINGS
Station #: A1520000 **Hydrologic Unit Code:** 03050105
Latitude: 35.39366 **Longitude:** -82.09476 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 9-(22)

Time period: 02/21/2006 to 11/16/2010

	#	#		Results not meeting EL			Percentiles						
	results	**ND**	**EL**	**#**	**%**	**%Conf**	**Min**	**10th**	**25th**	**50th**	**75th**	**90th**	**Max**
Field													
D.O. (mg/L)	39	0	<4	0	0		6.5	7.3	7.9	9.4	11.2	12.2	13.5
	39	0	<5	0	0		6.5	7.3	7.9	9.4	11.2	12.2	13.5
pH (SU)	44	0	<6	2	4.5		5.8	6.2	6.5	7	7.2	7.4	7.8
	44	0	>9	0	0		5.8	6.2	6.5	7	7.2	7.4	7.8
Spec. conductance (umhos/cm at 25°C)	43	0	N/A				33	35	37	40	44	46	49
Water Temperature (°C)	45	0	>29	0	0		4.5	7.4	10.7	17.8	24.6	25.8	28
Other													
Hardness (mg/L)	4	0	N/A				10	10	10	11	16	17	17
TSS (mg/L)	20	10	N/A				2.5	2.7	6.2	6.2	16	35.7	48
Turbidity (NTU)	47	0	>50	0	0		1.9	2.3	3	4.2	8	14.2	31
Nutrients (mg/L)													
NH3 as N	1	1	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.02
NO2 + NO3 as N	1	0	N/A				0.14	0.14	0.14	0.14	0.14	0.14	0.14
TKN as N	1	1	N/A				0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Phosphorus	1	1	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.02
Metals (ug/L)													
Aluminum, total (Al)	5	0	N/A				90	90	100	220	1135	2000	2000
Arsenic, total (As)	5	5	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	5	5	>2	0	0		1	1	1.5	2	2	2	2
Chromium, total (Cr)	5	5	>50	0	0		10	10	18	25	25	25	25
Copper, total (Cu)	5	5	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	5	0	>1000	1	20		160	160	180	330	975	1500	1500
Lead, total (Pb)	5	5	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	5	5	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	5	5	>50	0	0		10	10	10	10	10	10	10

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
47	55.8	2	4.3	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: SECOND BROAD RIV AT SR 1538 NR LOGAN
Station #: A2700000 **Hydrologic Unit Code:** 03050105
Latitude: 35.40424 **Longitude:** -81.87201 **Stream class:** WS-IV
Agency: NCAMBNT **NC stream index:** 9-41-(10.5)

Time period: 02/21/2006 to 11/16/2010

	#	#		Results not meeting EL			Percentiles						
	results	**ND**	**EL**	**#**	**%**	**%Conf**	**Min**	**10th**	**25th**	**50th**	**75th**	**90th**	**Max**
Field													
D.O. (mg/L)	42	0	<4	0	0		6.9	7.3	7.7	9.1	11	11.5	12.6
	42	0	<5	0	0		6.9	7.3	7.7	9.1	11	11.5	12.6
pH (SU)	47	0	<6	1	2.1		5.7	6.4	6.6	6.8	7.1	7.3	7.4
	47	0	>9	0	0		5.7	6.4	6.6	6.8	7.1	7.3	7.4
Spec. conductance (umhos/cm at 25°C)	46	0	N/A				52	54	59	62	65	67	70
Water Temperature (°C)	48	0	>29	0	0		4.9	7.9	9.6	16.3	22	23.8	26.7
Other													
Hardness (mg/L)	4	0	>100	0	0		20	20	20	20	21	21	21
TSS (mg/L)	20	6	N/A				4.8	5.1	6.2	8.2	19.5	35.5	144
Turbidity (NTU)	50	0	>50	1	2		3.1	4.4	5.3	9.1	18.2	31.7	180
Nutrients (mg/L)													
NH3 as N	2	2	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.02
NO2 + NO3 as N	2	0	>10	0	0		0.13	0.13	0.13	0.13	0.13	0.13	0.13
TKN as N	1	1	N/A				0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Phosphorus	2	0	N/A				0.02	0.02	0.02	0.04	0.06	0.06	0.06
Metals (ug/L)													
Aluminum, total (Al)	5	0	N/A				220	220	300	410	1255	2000	2000
Arsenic, total (As)	5	5	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	5	5	>2	0	0		1	1	1.5	2	2	2	2
Chromium, total (Cr)	5	5	>50	0	0		10	10	18	25	25	25	25
Copper, total (Cu)	5	4	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	5	0	>1000	2	40		700	700	785	960	1750	2400	2400
Lead, total (Pb)	5	5	>25	0	0		10	10	10	10	10	10	10
Manganese, total (Mn)	5	0	>200	0	0		54	54	56	63	75	75	75
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	5	5	>25	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	5	2	>50	0	0		10	10	10	10	12	12	12

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
50	187.4	10	20	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: SECOND BROAD RIV AT US 221 ALT AT CLIFFSIDE
Station #: A4400000 **Hydrologic Unit Code:** 03050105
Latitude: 35.23872 **Longitude:** -81.76667 **Stream class:** WS-IV
Agency: NCAMBNT **NC stream index:** 9-41-(24.7)

Time period: 02/21/2006 to 11/16/2010

	#	#		Results not meeting EL			Percentiles						
	results	**ND**	**EL**	**#**	**%**	**%Conf**	**Min**	**10th**	**25th**	**50th**	**75th**	**90th**	**Max**
Field													
D.O. (mg/L)	42	0	<4	0	0		5.4	6	7.2	9.4	11.3	12.3	12.8
	42	0	<5	0	0		5.4	6	7.2	9.4	11.3	12.3	12.8
pH (SU)	47	0	<6	1	2.1		5.7	6.4	6.7	7	7.2	7.3	7.7
	47	0	>9	0	0		5.7	6.4	6.7	7	7.2	7.3	7.7
Spec. conductance (umhos/cm at 25°C)	46	0	N/A				48	59	69	97	195	284	800
Water Temperature (°C)	48	0	>29	0	0		4.9	6.8	10	17	23.4	26.1	28.2
Other													
Hardness (mg/L)	4	0	>100	0	0		19	19	19	20	23	24	24
TSS (mg/L)	20	5	N/A				4	5.8	6.2	8.2	13.8	23.9	64
Turbidity (NTU)	50	0	>50	2	4		3.5	5.8	8.2	12.5	19.2	39.1	170
Nutrients (mg/L)													
NH3 as N	46	5	N/A				0.02	0.02	0.03	0.04	0.06	0.08	0.13
NO2 + NO3 as N	46	0	>10	0	0		0.15	0.26	0.3	0.38	0.44	0.61	1.3
TKN as N	45	13	N/A				0.2	0.2	0.2	0.23	0.33	0.44	0.71
Total Phosphorus	45	0	N/A				0.02	0.04	0.06	0.07	0.09	0.16	0.37
Metals (ug/L)													
Aluminum, total (Al)	5	0	N/A				250	250	265	570	1445	2100	2100
Arsenic, total (As)	5	5	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	5	5	>2	0	0		1	1	1.5	2	2	2	2
Chromium, total (Cr)	5	5	>50	0	0		10	10	18	25	25	25	25
Copper, total (Cu)	5	1	>7	0	0		2	2	2	3	4	4	4
Iron, total (Fe)	5	0	>1000	3	60		770	770	855	1100	1900	2400	2400
Lead, total (Pb)	5	5	>25	0	0		10	10	10	10	10	10	10
Manganese, total (Mn)	2	0	>200	0	0		62	62	62	76	89	89	89
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	5	5	>25	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	5	4	>50	0	0		10	10	10	10	13	16	16

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
50	109.2	4	8	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: BROAD RIV AT NC 150 NR BOILING SPRINGS
Station #: A4700000 **Hydrologic Unit Code:** 03050105
Latitude: 35.20131 **Longitude:** -81.66553 **Stream class:** WS-IV
Agency: NCAMBNT **NC stream index:** 9-(40.5)

Time period: 01/26/2006 to 12/08/2010

	#	#		Results not meeting EL			Percentiles						
	results	**ND**	**EL**	**#**	**%**	**%Conf**	**Min**	**10th**	**25th**	**50th**	**75th**	**90th**	**Max**
Field													
D.O. (mg/L)	57	0	<4	0	0		6.4	7.4	8	9.5	11.1	12	14.3
	57	0	<5	0	0		6.4	7.4	8	9.5	11.1	12	14.3
pH (SU)	60	0	<6	3	5		4.1	6.1	6.4	7.2	7.5	8	8.6
	60	0	>9	0	0		4.1	6.1	6.4	7.2	7.5	8	8.6
Spec. conductance (umhos/cm at 25°C)	55	0	N/A				26	43	50	63	84	107	201
Water Temperature (°C)	60	0	>29	10	16.7	92.7	3.4	7.7	10.6	18.6	25.7	30.2	32.5
Other													
Hardness (mg/L)	4	0	>100	0	0		11	11	12	15	20	22	22
TSS (mg/L)	20	9	N/A				2.5	3.5	6.2	7.6	14.8	64.4	400
Turbidity (NTU)	60	0	>50	3	5		3.2	3.8	5.1	6.8	14	34.3	390
Nutrients (mg/L)													
NH3 as N	59	43	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.28
NO2 + NO3 as N	59	0	>10	0	0		0.12	0.19	0.22	0.26	0.3	0.36	0.47
TKN as N	59	38	N/A				0.2	0.2	0.2	0.2	0.22	0.34	0.9
Total Phosphorus	59	0	N/A				0.02	0.02	0.03	0.04	0.06	0.09	0.54
Metals (ug/L)													
Aluminum, total (Al)	6	0	N/A				270	270	278	330	728	1200	1200
Arsenic, total (As)	6	6	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	6	6	>2	0	0		1	1	1	2	2	2	2
Chromium, total (Cr)	6	6	>50	0	0		10	10	10	25	25	25	25
Copper, total (Cu)	6	4	>7	0	0		2	2	2	2	2	3	3
Iron, total (Fe)	6	0	>1000	1	16.7		440	440	462	615	1135	1600	1600
Lead, total (Pb)	6	6	>25	0	0		10	10	10	10	10	10	10
Manganese, total (Mn)	3	0	>200	0	0		19	19	19	57	120	120	120
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	6	6	>25	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	6	6	>50	0	0		10	10	10	10	10	10	10

Fecal Coliform Screening(#/100mL)

# results:	**Geomean**	**# > 400:**	**% > 400:**	**%Conf:**
59	38	5	8.5	

Key:
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Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: FIRST BROAD RIV AT SR 1530 NR CASAR
Station #: A4800000 **Hydrologic Unit Code:** 03050105
Latitude: 35.49331 **Longitude:** -81.68133 **Stream class:** WS-V Tr
Agency: NCAMBNT **NC stream index:** 9-50-(1)

Time period: 01/26/2006 to 12/08/2010

	#	#		Results not meeting EL			Percentiles						
	results	**ND**	**EL**	**#**	**%**	**%Conf**	**Min**	**10th**	**25th**	**50th**	**75th**	**90th**	**Max**
Field													
D.O. (mg/L)	58	0	<6	1	1.7		5.8	7.4	8.1	9.5	11.1	12.3	14.5
pH (SU)	60	0	<6	12	20	98.5	5.2	5.7	6	6.5	6.9	7.4	7.9
	60	0	>9	0	0		5.2	5.7	6	6.5	6.9	7.4	7.9
Spec. conductance (umhos/cm at 25°C)	56	0	N/A				23	32	35	38	41	43	50
Water Temperature (°C)	60	0	>29	0	0		1.1	5	9.5	16.2	22.2	25.8	27.4
Other													
Hardness (mg/L)	4	0	>100	0	0		11	11	11	12	14	14	14
TSS (mg/L)	20	15	N/A				2.5	2.8	6.2	6.2	7	13.8	180
Turbidity (NTU)	60	3	>10	5	8.3		1	1.1	1.6	2.4	5	9.3	90
Metals (ug/L)													
Aluminum, total (Al)	6	0	N/A				56	56	61	110	668	1200	1200
Arsenic, total (As)	6	6	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	6	6	>0.4	0	0		1	1	1	2	2	2	2
Chromium, total (Cr)	6	6	>50	0	0		10	10	10	25	25	25	25
Copper, total (Cu)	6	6	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	6	0	>1000	1	16.7		130	130	160	290	710	1100	1100
Lead, total (Pb)	6	6	>25	0	0		10	10	10	10	10	10	10
Manganese, total (Mn)	6	0	>200	0	0		13	13	14	19	33	46	46
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	6	6	>25	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	6	5	>50	0	0		10	10	10	10	10	11	11

Fecal Coliform Screening(#/100mL)

# results:	**Geomean**	**# > 400:**	**% > 400:**	**%Conf:**
60	33.8	3	5	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: FIRST BROAD RIV AT SR 1140 NR EARL
Station #: A6400000 **Hydrologic Unit Code:** 03050105
Latitude: 35.21776 **Longitude:** -81.60773 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 9-50-(28)

Time period: 01/26/2006 to 12/08/2010

	#	#		Results not meeting EL			Percentiles						
	results	**ND**	**EL**	**#**	**%**	**%Conf**	**Min**	**10th**	**25th**	**50th**	**75th**	**90th**	**Max**
Field													
D.O. (mg/L)	57	0	<4	0	0		6	6.4	7	8.7	11	12.1	13.9
	57	0	<5	0	0		6	6.4	7	8.7	11	12.1	13.9
pH (SU)	60	0	<6	2	3.3		5.8	6.2	6.3	6.5	6.9	7.3	7.5
	60	0	>9	0	0		5.8	6.2	6.3	6.5	6.9	7.3	7.5
Spec. conductance (umhos/cm at 25°C)	55	0	N/A				31	53	56	68	78	97	140
Water Temperature (°C)	60	0	>29	0	0		1.1	5.6	8.9	17.5	24.7	27.6	28.8
Other													
Hardness (mg/L)	4	0	N/A				17	17	17	19	31	34	34
TSS (mg/L)	20	2	N/A				5	5.6	6.7	11	20.8	81	850
Turbidity (NTU)	60	0	>50	6	10	43.7	2.8	5.3	7.1	12	22.8	59	800
Nutrients (mg/L)													
NH3 as N	60	2	N/A				0.02	0.03	0.06	0.15	0.36	0.51	1.2
NO2 + NO3 as N	60	0	N/A				0.3	0.37	0.47	0.54	0.64	0.69	1
TKN as N	60	3	N/A				0.2	0.22	0.29	0.4	0.68	0.94	1.4
Total Phosphorus	60	0	N/A				0.03	0.04	0.06	0.08	0.17	0.32	1.2
Metals (ug/L)													
Aluminum, total (Al)	6	0	N/A				230	230	245	340	1190	2900	2900
Arsenic, total (As)	6	6	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	6	6	>2	0	0		1	1	1	2	2	2	2
Chromium, total (Cr)	6	6	>50	0	0		10	10	10	25	25	25	25
Copper, total (Cu)	6	4	>7	0	0		2	2	2	2	3	4	4
Iron, total (Fe)	6	0	>1000	2	33.3		500	500	598	785	1550	2900	2900
Lead, total (Pb)	6	6	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	6	6	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	6	5	>50	0	0		10	10	10	10	11	14	14

Fecal Coliform Screening(#/100mL)

# results:	**Geomean**	**# > 400:**	**% > 400:**	**%Conf:**
59	121.3	10	16.9	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: SUGAR BRANCH AT NC 150 NR BOILING SPRINGS
Station #: A6450000 **Hydrologic Unit Code:** 03050105
Latitude: 35.24938 **Longitude:** -81.62025 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 9-50-32-3

Time period: 01/26/2006 to 12/08/2010

	#	#		Results not meeting EL			Percentiles						
	results	**ND**	**EL**	**#**	**%**	**%Conf**	**Min**	**10th**	**25th**	**50th**	**75th**	**90th**	**Max**
Field													
D.O. (mg/L)	56	0	<4	6	10.7	50.7	1.2	3.7	5.7	7.8	9.1	10.7	12.4
	56	0	<5	8	14.3	80.7	1.2	3.7	5.7	7.8	9.1	10.7	12.4
pH (SU)	59	0	<6	13	22	99.5	5.3	5.7	6	6.3	6.6	6.9	7.4
	59	0	>9	0	0		5.3	5.7	6	6.3	6.6	6.9	7.4
Spec. conductance (umhos/cm at 25°C)	55	0	N/A				63	71	74	80	87	95	113
Water Temperature (°C)	59	0	>29	0	0		2.2	6.7	10.4	15.8	21.6	24.5	28.4
Other													
Hardness (mg/L)	4	0	N/A				20	20	21	23	24	24	24
TSS (mg/L)	19	14	N/A				2.5	2.5	5	6.2	6.2	22	42
Turbidity (NTU)	59	3	>50	3	5.1		1	1.3	2.2	4.3	9.9	17	80
Metals (ug/L)													
Aluminum, total (Al)	6	0	N/A				120	120	120	165	2058	7000	7000
Arsenic, total (As)	6	6	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	6	6	>2	0	0		1	1	1	2	2	2	2
Chromium, total (Cr)	6	6	>50	0	0		10	10	10	25	25	25	25
Copper, total (Cu)	6	5	>7	1	16.7		2	2	2	2	4	9	9
Iron, total (Fe)	6	0	>1000	1	16.7		270	270	300	375	3890	14000	14000
Lead, total (Pb)	6	6	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	6	5	>88	0	0		10	10	10	10	11	13	13
Zinc, total (Zn)	6	5	>50	0	0		10	10	10	10	18	43	43

Fecal Coliform Screening(#/100mL)

# results:	**Geomean**	**# > 400:**	**% > 400:**	**%Conf:**
59	222.4	19	32.2	98.2

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: BUFFALO CRK AT NC 198 NR GROVER
Station #: A8600000 **Hydrologic Unit Code:** 03050105
Latitude: 35.17076 **Longitude:** -81.51679 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 9-53-(5)

Time period: 01/26/2006 to 12/08/2010

	#	#		Results not meeting EL			Percentiles						
	results	**ND**	**EL**	**#**	**%**	**%Conf**	**Min**	**10th**	**25th**	**50th**	**75th**	**90th**	**Max**
Field													
D.O. (mg/L)	57	0	<4	0	0		5.8	7	7.6	9.2	11.4	12	13.5
	57	0	<5	0	0		5.8	7	7.6	9.2	11.4	12	13.5
pH (SU)	60	0	<6	4	6.7		5.7	6.1	6.3	6.6	6.9	7.3	7.9
	60	0	>9	0	0		5.7	6.1	6.3	6.6	6.9	7.3	7.9
Spec. conductance (umhos/cm at 25°C)	55	0	N/A				52	75	98	139	178	236	359
Water Temperature (°C)	60	0	>29	0	0		3.1	5.9	9.7	17.2	22.8	25.6	28.9
Other													
Hardness (mg/L)	4	0	N/A				23	23	23	24	25	25	25
TSS (mg/L)	20	4	N/A				5	6.2	6.8	11	21	53.1	280
Turbidity (NTU)	60	0	>50	5	8.3		1	4.2	6.1	8.6	14	36.4	160
Metals (ug/L)													
Aluminum, total (Al)	6	0	N/A				180	180	210	430	940	1900	1900
Arsenic, total (As)	6	6	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	6	6	>2	0	0		1	1	1	2	2	2	2
Chromium, total (Cr)	6	6	>50	0	0		10	10	10	25	25	25	25
Copper, total (Cu)	6	2	>7	0	0		2	2	2	2	3	4	4
Iron, total (Fe)	6	0	>1000	3	50		680	680	710	985	1275	1800	1800
Lead, total (Pb)	6	6	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	6	6	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	6	3	>50	0	0		10	10	10	10	15	16	16

Fecal Coliform Screening(#/100mL)

# results:	**Geomean**	**# > 400:**	**% > 400:**	**%Conf:**
60	174.1	12	20	

Key:
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Stations with less than 10 results for a given parameter were not evaluated for statistical confidence