

# Chapter 2

## Neuse River Subbasin 03-04-02

Including the: Crabtree Creek, Walnut Creek, Swift Creek and Marks Creek

### 2.1 Subbasin Overview

#### *Subbasin 03-04-02 at a Glance*

##### Land Cover (percent)

Forest/Wetland:	53.5
Surface Water:	0.7
Urban:	29.5
Cultivated Crop:	13.1
Pasture/ Managed Herbaceous:	3.0

##### Counties

Durham, Franklin, Johnston and Wake

##### Municipalities

Raleigh, Wake Forest, Cary, Garner,  
Clayton, Smithfield, Morrisville,  
Rolesville, Selma and Knightdale

##### Stream Statistics

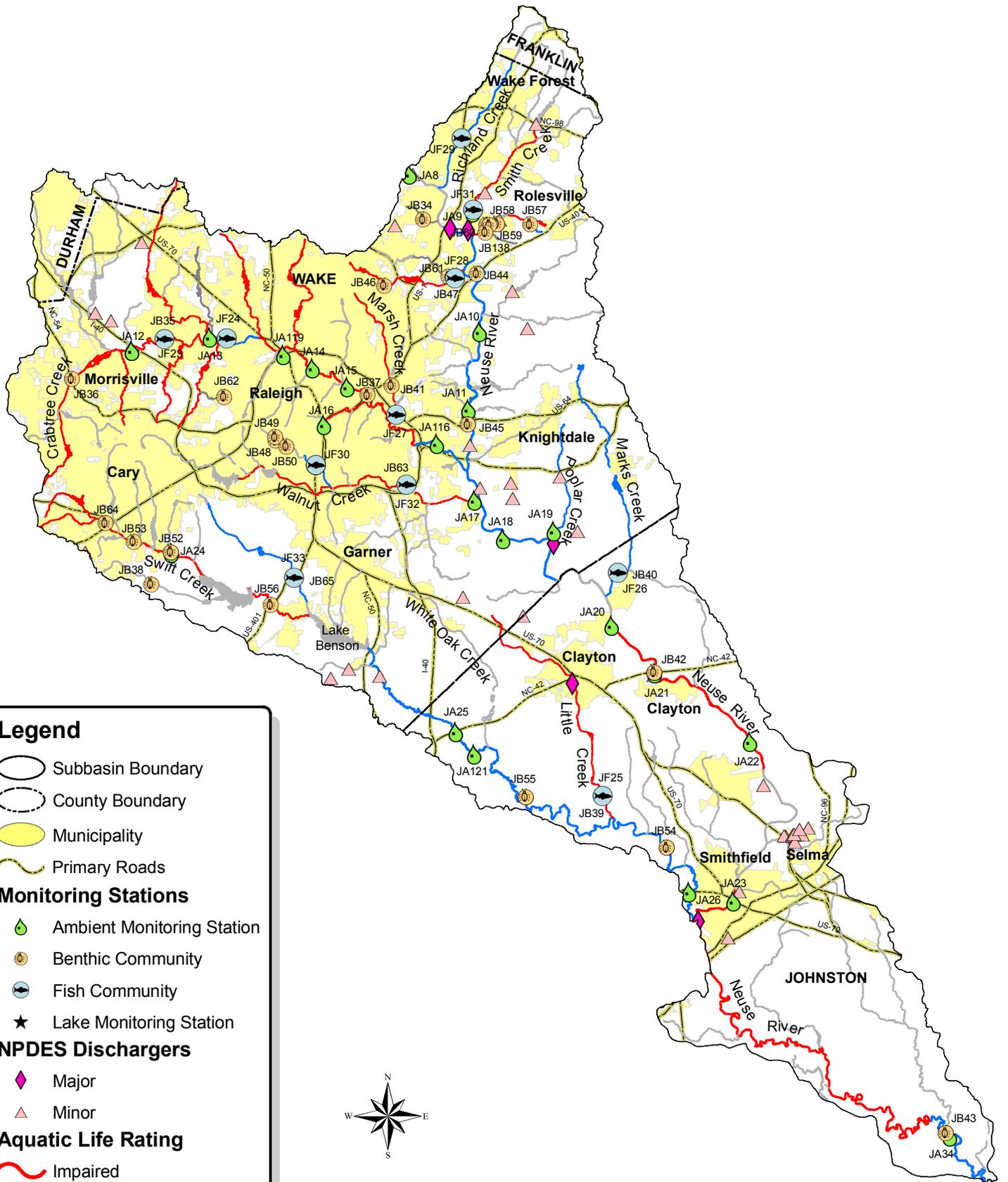
Total Streams:	511.8 mi/1860.6 ac
Total Supporting:	100.5 mi
Total Impaired:	151.1 mi
Total Not Rated:	2.0 mi/0.0 ac
Total No Data:	249.9 mi

This subbasin contains the most urbanized areas in the entire basin, including the greater Raleigh metropolitan area which includes the cities of Raleigh, Cary, Morrisville and Garner. The City of Raleigh lies in the northern half of this subbasin. Raleigh has grown 23.2 percent (64,000) between 1990 and 2000 and has estimated an additional 80,000 people between 2000 and 2007 for a population of 367,098. From 2000 to 2007 Cary increased their population to an estimated 132,443 or 40.1 percent. Due to aggressive urban sprawl east and west of Raleigh, as well as the rapid growth in Johnston County around Clayton and Smithfield, the percentage of forest and wetlands coverage has rapidly declined. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 16.

There are 47 minor and 6 major NPDES wastewater discharge permits in this subbasin with a permitted flow of 133.4 MGD. The largest of them are Raleigh Neuse River WWTP (75 MGD), North Cary WWTP (12 MGD), Central Johnston WWTP (13.5 MGD), and Smith Creek WWTP (6 MGD). Two large wastewater spills occurred in this subbasin during this assessment period. A 9 million gallon sanitary sewer overflow (SSO) occurred in Walnut Creek in December 23.5002 and a 7.9 million gallon SSO occurred in Swift Creek in June 2006. There are also 88 individual NPDES stormwater permits in the subbasin. Refer to Appendix III for identification and more information on NPDES permit holders. Raleigh has a Phase I stormwater permit. Cary, Apex, Garner, Smithfield, Durham County and Wake County have developed stormwater programs under Phase II. Johnston County in addition to those listed above except for Apex has developed model stormwater ordinances and administer local stormwater programs as required by the Neuse NSW strategy stormwater rules (Chapter 18). There are also 7 permitted animal operations in this subbasin.

This subbasin consists primarily of piedmont streams. Along the western edge of the subbasin, the headwaters of Crabtree Creek and a small portion of the Swift Creek headwaters lie within the Triassic basin ecoregion. Within this subbasin, Swift and Crabtree Creeks are the largest tributaries to the Neuse River. These along with the majority of the smaller tributaries which lie within the many municipalities are primarily affected by stormwater runoff. The high amount of impervious area associated with urban development contributes to rapid and significant increases in stream flow after a rainfall event. Stream bank erosion and sedimentation associated with these events contribute to habitat degradation. Stormwater also contributes high nutrient,

# Figure 7 Neuse River Basin 03-04-02



**Legend**

- Subbasin Boundary
- County Boundary
- Municipality
- Primary Roads

**Monitoring Stations**

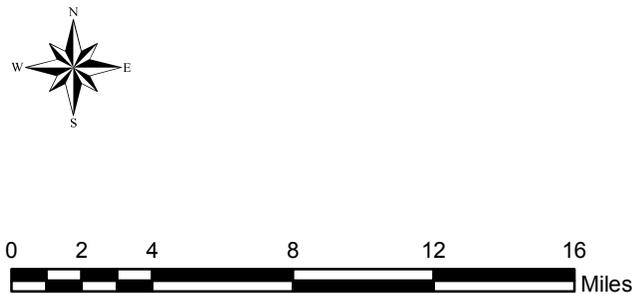
- Ambient Monitoring Station
- Benthic Community
- Fish Community
- Lake Monitoring Station

**NPDES Dischargers**

- Major
- Minor

**Aquatic Life Rating**

- Impaired
- No Data
- Not Rated
- Supported



Planning Section  
 Basinwide Planning Unit  
 March 2008

**Table 6 Neuse River Basin**

**Subbasin (WBD-8 Number) 03020201**

**DWQ Subbasin**

**03-04-02**

Assessment Unit Number	Name		Overall Category	Potential Stressors	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Description	DWQ Subbasin	Miles/Acres		Potential Sources							
<b>Watershed (WBD-10 Number) 0302020107</b>					<b>Milburnie Lake-Neuse River</b>						
<b>Subwatershed (WBD-12 Number) 030202010701</b>					<b>Richland Creek</b>						
<b>27-21-(1.5)</b>	<b>Richland Creek</b>		<b>2</b>		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
From Wake-Franklin County Line to Neuse River											
WS-IV;NSW	03-04-02	6.3	FW Miles								
<b>Subwatershed (WBD-12 Number) 030202010702</b>					<b>Smith Creek</b>						
<b>27-23-(2)</b>	<b>Smith Creek</b>		<b>5</b>	<b>Ammonia</b>	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
From dam at Wake Forest Reservoir to Neuse River											
C;NSW	03-04-02	5.8	FW Miles	WWTP NPDES	Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
<b>Habitat Degradation</b>											
Construction											
				MS4 NPDES	Aquatic Life	Impaired	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005	2008	5
WWTP NPDES											
					Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
					Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
<b>Subwatershed (WBD-12 Number) 030202010704</b>					<b>Perry Creek-Neuse River</b>						
<b>27-(20.7)</b>	<b>NEUSE RIVER</b>		<b>2</b>		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
From dam at Falls Lake to a point 0.5 mile upstream of Town of Wake Forest proposed water supply intake (Former water supply intake for Burlington Mills Wake Finishing Plant)											
WS-IV;NSW	03-04-02	3.0	FW Miles		Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
					Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
<b>27-(22)ut1</b>	<b>UT1 to NEUSE RIVER</b>		<b>3a</b>		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2005		3a
From source to Neuse River											
WS-IV;NSW,CA	03-04-02	1.6	FW Miles								
<b>27-(22.5)</b>	<b>NEUSE RIVER</b>		<b>2</b>		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
From Town of Wake Forest proposed water supply intake to mouth of Beddingfield Creek											
C;NSW	03-04-02	22.6	FW Miles		Aquatic Life	Not Rated	Data Inconclusive	Copper	2006		3m
					Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
					Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
					Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
<b>27-24a1</b>	<b>Toms Creek (Mill Creek)</b>		<b>5</b>	<b>Habitat Degradation</b>	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5
From source to Browns Lake											
C;NSW	03-04-02	1.6	FW Miles	MS4 NPDES							
				WWTP NPDES							







**Table 6 Neuse River Basin**

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**DWQ Subbasin**

**03-04-02**

Assessment Unit Number	Name		Overall Category	Potential Stressors	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Description	DWQ Subbasin	Miles/Acres		Potential Sources							
<b>27-33-(10)b</b>	<b>Crabtree Creek</b>		<b>5</b>	<b>Fecal Coliform Bacteria</b> MS4 NPDES	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
From mouth of Hairsnipe Creek to 2.75 miles upstream of Neuse River				<b>Habitat Degradation</b> MS4 NPDES	Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2004	5
C;NSW	03-04-02	10.9 FW Miles		WWTP NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	4s
				<b>PCB</b> Industrial Site	Fish Consumption	Impaired	Standard Violation	PCB	2006	2008	5
				<b>Turbidity</b> MS4 NPDES	Recreation	Not Rated	Potential Standards Violation	Fecal Coliform (recreation)	2006		3a
				<b>Subwatershed (WBD-12 Number) 030202010804</b>				<b>Lower Crabtree Creek</b>			
<b>27-33-18</b>	<b>Pigeon House Branch</b>		<b>5</b>	<b>Fecal Coliform Bacteria</b> MS4 NPDES	Aquatic Life	Not Rated	Potential Standards Violation	Zinc	2006		3m
From source to Crabtree Creek				<b>Habitat Degradation</b> MS4 NPDES	Aquatic Life	Not Rated	Data Inconclusive	Copper-Historic Listing	1998	1998	4a
C;NSW	03-04-02	2.9 FW Miles		<b>Toxic Impacts</b> MS4 NPDES	Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
				<b>Turbidity</b> MS4 NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2000	1998	5
					Recreation	Impaired	Standard Violation	Fecal Coliform (recreation)	2006	1998	4a
<b>27-33-20</b>	<b>Marsh Creek</b>		<b>5</b>	<b>Habitat Degradation</b> MS4 NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5
From source to Crabtree Creek											
C;NSW	03-04-02	6.0 FW Miles									
<b>27-33-(10)c</b>	<b>Crabtree Creek</b>		<b>5</b>	<b>Fecal Coliform Bacteria</b> MS4 NPDES	Aquatic Life	Not Rated	Data Inconclusive	Copper	2006		3m
From 2.75 miles upstream of Neuse River to Neuse River				MS4 NPDES	Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
C;NSW	03-04-02	2.8 FW Miles		<b>Habitat Degradation</b> MS4 NPDES	Fish Consumption	Impaired	Standard Violation	PCB	2006	2008	5
				<b>Low Dissolved Oxygen</b>	Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
				<b>Nutrient Impacts</b> MS4 NPDES							
				WWTP NPDES							
				<b>PCB</b> Industrial Site							
				<b>Turbidity</b> MS4 NPDES							
				<b>Watershed (WBD-10 Number) 0302020110</b>				<b>Swift Creek</b>			
				<b>Subwatershed (WBD-12 Number) 030202011001</b>				<b>Lake Wheeler-Swift Creek</b>			

**Table 6 Neuse River Basin**

**Subbasin (WBD-8 Number) 03020201**

**DWQ Subbasin**

**03-04-02**

Assessment Unit Number	Name		Overall Category	Potential Stressors	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Description	DWQ Subbasin	Miles/Acres		Potential Sources							
<b>27-43-(1)a</b>	<b>Swift Creek</b>		<b>5</b>	<b>Habitat Degradation</b>	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	1989	1998	5
From source to confluence with Williams Creek											
WS-III;NSW	03-04-02	2.6 FW Miles									
<b>27-43-(1)b</b>	<b>Swift Creek</b>		<b>5</b>	<b>Habitat Degradation</b>	Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
From confluence with Williams Creek to backwaters of Lake Wheeler (0.5 miles upstream of Penny Road SR 1379)											
WS-III;NSW	03-04-02	5.5 FW Miles		Impoundment MS4 NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2001	1998	5
				<b>Low Dissolved Oxygen</b>	Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
				<b>Nutrient Impacts</b>	Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
				MS4 NPDES WWTP NPDES							
				<b>Toxic Impacts</b>							
				MS4 NPDES							
				<b>Turbidity</b>							
				MS4 NPDES							
<b>27-43-2</b>	<b>Williams Creek</b>		<b>5</b>		Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	1989	1998	5
From source to Swift Creek											
WS-III;NSW	03-04-02	2.6 FW Miles									
<b>Subwatershed (WBD-12 Number) 030202011002</b>											
<b>27-43-5-(1.5)</b>	<b>Unnamed Tributary to Swift Creek (Yates Mill Pond)</b>		<b>2</b>		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2004		1
From dam at Silver Lake to a point 0.5 mile upstream of mouth											
WS-III;NSW	03-04-02	6.2 FW Miles			Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2004		1
<b>27-43-(1)d</b>	<b>Swift Creek</b>		<b>5</b>	<b>Habitat Degradation</b>	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2004	2008	5
From Lake Wheeler Dam to a point 0.6 mile upstream of Wake County SR 1006											
WS-III;NSW	03-04-02	2.4 FW Miles		Impoundment MS4 NPDES							
<b>27-43-(5.5)a</b>	<b>Swift Creek (Lake Benson)</b>		<b>5</b>	<b>Habitat Degradation</b>	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2004	2008	5
From a point 0.6 mile upstream of Wake County SR 1006 to backwaters of Lake Benson											
WS-III;NSW,CA	03-04-02	0.9 FW Miles		Impoundment MS4 NPDES							
<b>27-43-(5.5)b</b>	<b>Swift Creek (Lake Benson)</b>		<b>2</b>		Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2005		1
From backwaters of Lake Benson to dam at Lake Benson											
WS-III;NSW,CA	03-04-02	472.0 FW Acres									

**Subwatershed (WBD-12 Number) 030202011004**

**Mahlers Creek-Swift Creek**



**Table 6 Neuse River Basin**

**Subbasin (WBD-8 Number) 03020201**

**DWQ Subbasin**

**03-04-02**

Assessment Unit Number	Name		Overall Category	Potential Stressors Potential Sources	Use Support	Use Support	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category	
Description Classification	DWQ Subbasin	Miles/Acres			Category	Rating						
<b>Subwatershed (WBD-12 Number) 030202011103</b>					<b>Poplar Creek-Neuse River</b>							
<b>27-(36)</b>	<b>NEUSE RIVER</b>		<b>2</b>		Aquatic Life	Not Rated	Data Inconclusive	Zinc	2006		3m	
From mouth of Beddingfield Creek to a point 0.2 mile downstream of Johnston County SR 1700					Aquatic Life	Not Rated	Data Inconclusive	Iron	2006	3m		
WS-V;NSW	03-04-02	4.3 FW Miles			Aquatic Life	Not Rated	Data Inconclusive	Copper	2006	3m		
					Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006	1		
					Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006	1		
<b>27-(38.5)</b>	<b>NEUSE RIVER</b>		<b>5</b>	<b>Turbidity</b> Construction General Agriculture/Pasture Stormwater Runoff	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m	
From a point 0.2 mile downstream of Johnston County SR 1700 to point 1.4 mile downstream of Johnston County SR 1908					Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2008 5		
WS-IV;NSW	03-04-02	9.7 FW Miles			Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1		
					Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006	1		
					Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006	1		
<b>27-35</b>	<b>Poplar Creek</b>		<b>2</b>		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1	
From source to Neuse River					Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006	1		
C;NSW	03-04-02	5.5 FW Miles										
<b>Subwatershed (WBD-12 Number) 030202011105</b>					<b>Buffalo Creek-Neuse River</b>							
<b>27-(41.7)</b>	<b>NEUSE RIVER</b>		<b>5</b>	<b>Fecal Coliform Bacteria</b> MS4 NPDES <b>Mercury</b> WWTP NPDES <b>Turbidity</b> Construction MS4 NPDES WWTP NPDES	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m	
From City of Smithfield water supply intake to a point 1.7 miles upstream of Bawdy Creek					Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2008 5		
WS-V;NSW	03-04-02	26.2 FW Miles			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006	1		
					Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006	1		
<b>Watershed (WBD-10 Number) 0302020117</b>					<b>Moccasin Creek-Neuse River</b>							
<b>Subwatershed (WBD-12 Number) 030202011702</b>					<b>Polecat Branch-Neuse River</b>							
<b>27-(49.5)a</b>	<b>NEUSE RIVER</b>		<b>2</b>		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m	
From a point 1.7 miles upstream of Bawdy Creek to subbasin 030402-030412 boundary					Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1		
WS-IV;NSW	03-04-02	7.0 FW Miles			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006	1		
					Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006	1		

Note: See Section 23.3 for Overall and IR Category explanation.

Supporting waters are listed in Categories 1-3. Impaired waters are listed in Categories 4 or 5.

sediment and bacteria loads resulting in turbidity standard violations and low dissolved oxygen levels which contributes to poor biological integrity as well as to recreation impairments. Impaired biological communities are typical of streams that run through urban areas; great efforts will be needed to reduce impacts from urban runoff.

The Neuse River mainstem is also primarily affected by stormwater runoff. Approximately 36 miles of the Neuse mainstem have been added to NC 2008 impaired waters list due to elevated turbidity levels. The turbidity levels at the majority of the sites along the Neuse River in this subbasin ranged between 7 and 12 percent exceedance of the standard. The number of exceedances has increased in this segment since the last assessment period. Low dissolved oxygen is also seen in the area above and directly below the Milburnie dam. The Neuse in this subbasin is likely impacted by the large amount of development that is occurring throughout Wake and Johnston Counties. With the projected increase in population growth for this area, this trend is likely to continue unless we take steps now to preserve critical areas against further development. Local governments, land trusts and watershed groups need to work together to protect and preserve sensitive lands within this watershed.

Lake Crabtree, Crabtree Creek, Brier Creek, Little Brier Creek, Walnut Creek, Rocky Branch and the Neuse River from Crabtree Creek to Auburn-Knightdale Road are all posted by the Department of Health and Human Services for a fish consumption advisory due to high levels of polychlorinated biphenyl (PCB) concentrations in certain species of fish in these areas. The fish consumption advisories are different for each of the streams listed. See details listed under each stream within this subbasin chapter or visit the NC DHHS Division of Public Health website at <http://www.schs.state.nc.us/epi/fish/current.html>. The source of the PCB contamination is the former Ward Transformer facility. This site was included on the National Priorities List /Superfund List in April 2003.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 4. Table 6 contains a list of assessment unit numbers (AU#) and length, streams monitored, monitoring data types, locations and use support ratings for waters in the subbasin. Refer to [http://h2o.enr.state.nc.us/tmdl/General\\_303d.htm](http://h2o.enr.state.nc.us/tmdl/General_303d.htm) for more information about use support methodology.

Waters in the following sections and in Table 6 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters and identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

## **2.2 Use Support Assessment Summary**

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. For aquatic life, an Excellent, Good, Good-Fair, Fair, or Poor bioclassification is assigned to a stream based on the biological data collected by DWQ. For more information about bioclassification and use support assessment, refer to [http://h2o.enr.state.nc.us/tmdl/General\\_303d.htm](http://h2o.enr.state.nc.us/tmdl/General_303d.htm). Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 7 for a summary of use support for waters in subbasin 03-04-02 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

## 2.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's impaired waters list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology can be found at [http://h2o.enr.state.nc.us/tmdl/General\\_303d.htm](http://h2o.enr.state.nc.us/tmdl/General_303d.htm).

Table 7 Summary of Use Support Ratings in Subbasin 03-04-02

Units	Total Monitored Waters		Total Impaired Waters		Total Supporting Waters		Total Not Rated Waters		Total No Data	Total
	Miles/ Acres	Miles/ Acres	%	Miles/ Acres	%	Miles/ Acres	Miles/ Acres	Miles/ Acres	Miles/ Acres	
Freshwater acres (impoundments)	1,018	546	29	472	25	0	842	1,861		
Freshwater miles (streams)	262	151	30	101	20	10	250	512		

% - Percent of total miles/acres.

### 2.3.1 Crabtree Creek Watershed [AU# 27-33-(1), 27-33-(3.5)a, 27-33-(3.5)b1, 27-33-(3.5)b2, 27-33-(10)a, 27-33-(10)b & 27-33-(10)c]

Crabtree Creek Watershed Map (Figure 8)

#### 2002 Recommendations

DWQ will continue monitoring Crabtree Creek. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Crabtree Creek. DWQ will continue to support the City of Raleigh stormwater programs.

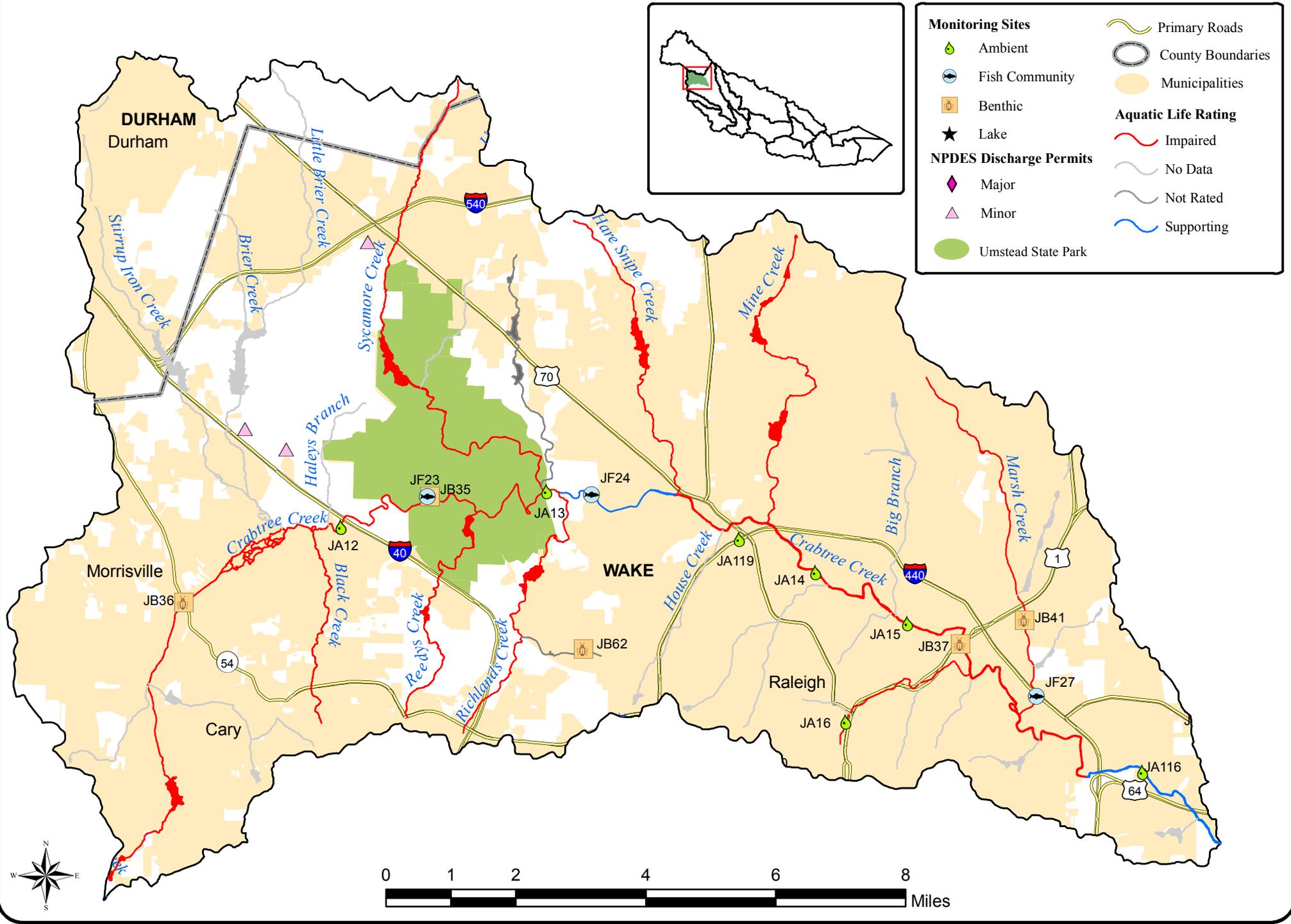
The impaired biological community in Crabtree Creek is typical of streams that run through urban areas. As can be seen by the water quality improvement in Umstead Park, undisturbed land with little impervious surface area can help to maintain aquatic habitats and the integrity of the biological community.

#### Current Status

##### Crabtree Creek [AU# 27-33-(1)]

Crabtree Creek [AU# 27-33-(1); C; NSW] from the source to backwaters of Crabtree Lake (5.1 miles) is Impaired due to a Poor benthic community bioclassification at site JB36. This rating is unchanged from 1995 and 2000. The stream banks were moderately eroded and the stream was turbid and smelled of sewage at the time of sampling. Both the taxa richness and EPT richness

# Figure 8 Crabtree Watershed



have decreased by 50 percent since the 2000 sampling date indicating continued water quality degradation. This segment of Crabtree Creek will remain on the 303(d) list for impaired biological integrity.

Crabtree Creek (Crabtree Lake) [AU# 27-33-(3.5)a]

Crabtree Creek (Crabtree Lake) [AU# 27-33-(3.5)a; B; NSW] from the backwaters of Crabtree Creek to Cary WWTP (6.8 miles) is currently Impaired for aquatic life due to turbidity standard violations in 16 percent of the samples collected at ambient monitoring station JA12. The maximum recorded reading was 140 NTUs. The dissolved oxygen levels were also lower than 5 mg/l in 11 percent and lower than the state's 4 mg/l instantaneous DO standard in 5 percent of the samples analyzed. The conductivity was also high in this stretch of Crabtree Creek with reading ranging between 65 and 378  $\mu\text{mhos/cm}$ . Nutrients were not assessed at this location.

This segment of Crabtree Creek is classified as primary recreational waters (Class B) and is Supporting recreational uses because fecal coliform bacteria screening was not exceeded at JA12.

There were no macroinvertebrate or fish community samples collected during this assessment period for this section of Crabtree Creek. This segment will remain on the 303(d) list for impaired biological integrity and will be added to the list due to the turbidity standards violation.

This segment will be also be added to the 2008 303(d) impaired waters list for Fish Consumption Advisory for PCBs (see *Crabtree Watershed - Site Specific PCB Fish Consumption Advisory* information below for more details).

Crabtree Creek (Crabtree Lake) [AU# 27-33-(3.5)b]

Crabtree Creek [AU# 27-33-(3.5)b; B; NSW] from the Cary WWTP to the mouth of Richlands Creek (5.4 miles) is Impaired for aquatic life because the turbidity standard of 50 NTU was exceeded in 14 percent of the samples at ambient monitoring station JA13. The conductivity and nutrient levels were elevated at this station with conductivity readings ranging between 82 and 480  $\mu\text{mhos/cm}$  and the maximum  $\text{NH}_3$ ,  $\text{NO}_3+\text{NO}_2$ , TKN and TP readings of 0.14, 1.4, 1.2, and 1.4 mg/l respectively.

This segment of Crabtree Creek is currently on the 303(d) list for turbidity and low dissolved oxygen standard violations, however the dissolved oxygen levels during this assessment period were all above the 4 mg/l instantaneous standard. This segment will be removed from the 303(d) list for low dissolved oxygen and remain on the list for turbidity standard violations.

This segment of Crabtree Creek is supporting a Good-Fair benthic and an Excellent fish community bioclassification at sites JB35 and JF23 respectively. These sites are located 1 mile down stream from the Cary WWTP and located within Umstead State Park. The instream substrate was covered in thick periphyton indicative of excess nutrients and there was a slight smell of chlorine. The conductivity was also elevated during both the benthic and fish sampling dates. The benthic site has consistently had a Good-Fair benthic rating since 1995. However, both the taxa and ETP richness decreased since 2000 indicating a decline in water quality. This was the first time the fish community was sampled at this location. It appears that the upstream WWTP does not seem to be having a negative effect on the fish community in this section of Crabtree Creek.

This segment of Crabtree Creek is classified as primary recreational waters (Class B) and is Supporting recreational uses because fecal coliform bacteria screening was not exceeded at JA13.

This segment will be also be added to the 2008 303(d) impaired waters list for Fish Consumption Advisory for PCBs (see *Crabtree Watershed - Site Specific PCB Fish Consumption Advisory* information below for more details).

Crabtree Creek [AU# 27-33-(10)a, b, & c]

These segments will be also be added to the 2008 303(d) impaired waters list for Fish Consumption Advisory for PCBs (see *Crabtree Watershed - Site Specific PCB Fish Consumption Advisory* information below for more details).

Crabtree Creek [AU# 27-33-(10)a; C; NSW] from mouth of Richlands Creek to mouth of Hare Snipe (2.0 miles) is Supporting aquatic life due to an Excellent fish community bioclassification at site JF24. This site received an excellent rating in both 2000 and 2005. The instream riparian habitat was of good quality at this location.

Crabtree Creek [AU# 27-33-(10)b; C; NSW] from the mouth of Hare Snipe to 2.75 miles upstream of Neuse River (10.9 miles) is Impaired for aquatic life due to a Fair benthic community bioclassification at site JB37 and a turbidity standards violation at ambient monitoring station JA15. Benthic site JB37 has been consistently rated Fair since 1984. The visible land cover was predominately commercial. Instream habitat was sparse and the stream banks were severely eroded. At the time of sampling, the site smelled of urine and a large amount of trash was present in and around the stream. Based on the benthic data, no major changes in water quality have been observed.

Based on EPA guidance, Crabtree Creek [AU# 27-33-(10)b] was added to the 2004 303(d) list for turbidity standard violations. DWQ missed this during the last assessment period, possibly due to a sample location change in March of 1999. The data indicated that turbidity at site JA15 had exceeded the state standard in 16 percent of the samples collected between March 1999 and August 2000. During this assessment period, turbidity exceeded the state standard in 5 percent of the samples at site JA14 and in 12 percent of the samples at site JA15. The conductivity and nutrients were also elevated in this segment of Crabtree Creek with conductivity ranging between 56 and 414 at these two stations. Nutrient analysis assessed at station JA14 found maximum recorded levels of NH<sub>3</sub>, NO<sub>3</sub>+NO<sub>2</sub>, TKN and TP at 0.28, 2.82, 4.39, and 2.51 mg/l respectively. Dissolved oxygen levels were also below 5 mg/l in 18 percent of the samples tested at JA14 with a minimum recorded reading of 3.4 mg/l.

This segment of Crabtree Creek will remain on the 303(d) impaired waters list for impaired biological integrity and for turbidity standard violations.

Crabtree Creek [AU# 27-33-(10)c; C; NSW] from 2.75 miles upstream of Neuse River to Neuse River (2.8 miles) is Supporting aquatic life due to No Criteria Exceeded at ambient monitoring station JA116. The dissolved oxygen levels were below 5 mg/l in 7 percent of the samples tested. It is apparent that most of Crabtree Creek suffers from excessive stormwater runoff as it flows through Raleigh, resulting in high nutrient and sediment loading which contributes to the turbidity standard violations, low dissolved oxygen levels and poor biological integrity.

Crabtree Creek AU# 27-33-(10)b and 27-33-(10)c are also Not Rated for recreational use due to elevated fecal coliform levels at JA15 (28 percent) and JA116 (20 percent). The fecal coliform bacteria levels were above the state standard of a geometric mean of greater than 200 colonies/100 ml and/or greater than 400 colonies/100 ml in more than 20 percent of the samples. Fecal coliform levels were also elevated at site JA14 (12 percent). Fecal coliform levels are also affected by stormwater flows.

#### Crabtree Watershed - Site Specific PCB Fish Consumption Advisory

Lake Crabtree and Crabtree Creek is Impaired for fish consumption based on a Department of Health and Human Services (DHHS) advisory for polychlorinated biphenyls (PCBs). DHHS advises the general public not to eat carp or catfish from Lake Crabtree and to limit all other fish consumption from Lake Crabtree to no more than one meal per month. DHHS also advises limiting consumption of carp, catfish and largemouth bass from the area of Crabtree Creek below Lake Crabtree to the Neuse River to no more than one meal per month. The PCB advisories include Brier Creek and Little Brier Creek (see 2.3.2 as the advisory for these creeks are very different than these listed for Crabtree Creek and Lake Crabtree). Swimming, boating and other recreational activities present no known significant health risk due PCB contamination. Consumption of fish beyond what is recommended may increase a person's risk of developing cancer, infection, skin problems such as cracked fingernails and may cause learning deficits in infants from maternal exposure. For more information regarding fish consumption advisories, call (919) 707-5900 or visit the NC DHHS Division of Public Health website at <http://www.schs.state.nc.us/epi/fish/current.html>.

Walnut Creek, Rocky Branch and the Neuse River from just below Crabtree Creek to Auburn-Knightdale Road were added to the fish consumption advisory for PCBs on April 2, 2008. These will be added to the 2010 impaired waters list. This advisory came in too late to be added to the 2008 list. Specifics for each of these will be discussed in the write up for each stream segment below.

Wake County adopted a policy of "catch and release" for fishing in Lake Crabtree and Crabtree Creek below the lake. For more information, Wake County has developed an educational pamphlet, Lake Crabtree and PCBs: What you should know (<http://www.wakegov.com/NR/rdonlyres/2D9B65EA-D05B-448B-8478-970181AADAC3/0/PCBbrochure.pdf>).

The former Ward Transformer facility is the source of the PCB contamination in this area. The process that the company used from 1964 to 1997 allowed PCBs to escape into the environment. This entire area is on the National Priority List for investigation by the USEPA (see segment 2.5.2 for more details).

This entire area will be added to the 2008 303(d) impaired waters list for Fish Consumption Advisory for PCBs (Figure 9).

See Table 8 for a list of impaired creeks within the Crabtree Creek watershed that were not sampled during this assessment period. These will remain on the 303(d) impaired waters list for impaired biological integrity.

# Figure 9 Crabtree Watershed

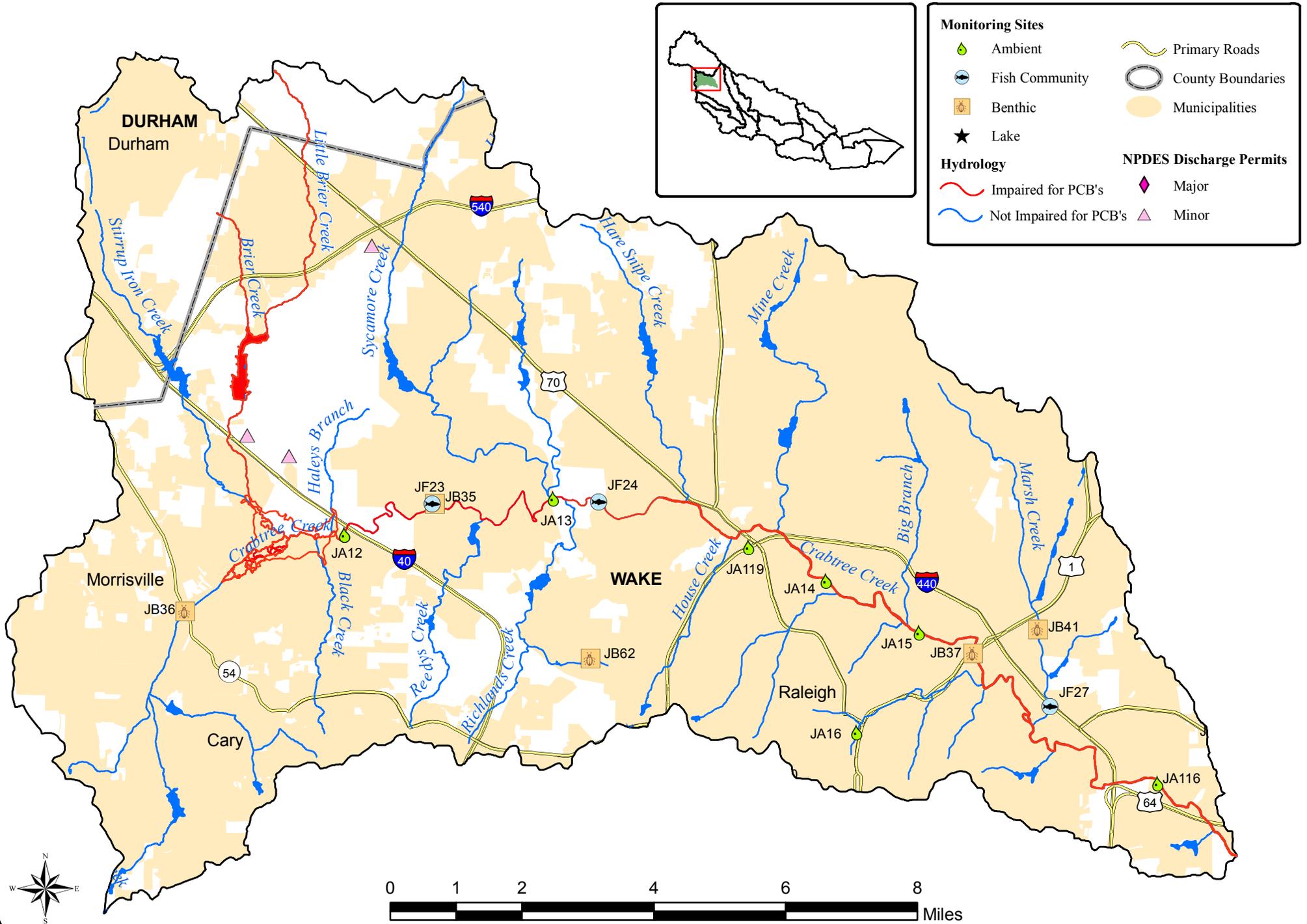


Table 8 Impaired Streams in the Crabtree Creek Watershed (not sampled during this assessment period; see Figure 8).

Creek Name	AU #	Macroinvertebrate Bioclassification Rating	Biological Sampling Date	Year 303(d) Listed
Black Creek	27-33-5	Fair	7/27/2000	1998
Hare Snipe	27-33-12-(2)	Poor	3/17/2000	1998
Hare Snipe Creek (Lynn Lake)	27-33-12-(1)	Fair	1995	1998
Marsh Creek*	27-33-20	Fair	8/25/2005	1998
Mine Creek	27-33-14a	Fair	9/26/1995	1998
Mine Creek	27-33-14b	Poor	3/17/2000	1998
Pigeon House Creek	27-33-18	Poor	2/27/2000	1998
Richlands Creek	27-33-11	Fair	8/15/1996	2004

\* Assessed during this assessment period, see 2.3.8.

### Recommendations

There is a need for better urban stormwater controls/BMPs to help reduce the impacts from development to this watershed. The runoff from development in this area has resulted in a tremendous amount of sedimentation as well as increased the flashiness after storm events which also results in stream bank erosion adding to the sediment load moving downstream.

Recommendations on how to protect and reduce water quality impacts from existing and future urbanization of the watershed can be found in Chapter 12 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (<http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>).

### Water Quality Initiatives

The Triangle Greenway Council's Riparian Corridor Conservation Plan identified Crabtree Creek as one of several focus areas for attention. A donation of 13 acres was accepted along the proposed Turkey Creek greenway corridor that passes through Umstead State Park before reaching Crabtree Creek.

The Triangle Greenway Council also accepted the donation of 75 acres along Crabtree Creek at Marsh Creek that is within an existing greenway corridor. Negotiations are ongoing with the owners of an additional 140 acres of adjoining floodplains and wetlands that may be conserved.

The City of Raleigh has several stream enhancement projects planned within the Mine Creek watershed, a tributary of Crabtree Creek. Three stream enhancement projects and one stream restoration project is currently under design and planned to begin construction in late 2009 or early 2010.

## **2.3.2 Brier Creek [AU# 27-33-4] & Little Brier Creek [AU# 27-33-4-1]**

### Current Status

Brier Creek [AU# 27-33-4; C; NSW] from the source to Crabtree Lake (Crabtree Creek) (6.5 miles) and Little Brier Creek [AU# 27-33-4-1; C; NSW] from the source to Brier Creek (5.3

miles) and the tributaries to Little Brier Creek are Impaired for fish consumption based on a DHHS advisory for polychlorinated biphenyls (PCBs) (Figure 9). DHHS advises the general public Not To Eat Any Fish from these areas. Fish from these waters are not safe to eat. Swimming, boating and other recreational activities present no known significant health risk from PCBs. Consumption of fish beyond what is recommended may increase a person's risk of developing cancer, infections, skin problems such as cracked fingernails and may cause learning deficits in infants from maternal exposure. For more information regarding fish consumption advisories, call (919) 707-5900 or visit the NC DHHS Division of Public Health website at <http://www.schs.state.nc.us/epi/fish/current.html>. For more information on the PCB contamination see section 2.5.2.

There were no other water quality parameters monitored on these two creeks during this assessment period. This area has experience a great deal of development over the last several years. These streams are suffering from stormwater related problem such as erosion from increase stream velocity as well as excess nutrients, toxicants and sediment from runoff events.

### **2.3.3 Black Creek [AU# 27-33-5]**

#### *Current Status*

Black Creek [AU#27-33-5; C; NSW] from the source to Crabtree Lake (3.6 miles) is currently on the NC 303(d) list of impaired waters due to impaired biological integrity (Figure 8). This creek was not assessed during the current assessment period. There is an independent WECO (Watershed Education for Communities and Officials) watershed project underway on Black Creek which assessed biological data in 2006. This data can not be used for use support assessment; however the data indicated that this stream is still highly impacted by urban runoff. The species present were indicators of toxic elements present in the sediment and water column. This creek received a Fair benthic rating during a DWQ assessment in both 1994 and 2000 and was placed on the 1998 303(d) impaired waters list.

#### *Water Quality Initiative*

NCSU WECO have partnered with the Town of Cary to develop a Black Creek Watershed Association, monitoring and restoration planning program which is funded through an USEPA 319 grant. NCSU and the Town of Cary are also contributing funds to this project. The project timeline is January 2006-December 2008, and involves two components:

1. Convene a watershed association of representative stakeholders to collaboratively develop community supported recommendations for watershed management and restoration.
2. Conduct a watershed assessment and monitoring program to determine the causes of Black Creek's impairment and identify practices that will improve its health.

This group will develop a watershed plan that contains consensus based recommendations for protecting and improving the Black Creek watershed. The plan will address the 9 key elements required in a USEPA watershed plan (see EPA website for 9 element plan information [http://www.epa.gov/owow/nps/watershed\\_handbook/](http://www.epa.gov/owow/nps/watershed_handbook/)). You can find out more information on the Black Creek watershed plan process at <http://www.ces.ncsu.edu/depts/agecon/WECO/blackcreek/index.htm>.

### **2.3.4 Pigeon House Branch [AU# 27-33-18]**

#### 2002 Recommendations

DWQ will continue monitoring Pigeon House Branch. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Pigeon House Branch.

The impaired biological community in Pigeon House Branch is typical of streams that run through urban areas. As with Crabtree Creek and the other creeks draining urban Raleigh and Cary, great efforts will be needed to reduce impacts from urban runoff.

#### Current Status

Pigeon House Branch [AU# 27-33-18; C; NSW] from the source to Crabtree Creek (2.9 miles) is currently Not Rated for aquatic life and for recreational use. Pigeon House Branch runs through downtown Raleigh and is severely impacted by urban runoff. The benthic community was not evaluated during this assessment period but received a Poor rating in 1995 and in 2000. The ambient monitoring data at JA16 recorded elevated turbidity levels greater than 50 NTUs in 7 percent of the samples with a maximum reading of 200 NTUs. Conductivity was extremely high at times with readings ranging between 64 and 2237  $\mu\text{mhos/cm}$ . The copper concentrations were also above the state action level of 7  $\mu\text{g/l}$  in 65 percent of the samples with a maximum recorded level of 28  $\mu\text{g/l}$ . Fecal coliform bacteria levels were also extremely high with a geometric mean of 1266 CFU/100 ml and 81 percent of the samples above 400 CFU/100 ml.

Pigeon House Branch will remain on the 303(d) impaired waters list for impaired biological integrity.

A TMDL for fecal coliform bacteria and for copper to Pigeon House Branch was approved in August 2003 by the USEPA. The TMDL recommends a 78 percent reduction in fecal coliform bacteria and a 66 percent reduction in load for copper in order for Pigeon House Branch to meet acceptable state water quality standards. The TMDL study determined that loading of these two pollutants is mainly due to urban stormwater runoff. At the time of the TMDL this watershed was estimated to have 57-78 percent impervious surface cover. Two entities are permitted through the Phase I NPDES stormwater program, the City of Raleigh (NC0029033) and NC DOT (NCS000250). Wake County has a NPDES stormwater permit through the Phase II stormwater program. The State of North Carolina Government Complex and some federal land has stormwater infrastructure within this watershed as well; however they do not have an NPDES permit. All entities with or without an NPDES permit needs to work to reduce these pollutants from stormwater runoff to Pigeon House Branch.

The source for copper is mainly from automobile brake deposits, followed by buildings and atmospheric deposition. The sources of fecal coliform are less certain. The primary sources are likely to be urban runoff containing fecal coliform from pet waste, wildlife waste and potentially human waste as well as from leaky sewer systems and illicit discharges/connections. There have been several sanitary sewer overflows that have also occurred in this watershed.

The City of Raleigh monitored several locations throughout the Pigeon House Branch watershed and identified hot spots for both copper and fecal coliform contributions. The City strategically installed BMPs in this watershed to help reduce copper and fecal coliform at these locations (details in the Water Quality Initiative section below). Three 18,000 gallon cisterns were

installed to collect rainwater and air conditioning condensate from the Legislative Building on the State of North Carolina Government Complex. The captured water is used to irrigate the grounds and gardens as well as provide water for fountains at the Legislative Buildings. This has reduced the flow of stormwater into the City of Raleigh's stormwater sewer system, reduced the amount for nitrogen delivered to the Neuse River and promotes water conservation. The State is also building a new Green Square Complex on two blocks of the government complex. These new buildings will be built using green building technology and will capture and utilize all the stormwater that falls on Green Square Complex. All of these projects will help reduce the amount of runoff and pollutants reaching Pigeon House Branch. The Pigeon House Branch TMDL can be found at [http://h2o.enr.state.nc.us/tmdl/Docs\\_TMDL/Pigeon%20House%20TMDLs\\_final%20version%20approved%20by%20EPA.pdf](http://h2o.enr.state.nc.us/tmdl/Docs_TMDL/Pigeon%20House%20TMDLs_final%20version%20approved%20by%20EPA.pdf).

### Recommendations

Implementation of bacteria and copper controls will be necessary to restore designated uses in Pigeon House Branch. Further reduction strategies are needed.

DWQ will continue to collect ambient data at station JA16 (J3300000) in order to evaluate TMDL compliance.

### Water Quality Initiative

The City of Raleigh received grant funds from the EPA's Section 319 Grant Program and NC Clean Water Management Trust Fund to construct a wetland in Fred Fletcher Park in downtown Raleigh. This wetland will treat runoff for an approximate 60 acre watershed around the park, which is about 40 percent impervious. The wetland will treat the 1in-24hr storm for this area before it flows into Pigeon House Branch reducing much of the nutrient, fecal, and sediment load to this segment of the stream. Construction of the wetland at Fred Fletcher Park began in spring 2008 and completed in fall 2008.

The City is also involved in several other projects to reduce impacts to Pigeon House Branch. Two bioretention areas have been installed to serve City maintenance facilities located directly adjacent to the main channel of Pigeon House Branch near downtown Raleigh. The first bioretention area is approximately 6,000 square feet and treats runoff from a 100% impervious watershed approximately 1 acre in size. The second bioretention area is approximately 1,000 square feet and treats runoff from a 100% impervious watershed of approximately 0.4 acre. These projects were completed in the summer and early fall of 2008.

Three additional stream enhancement projects are planned within the Pigeon House Branch watershed beginning in early 2009. Each stream enhancement project is aimed at improving water quality by stabilizing existing stream bank erosion, preventing future stream bank erosion, and improving habitat while protecting large mature trees within the existing stream buffer. The three stream enhancement projects total 2,250 linear feet of stream.

## **2.3.5 Smith Creek [AU# 27-23-(2)]**

### Current Status

Smith Creek [AU# 27-23-(2); C; NSW] from the Wake Forest Reservoir to Neuse River (5.8 miles) is Impaired for aquatic life based on a Fair fish community bioclassification at site JF31 (Figure 9). The fish community has been sampled at this location in the last three basinwide monitoring cycles, with ratings of Good-Fair, Excellent, and Fair, respectively (Table 9).

Species richness and composition has fluctuated over the ten-year monitoring period and may reflect differences in historic flows and the close proximity to the Neuse River, affecting fish recruitment. Frequent flooding events prior to the 2000 sample may have enhanced the fish communities' diversity by lengthening the free flowing sections of the stream. The 2005 rating dropped from Excellent to Fair because the trophic structure was extremely skewed towards tolerant insectivore species. Most notably, the Eastern mosquito fish (tolerant and abundant in shallow sandy streams) made up almost 45 percent of the total catch in 2005.

The benthic community was classified as Good-Fair during this assessment period. The benthic community has also varied greatly in their bioclassification between Fair and Good since 1995. See Table 9 for the rating changes for Smith Creek overtime.

Table 9 Smith Creek benthic and fish community ratings overtime (at SR2045).

Benthic Sampling Date	Benthic Rating	Fish Sampling Date	Fish Rating
12/2/86	Poor		
7/25/95	Good-Fair	5/18/95	Good-Fair
7/6/00	Fair	4/3/00	Excellent
8/20/01	Good		
8/12/05	Good-Fair	04/05/05	Fair

This area of Smith Creek is surrounded by a mixture of land use cover including forest, residential and industrial and the headwaters for this creek include the rapidly developing towns of Wake Forest and Rolesville. The riparian zone is wide, shaded and forested with some bank erosion and the stream substrate is almost all sand. No ambient monitoring standards were violated at station JA9. Conductivity at this site was elevated with readings ranging from 72 to 255  $\mu$ mhos/cm. Smith Creek is supporting for recreational uses.

There are now two minor NPDES dischargers within five miles upstream of the biological assessment site: Whippoorwill Valley WWTP and G.G. Hill WTP. Jones Dairy Farm WWTP permit was recinded in October 2005. They had several limit violations in the last few years of operation (BOD, TSS and nitrogen). These could have had an effect on the biological community in this area.

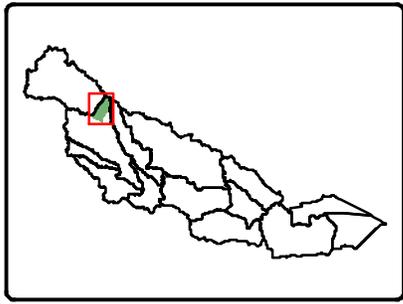
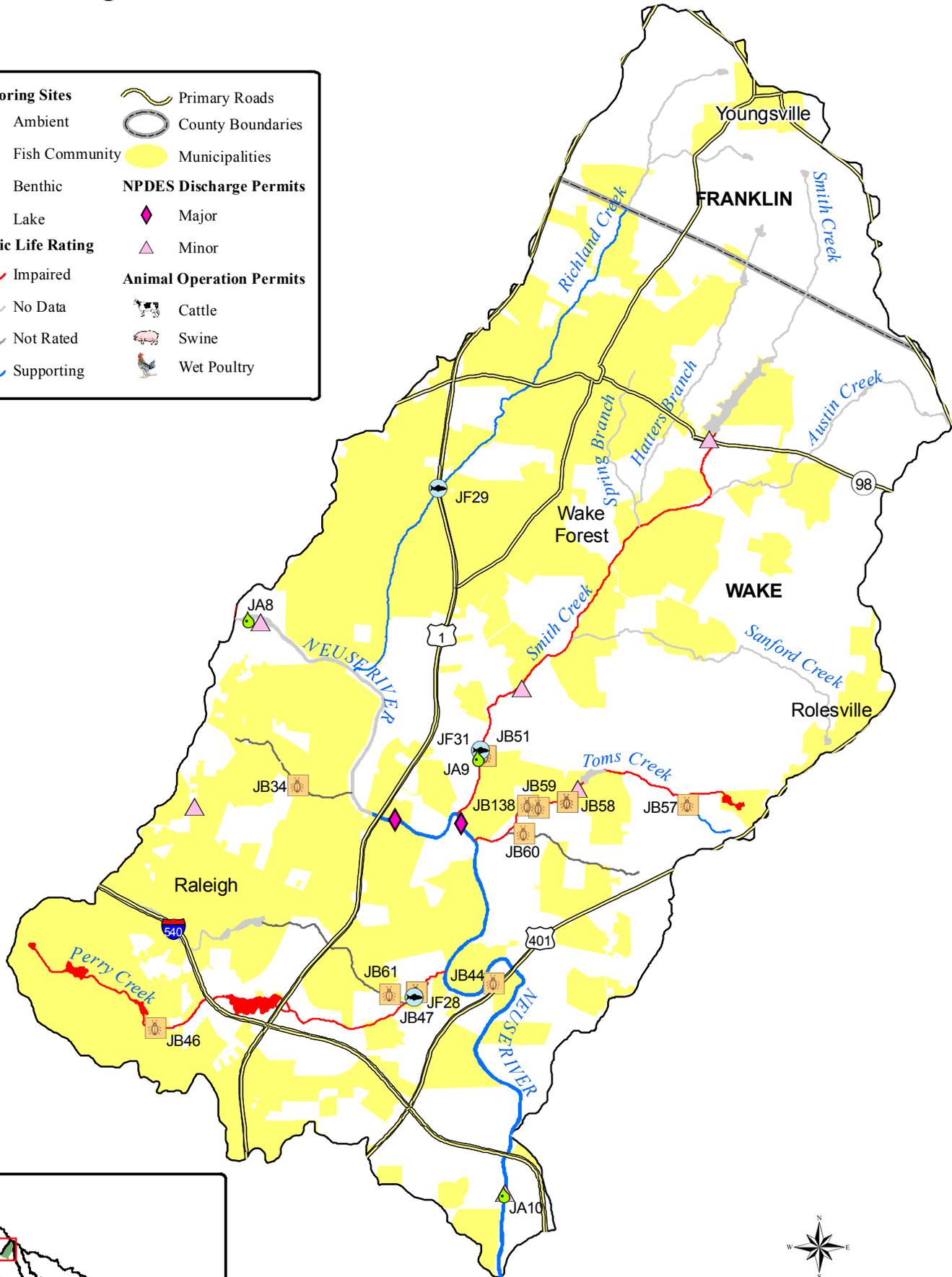
This segment of Smith Creek will be added to the 2008 303(d) list of impaired waters for impaired biological integrity due to the Fair Fish bioclassification.

Recommendations

The 2003 Wake County Watershed Management Plan noted that the Upper Smith Creek watershed was degraded even though this area is not heavily developed (4.3 percent imperviousness) and the upper reaches have high levels of regulations due to the WS-II classification from the source to the dam at Wake Reservoir (Wake County Watershed Management Plan, 2003 [http://projects.ch2m.com/WakeCounty/Docs/MT\\_01\\_2003.pdf](http://projects.ch2m.com/WakeCounty/Docs/MT_01_2003.pdf)). DWQ should sample above the reservoir during the next assessment period to determine the impact from development occurring in this area.

# Figure 10 Smith, Toms, and Richland Creek Watersheds

<b>Monitoring Sites</b>	Primary Roads
Ambient	County Boundaries
Fish Community	Municipalities
Benthic	<b>NPDES Discharge Permits</b>
Lake	Major
<b>Aquatic Life Rating</b>	Minor
Impaired	<b>Animal Operation Permits</b>
No Data	Cattle
Not Rated	Swine
Supporting	Wet Poultry



### 2.3.6 Toms Creek (Mill Creek) Watershed [AU# 27-24a1, 27-24a2, 27-24b & 27-24aut2]

Smith Creek, Toms Creek and Richland Creek Watershed Map (Figure 10).

#### 2002 Recommendations

In order to restore the biological community in Toms Creek, the discharger problems need to be addressed, and then aquatic habitat will need to be restored below the dam at Browns Lake. DWQ will work with Deer Chase WWTP to reduce impacts to Toms Creek related to the discharge. Current NSW riparian buffer rules and the NSW and NPDES Phase II stormwater rules need to be fully enforced to prevent increased habitat degradation in Toms Creek.

#### Current Status

UT2 to Toms Creek [AU# 27-24aut2; C; NSW] from source to Toms Creek (0.7 miles) is Supporting aquatic life due to a Not Impaired benthic bioclassification at site JB57. This site was assessed to determine the conditions above Browns Lake, where there was little development at the time of sampling in 2005. No riffles were present, but other types of habitat were common. The riparian zone was wide and densely wooded. This site exhibited remarkable taxa richness for a small Piedmont stream.

Toms Creek [AU# 27-24a1; C; NSW] from source to Browns Creek/Saint Andrews Plantation (1.6 miles) is Impaired for aquatic life based on a historical benthic sample. This section was not sampled during this assessment period, however it appears that this section as well as the Lake are being heavily influenced by sediment runoff from the development that is occurring in this watershed.

Toms Creek (Browns Lake/ Saint Andrews Plantation) [AU# 27-24a2; C; NSW] (8.1 acres) had no data collected during this assessment period therefore it is officially rated as ND (no data).

Toms Creek [AU# 27-24b; C; NSW] from Browns Creek/Saint Andrews Plantation to Neuse River (1.5 miles) is Impaired for aquatic life based on a Poor benthic community bioclassification at site JB138. Sediment from nearby development in 1995 buried the riffles and eliminated the intolerant taxa, dropping EPT taxa richness and the bioclassification to a Fair rating. No recovery was evident in 2000 or 2005 in either the habitat or benthic community. The EPT taxa numbers continued to drop in 2005 resulting in the drop in bioclassification to Poor.

Land cover surrounding the site was predominantly residential. The benthic substrate was all sand and instream habitat for macroinvertebrate colonization was poor. The riparian zone was wide, shaded, and forested with a few breaks.

A DWQ Watershed Assessment and Restoration Project (WARP) was performed in June 2001 on Toms Creek (NCDENR-DWQ June 2002).

Toms Creek at Kemble Ridge Dr. below the Deer Chase WWTP discharge (site JB58) was sampled to evaluate the impact of the discharge and was located below the discharging mixing point. Poor habitat and instream stability was evident. The stream channel was deeply incised, with steep banks composed largely of sand. The benthic community was severely impacted and the poor habitat and substrate instability make it difficult for a permanent benthic community to become established. The benthic community at this station was also severely degraded. The

EPT richness and other indicators were indicative of a more impacted community such as the signs of toxic effects possibly associated with residual chlorine levels.

A WARP management strategy for Toms Creek was as follows:

1. DWQ should ensure that chlorine concentrations in the Deer Chase WWTP effluent are reduced to nontoxic levels.
2. The gully at the outlet to Browns Lake should be rehabilitated so that the side slopes are stable and are no longer a source of sediment to Toms Creek.
3. More Effective sediment and erosion control practices are essential in order to prevent future water quality deterioration related to new construction activities.
4. The Neuse River basin riparian buffer and stormwater rules must be fully and effectively implemented to prevent channel erosion due to future hydrologic changes in the watershed.
5. Effective development planning and stormwater management should be implemented throughout the watershed, including those areas not covered by the Neuse River basin stormwater rules or the Phase II stormwater requirements.
6. Localized areas of bank erosion between Browns Lake and Ligon Mill Road should be stabilized using bioengineering techniques.
7. Riparian areas in the Saint Andrews Plantation and Carriage Run subdivisions should be replaced with native woody vegetation where it has been removed.
8. A watershed education program should be developed and implemented with the goal of targeting homeowners in order to reduce current stream damage and prevent future degradation

The Deer Chase WWTP currently has a total residual chlorine limit that went into place in November 1, 2004. The plant switched to using UV as apposed to chlorination for disinfection purposed. Residual chlorine levels should no longer be an issue in the creek.

The Browns Lake dam was repaired in the fall of 2005. The gully that had formed around the dam was also repaired in the process and according to the Division of Land Resources in Raleigh, there is no erosion currently resulting from this new spillway. This should help reduce some of the sediment impact to the lower portion of Toms Creeks, however this watershed is still experiencing a great deal of development.

The main stressors to this system are identified as sedimentation from new construction and stormwater runoff as well as stream bank instability. Discharge from the WWTP has also been a contributing factor towards the impairment of Toms Creek. The elevated chlorine levels have had a detrimental effect on the aquatic organisms, which could possibly be reversed in time if WWTP levels remain within permitted levels.

Though current bank erosion appears generally moderate, the steepness of the banks and sandy nature of the upper bank material results in a fairly high erosion potential for the main stem of Toms Creek between Brown Lake and Ligon Mill Road, and for much of Mill Creek (UT4 to Toms Creek). These streams will be highly vulnerable to future disturbances. Without stormwater controls for new development, increases in frequency or duration of erosive flows will promote bank erosion and stream widening, initiating a long period of channel instability.

The Watershed Assessment and Restoration Project (WARP) study in 2001 was valuable in defining the extent of impairment in Toms Creek and in determining the causes of impairment.

Extensive monitoring completed during the project determined that high chlorine levels in the Deer Chase WWTP discharge and habitat degradation from high stormwater flows in the lower part of the creek are mainly responsible for the biological impairment in this watershed.

#### Recommendations

Toms Creek is a small stream to serve as receiving waters for a wastewater discharge. Removal of the discharge from Toms Creek and connection to the Wake Forest system, which lies in close proximity to the outfall line, is the best long-term option.

The Neuse buffer regulations should also help prevent sediment inputs if they are properly implemented. These regulations do not apply to ephemeral streams, which are an important part of the channel network and receiving drainage from substantial areas. Education of landowners regarding the benefits of riparian vegetation and discouraging removal of additional riparian vegetation would be useful both in areas being developed under the Neuse buffer regulations and in existing developments.

#### Water Quality Initiative

Town of Wake Forest has received a grant from the Clean Water Management Trust Fund to purchase land for a greenway and riparian buffer along Toms Creek between Ligon Mill Road and the Neuse River.

### **2.3.7 Perry Creek [AU# 27-25-(1) & 27-25-(2)]**

#### 2002 Recommendations

Perry Creek is in an urbanizing area of Wake County. DWQ will continue monitoring Perry Creek. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Perry Creek.

The impaired biological community in Perry Creek is typical of streams that run through urban areas. As with Crabtree Creek and the other creeks draining urban Raleigh and Cary, great efforts will be needed to reduce impacts from urban runoff.

#### Current Status

Perry Creek [AU# 27-25-(1); B; NSW] from the source to dam at Greshams Lakes (2.4 miles) remains impaired due to a previous assessment. The current assessment could not be rated due to the proximity of the benthic monitoring site JB46 to an impoundment (Figure 10). This was the only plausible upstream location due to low flow conditions elsewhere in the upper watershed. However, this site proved to be a poor location, positioned 500 meters downstream from an impoundment. The benthic community was very sparse and composed of highly tolerant taxa suggesting a degraded benthic assemblage.

Perry Creek [AU# 27-25-(2); C; NSW] from the dam at Greshams Lake to the Neuse River (2.5 miles) is Impaired for Aquatic Life due to a Fair benthic community bioclassification at site JB47 (Figure 10). The benthic macroinvertebrate community has consistently been rated Fair in Perry Creek since 1995. The stream banks were unstable and exhibited moderate erosion. Sandbars were actively being developed, and the stream had a flashy appearance. Both sites lacked specific indicator taxa and exhibit highly tolerant benthic communities suggesting considerable impact from urban/suburban pressures. A 2004 TMDL stressor study found that the pH ranged from 5.7 to 6.4 throughout Perry Creek. The conductivity also ranged from 96 to 169,

indicative of an urban impacted stream. High nutrient levels and periphyton were also found throughout this watershed.

The Fish community was rated Good-Fair at site JF28. The most abundant species was the tolerant, Eastern mosquito fish (37 percent).

The entire length of Perry Creek will remain on the 303(d) list for impaired biological integrity.

The high amount of impervious area associated with the urban development present in the watershed of Perry Creek that is located in the City of Raleigh contributes to rapid and significant increases in stream flow after a rainfall event. The stream bank erosion and sedimentation associated with these events contribute to habitat degradation that would be associated with biological impairment. Additionally, nutrient enrichment associated with development around Greshams Lake may also contribute to biological impairment by causing algal activity and the resulting lowered dissolved oxygen levels.

#### Recommendations

There is a need for better urban stormwater controls/BMPs to help reduce the impacts from development to this watershed. The runoff from development in this area has resulted in a tremendous amount of sedimentation as well as increased the flashiness of this stream after storm event which also results in stream bank erosion adding to the sediment load moving downstream.

Recommendations on how to protect and reduce water quality impacts from existing and future urbanization of the watershed can be found in Chapter 12 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (<http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>).

### **2.3.8 Marsh Creek [AU#27-33-20]**

#### 2002 Recommendation

DWQ will continue monitoring Marsh Creek. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Marsh Creek.

The impaired biological community in Marsh Creek is typical of streams that run through urban areas. As with Crabtree Creek and the other creeks draining urban Raleigh and Cary, great efforts will be needed to reduce impacts from urban runoff.

#### Current Status

Marsh Creek [AU#27-33-20; C; NSW] from source to Crabtree Creek (6.0 miles) is Impaired for aquatic life based on a Fair benthic community bioclassification at site JB41. The stream banks are vertical, sparsely vegetated, and severely eroded. Instream habitat available for macroinvertebrate colonization was also very sparse. The fish were found to have a Good-Fair bioclassification at site JF27. No intolerant species were collected at this site.

Marsh Creek will remain on the 303(d) list for impaired biological integrity.

#### Recommendations

There is a need for better urban stormwater controls/BMPs to help reduce the impacts from development to this watershed. The runoff from development in this area has resulted in a

tremendous amount of sedimentation as well as increased the flashiness of this stream after storm events which also result in stream bank erosion adding to the sediment load moving downstream.

Recommendations on how to protect and reduce water quality impacts from existing and future urbanization of the watershed can be found in Chapter 12 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (<http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>).

#### Water Quality Initiative

Wake County Soil and Water Conservation District received funding through the Community Conservation Assistance Program Pilot Project through the Division of Soil and Water and Clean Water Management Trust Fund to do stormwater retrofits and education at Brentwood Elementary.

### **2.3.9 Walnut Creek [AU# 27-34-(1.7), 27-34-(4)a & 27-34-(4)b]**

#### 2002 Recommendations

Although water quality in Walnut Creek appears to be improving in the lower segments, the watershed drains urbanized and urbanizing areas of Raleigh and Cary and the potential for degradation of instream habitat is very high. DWQ will reestablish a biological monitoring station above Lake Raleigh and Lake Johnson to better assess impacts from stormwater runoff.

There are currently two NCEEP restoration projects ongoing in the Walnut Creek watershed designed to stabilize stream banks and reduce sedimentation.

#### Current Status

Walnut Creek [AU# 27-34-(1.7); C; NSW] from the dam at Lake Johnson to backwaters of Lake Raleigh (1.4 miles) is currently rated as ND (no data). This segment was however listed on the 1998 303(d) list of impaired water for impaired biological integrity due to a Poor fish rating in 1995. A biological TMDL will have to be completed for the Walnut Creek watershed by 2013.

Lake Raleigh [AU# 27-34-(3.5); B; NSW] was also not assessed during this assessment period and is currently rated ND.

Walnut Creek [AU# 27-34-(4)a; C; NSW] from the dam at Lake Raleigh to UT 0.6 miles west of I-440 (6.4 miles) is Impaired for aquatic life due to a Fair benthic bioclassification at JB63. This watershed contains a large amount of impervious surfaces resulting in a very flashy prone stream; leading to scouring and stream bank erosion. The vegetated canopy at this site was good and the riparian corridor was extensive, with no breaks.

The co-occurring fish community site JF32 was rated Good-Fair. The fish community data indicate an unbalanced trophic structure in this stream, dominated by insectivores and an increasing percentage of tolerant species.

This segment will remain on the 303(d) list for impaired biological integrity.

Walnut Creek [AU# 27-34-(4)b; C; NSW] from UT 0.6 miles west of I-440 to Neuse River (3.7 miles) is Impaired for aquatic life due to a turbidity standards violation at ambient monitoring station JA17. The turbidity was above the state standard of 50 NTUs in 13 percent of the

samples collected. This same segment is supporting recreational uses, however fecal coliform bacteria levels were elevated above 400 colonies/100 ml in 15 percent of the samples.

This section of Walnut Creek will be added to the 2008 303(d) list of impaired waters for a turbidity standards violation.

The largest wastewater spill in NC in the last decade occurred at the Barwell Road lift station on this segment of Walnut Creek. An ice storm on December 4, 2002 resulted in a countywide power outage, which resulted in 9 million gallons of raw sewage reaching Walnut Creek. The backup power generator failed to work at this location. A similar spill occurred after Hurricane Fran in 1996 due to a power outage.

A fish consumption advisory for Walnut Creek was recently added by Department of Health and Human Services (DHHS) for polychlorinated biphenyls (PCBs). DHHS advises the general public to limit fish consumption of carp and catfish to no more than one meal per month and to limit consumption of all other fish to no more than one meal per week. This advisory went into affect on April 2, 2008. This notice was past the date to be included on the 2008 303(d) impaired waters list, so Walnut Creek will be added to the 2010 impaired waters list for fish consumption impairment. Swimming, boating and other recreational activities present no known significant health risk from PCBs. Consumption of fish beyond what is recommended may increase a person's risk of developing cancer, infection, skin problems such as cracked fingernails and may cause learning deficits in infants from maternal exposure. For more information regarding fish consumption advisories, call (919) 707-5900 or visit the NC DHHS Division of Public Health website at <http://www.schs.state.nc.us/epi/fish/current.html>.

### Recommendations

There is a need for better urban stormwater controls/BMPs to help reduce the impacts from development to this watershed. The runoff from development in this area has resulted in a tremendous amount of sedimentation as well as increased the flashiness of this stream after storm event which also results in stream bank erosion adding to the sediment load moving downstream.

Recommendations on how to protect and reduce water quality impacts from existing and future urbanization of the watershed can be found in Chapter 12 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (<http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>).

### Water Quality Initiatives

The Triangle Greenways Council's Riparian Corridor Conservation Plan identified Walnut Creek as one of the several focus areas for attention. Since then the Triangle Greenway Council has collaborated with the Partners for Environmental Justice to enhance Raleigh's existing greenway corridor network and advance outdoor classroom opportunities for a proposed Urban Wetland Park and Environmental Education Center. To date, within two miles of the State's historic Capital building, 51 acres have been conserved by donation, 91 acres are under option for acquisition, and negotiations continue on the conservation of an additional 60 acres with the corridor and included Walnut Creek Bottomland Forest Natural Heritage Area. Funding for this initiative has come from the Clean Water Management Trust Fund and phase VI and VII funds administrated by the Conservation Trust of NC.

### **2.3.10 Neuse River [AU# 27-(38.5) & 27-(41.7)]**

#### Neuse River [AU# 27-(38.5)]

Neuse River [AU# 27-(38.5); WS-IV; NSW] from a point 0.2 miles downstream of Johnston County SR 1700 to a point 1.4 miles downstream of Johnston County SR1908 (9.7 miles) is Impaired for aquatic life due to a turbidity exceedance of 10 percent at ambient monitoring station JA21 and JA22 (Table 10, in section 2.4.1). Ambient monitoring station JA21 is a DWQ and LNBA (Lower Neuse Basin Association) co-located site in which the data was combined and the overall average was used to assess use support.

The benthic rating at site JB42 dropped from a Good in 2000 to Good-Fair in 2002 and 2005. The instream habitat for macroinvertebrate colonization was reported as poor and the stream banks were moderately eroded even though the riparian zone was wide with no brakes and forested.

This segment of the Neuse River will be added to the 2008 303(d) list for turbidity standard violation.

#### Neuse River [AU# 27-(41.7)]

Neuse River [AU# 27-(41.7); WS-V; NSW] from the City of Smithfield water supply intake to a point 1.7 miles upstream of Bawdy Creek (26.2 miles) is Impaired for aquatic life due to a turbidity exceedance of 12 percent at ambient monitoring station JA23.

This segment of the Neuse River is Supporting for recreational uses because the fecal coliform bacteria screening criteria was not exceeded at this ambient monitoring station (exceeding in 17.5 percent of the samples at this station which is below the 20 percent allowable fecal exceedances).

This segment of the Neuse River will be added to the 2008 303(d) list for turbidity standard violation.

The Wet Log Storage WWTP (NC0085936) in this segment of the river had 3 total suspended solids violations in 2006 and several settleable solids violation in 2004. They installed additional screening devices that have reduced the solids problem. According to the regional office staff, this facility discharges into a ditch far upstream from the Neuse and is not likely a major contributor to the sediment issue in this segment of the Neuse. They did recommend that this facility consider recycling wastewater.

The Central Johnston County WWTP (NC0025453) is conducting a pilot project to enhance denitrification filter operations. They are also applying about 58 million gallons of effluent on reuse fields. At their 2006 estimated discharge rate (15.896 lbs/million gallons), this was an estimated reduction of about 900 lbs of nitrogen or about 450 lbs to the Neuse River Estuary from their reuse program alone.

See section 2.4.1 below for Neuse River subbasin 03-04-02 watershed discussion.

#### Recommendations

There is a need for better urban stormwater controls/BMPs to help reduce the impacts from development to this watershed. The runoff from development throughout the watershed has resulted in a tremendous amount of sedimentation.

Further recommendations on how to protect and reduce water quality impacts from existing and future urbanization of the watershed can be found in Chapter 12 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (<http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>).

DWQ also recommends that all wastewater treatment facilities consider wastewater recycling/reuse systems to further reduce the nitrogen and phosphorus load to the Neuse River system.

### **2.3.11 Swift Creek Watershed [AU# 27-43-(1)a, 27-43-(1)b, 27-43-(5.5), & 27-43-8]**

#### 2002 Recommendations

DWQ will continue monitoring Swift Creek. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Swift Creek. DWQ will use the information in the WARP report on Swift Creek to develop recommendations to restore water quality in Swift Creek.

The impaired biological community in Swift Creek is typical of streams that run through urban areas. As with Crabtree Creek and the other creeks draining urban Raleigh and Cary, great efforts will be needed to reduce impacts from urban runoff.

Lower Swift Creek, below the Lake Wheeler Dam, is being studied for preservation by the Triangle Land Conservancy.

#### Current Status

##### Swift Creek [AU# 27-43-(1)a]

Swift Creek [AU# 27-43-(1)a; WS-III; NSW] from the source to the confluence with Williams Creek was not assessed during this assessment period, it will however remain on the 303(d) list for impaired biological integrity due to a 1998 benthic impairment listing.

##### Swift Creek [AU# 27-43-(1)b]

Swift Creek [AU# 27-43-(1)b; WS-III; NSW] from confluence with Williams Creek to backwaters of Lake Wheeler (5.5 miles) is Impaired due to Fair benthic bioclassification at sites JB52 (Holly Springs Rd.) and JB53 (Hemlock Bluffs). The land cover is predominantly residential. The stream banks were severely eroded with sparse mixed vegetation. Site JB52 has received a fair rating since 1989. This segment will also remain on the 303(d) list for impaired biological integrity.

Ambient data at site JA24 had DO levels below 5 mg/l in 9 percent of the samples and fecal coliform bacteria levels above 400 colonies/100 ml in 12 percent of the samples. This segment of Swift Creek is Supporting for recreational uses. A 5-in-30 fecal coliform bacteria study was done in August and September of 2001 as part of the 2000-2001 Watershed Assessment and Restoration Project (WARP) on the upper Swift Creek watershed. The geometric mean for the five samples was 68 CFU/100ml, well below the NC state standard of 200 CFU/100ml. Turbidity was above the state standard of 50 NTUs in 5 percent of the samples and the specific conductivity was elevated with reading ranging from 61 to 321  $\mu$ mhos/cm indicating that there are influences indicative of nonpoint source pollution.

The Town of Cary had a 7.9 million gallon wastewater spill in this segment of Swift Creek in June 2006. This was the third largest wastewater spill in the triangle in the past decade. A large

wastewater pipe was dislodged due to heavy rains from Tropical Storm Alberto. The town was upgrading the pumping station when the accident occurred. The county closed Lake Wheeler and Lake Benson downstream for several days after the spill to prevent any potential human contact. The Town of Cary worked very quickly to rectify the problem. The DWQ levied a civil penalty of \$44,000 on the Town of Cary for the accident.

#### NC WARP Assessment Report: Biological Impairment in the Upper Swift Creek Watershed

A WARP Study to address the biological impairment on the upper Swift Creek watershed (above Holly Springs Rd.) was done in 2000 and 2001 (DENR, June 2003). This data was collected outside of the assessment window for this plan, which started January 1, 2002.

The report outlines the most likely causes of the biological impairment and attempts to identify the major watershed activities and sources of the impairment. The report also outlines a watershed strategy that recommends restoration activities and BMPs to address the identified problems and improve the biological condition of the impaired streams.

Several of the major causes for the impairment are briefly discussed below. For more details see the original report (DENR, June 2003 or at <http://h2o.enr.state.nc.us/swpu/swift-upper/sufinal.pdf>).

Instream toxicity from stormwater runoff appears to be a primary contributor to the biological impairment in this area. A water column acute toxicity test was done from a water sample collected at the Holly Springs Road location after a storm event in 2001. The test indicated toxicity at a LC50 of 61 percent (mortality of 50 percent of the test organisms when sample was diluted to an estimated 61 percent of ambient concentration). One Hundred percent mortality occurred for test organisms at greater than or equal to 75 percent ambient sample concentration. Virtually all the benthic macroinvertebrates stations sampled in the upper Swift Creek watershed during the WARP study were dominated by organisms tolerant to a variety of stressors as well as some indicative of potential toxic impacts. Benthos were impaired at these locations despite adequate habitat to support a more diverse benthic assemblage.

Stormflow scour (excessive removal of organisms and microhabitat during storms) was considered a potential cause of impairment in the upper Swift Creek watershed. The data collected strongly suggest scouring of substrate occurs frequently, and likely contributes to both habitat degradation and dislodging of organisms. While difficult to isolate from other factors associated with a developed watershed, this is very likely an important and pervasive stressor that contributes to impairment of the macroinvertebrate community.

Hydromodification due to 5 impoundments/dams in the upper Swift Creek watershed above Holly Springs Road have impacted downstream aquatic communities in a number of ways. Instream impoundments serve as a barrier to downstream drift, preventing recolonization of aquatic organisms. The drainage area of Swift Creek at Holly Springs Road is 63 percent impounded (13 of 20.8 square miles). Only one of the five impoundments has a minimum release requirement. The most important impact of these impoundments in the study area is probably the exacerbation of low flow conditions and resulting impacts on habitat availability, temperature and dissolved oxygen.

Aquatic organisms in upper Swift Creek watershed are heavily impacted by multiple stressors associated with the high level of development in the watershed. The relative contribution of

these stressors cannot be clearly differentiated based on the available data. Toxic impacts, scour, habitat degradation due to limited microhabitat, hydromodification due to impoundments and organic/nutrient enrichment are all considered to be stressors that cumulatively cause impairment. Toxicity and scour may be the most important factors, however all these stressors must be viewed as significant.

The following actions are necessary to address current sources of impairment in Swift Creek and to prevent future degradation. Actions one through five are important to restoring and sustaining aquatic communities in the watershed, with the first three recommendations being the most important.

1. Feasible and cost effective stormwater retrofit projects should be implemented throughout the watershed to mitigate the hydrologic effects of development.
2. A strategy to identify and address toxic inputs should be developed and implemented, including a variety of source reduction and stormwater treatment methods based on source identification.
3. The technical, economic and regulatory feasibility of implementing minimum releases from Summit Lake, MacGregor Downs Lake, Loch Lomond and Lake Lochmere should be explored in order to restore baseflow levels in Swift Creek.
4. Stream channel restoration activities should be implemented in targeted areas, in conjunction with stormwater retrofit BMPs, in order to improve aquatic habitat.
5. Actions recommended above (e.g., stormwater quantity and quality retrofit BMPs) are likely to reduce nutrient and organic loading to some extent, although additional efforts may be necessary.
6. Prevention of further channel erosion and habitat degradation will require effective post-construction stormwater management for all new development in the study area.
7. Effective enforcement of sediment and erosion control regulations on the part of Apex, Cary and Wake County will be essential to the prevention of additional sediment inputs from construction activities.
8. The watershed education programs currently implemented by local governments should be continued and enhanced, with the goal of reducing current stream damage and prevent further degradation.

Historical DWQ data suggests a few select tributaries may harbor enough diversity to aide recolonization if the habitat and water quality in the mainstem is restored, however it is quite likely that those streams are currently being impacted by urban development as well. Although selected for future water supply use, the Swift Creek watershed as a whole is impacted by habitat degradation, urban influences, and nutrient enrichment resulting in low DO levels and an impaired biological community.

### NCEEP Upper Swift Creek Local Watershed Plan

The North Carolina Ecosystem Enhancement Program (NCEEP) developed an Upper Swift Creek Local Watershed Plan using the data from the WARP study described above as well as from historical DWQ data and information provided by many other local sources. The primary objective of the NCEEP local watershed plans are to identify the major causes of watershed degradation, to develop strategies addressing these problems that are consistent with the priorities of the local communities and to identify optimal sites for the implementation of watershed improvement projects. This local watershed plan identified specific needs and provides an integrated set of measures to restore functionality within this watershed. The Upper

Swift Creek Local Watershed Plan can be found at [http://www.nceep.net/services/lwps/Swift\\_Creek/Swift\\_Creek\\_DAR\\_Final\\_Report\\_V6\\_10-28-05.pdf](http://www.nceep.net/services/lwps/Swift_Creek/Swift_Creek_DAR_Final_Report_V6_10-28-05.pdf).

### NCDWQ Total Maximum Daily Load (TMDL) for Addressing Impaired Biological Integrity in the Headwaters of Swift Creek Watershed

The EPA approved a biological TMDL for the headwaters of the Swift Creek watershed in March 2009 (see [http://h2o.enr.state.nc.us/tmdl/TMDL\\_list.htm](http://h2o.enr.state.nc.us/tmdl/TMDL_list.htm) or Appendix IX). This TMDL addresses the following benthic macroinvertebrate sites (compliance points) with the most current (year) bioclassification: Swift Cr at SR 1152 (Holly Springs Rd), Fair (2005); Swift Cr at SR 1300 (Kildare Farm Rd.), Fair (2001); Swift Cr at US 1, Poor (2000); Swift Cr at McKenan Rd, Not Rated (2000); Swift Cr at Old Raleigh Rd, Not Rated (1989); Williams Cr at Old Raleigh Rd, Not Rated (2000); Williams Cr at US 64, Not Rated (2000). These waters have been on the NC 303(d) list of impaired waters since 1998. These sites comprise three assessment units in the Neuse River Basin that are listed in the draft 2008 303(d) list for impaired biological integrity: Swift Creek, Assessment Unit 27-43-(1)a (from source to the confluence of Williams Creek); Swift Creek, Assessment Unit 27-43-(1)b (from the confluence of Williams Creek to the backwaters of Lake Wheeler); and Williams Creek, Assessment Unit 27-43-2 (from source to Swift Creek).

The purpose of the TMDL is to address the aquatic life impairments in the upper Swift Creek watershed. The goal is to provide the basis for improving the watershed ecosystem through implementation of best management practices such that the beneficial uses of the waterbodies are restored.

The following candidate causes were determined to be significant causes of impairment in Swift Creek:

- Hydromodification and associated scour due to storm flows (resulting from high density development)
- Toxicity (resulting from residential and commercial development stormwater runoff)
- Hydromodification (resulting from dams)
- Organic and nutrient enrichment.

Based on the “weight of evidence” analysis for Swift Creek, the two most important factors are scour and toxicity (episodic); the impacts of enrichment and habitat degradation are more localized. The limitation of macroinvertebrate recolonization from the blockage of drift by impoundments (hydromodification) is also of concern. Although habitat degradation due to limited microhabitat was not viewed as a primary cause of impairment, combined with other causes of impairment, the cumulative effect can result in impairment. All of the stressors and indicator parameters are associated with the high levels of development in the Swift Creek watershed.

A TMDL must address stressors believed to be contributing to the impairment. Where the major cause of impairment is stormwater runoff, the use of surrogate indicators expressed as quantitative targets is appropriate in TMDL development. Because of stormwater-associated pollutants and the effects on the system’s hydrology, these targets are used as surrogates to estimate stormwater pollutant load reductions needed to meet water quality standards.

Research has indicated that the chance of a stream quality indicator attaining a high quality score is sharply diminished at higher impervious cover (IC) levels. This trend becomes pronounced within the 10 to 25% IC range and almost inevitable when watershed IC exceeds 25%. This pattern suggests that IC is a more robust and reliable indicator of overall stream quality beyond the 10% IC threshold (CWP 2003).

A total watershed impervious cover (IC) of 10% was used as the surrogate target for this TMDL and will be implemented through stormwater management. Because IC is a surrogate measure, eliminating IC is not necessary in reaching the TMDL target reductions. Measuring the aquatic life (benthic macroinvertebrate community) directly will be the method for assessing attainment of the TMDL goal. Achievement of this water quality standard may be met by implementing management practices designed to mitigate the effects of stormwater runoff on new or existing development. Examples of stormwater management practices include, but are not limited to, installing engineering best management practices (BMPs) to reduce the impacts of stormwater runoff from impervious areas, disconnecting impervious cover from the surface waterbodies to reduce peak flows and volumes of stormwater runoff, and adopting land use ordinances that require or allow low impact development (LID) techniques or other non-structural BMPs.

When the TMDL is implemented, stressors (scour and toxicity, for example) will be reduced or not delivered to the waterbody in the first place. Refer to the TMDL for suggested implementation and wasteload allocation information ([http://h2o.enr.state.nc.us/tmdl/TMDL\\_list.htm](http://h2o.enr.state.nc.us/tmdl/TMDL_list.htm) or Appendix IX).

#### Swift Creek (Lake Wheeler) [AU# 27-43-(1)c]

Swift Creek (Lake Wheeler) [AU# 27-43-(1)c; WS-III; NSW] from the backwaters of Lake Wheeler to Lake Wheeler dam ( 564.5 acres) is listed as ND (no data) since it was not monitored during this assessment period. The City of Raleigh has closed Lake Wheeler to primary recreation (swimming and water skiing) since the summer of 2006 due to elevated bacteria levels. Bacteria concentrations have regularly been above the EPA's allowable enterococcus and E. coli standards. An intensive bacterial study by Wake County and the City of Raleigh has identified three possible sources of bacteria affecting the lake. The study found an area with possible failing septic system on a small tributary to Lake Wheeler. Efforts are being made to track the location of these and have them corrected. There is also a large number of deer and other wildlife that are likely contributing to the bacteria problem. The boat dock/beach access area was also identified as the other area with high levels of bacteria. It appears that the contamination in this area is due to the large number of waterfowl that congregate in the area. The City of Raleigh and Wake County are working closely to correct the bacterial problem and open the lake to primary recreation as soon as possible. Lake Wheeler is currently open for boating and fishing.

#### Swift Creek [AU# 27-43-(1)d] & Swift Creek (Lake Benson) [AU# 27-43-(5.5)a]

Swift Creek [AU# 27-43-(1)d; WS-III; NSW] from the Lake Wheeler Dam to a point 0.6 miles upstream of Wake County SR 1006 (2.4 miles) and [AU# 27-43-(5.5)a; WS-III; NSW; CA] from SR1006 to backwaters of Lake Benson (0.9 miles) is Impaired for aquatic life due to a Poor benthic bioclassification at site JB56. This site showed signs of habitat degradation and urban influences. Despite controlled flows from Lake Wheeler, erosion is a large issue in this reach.

#### Swift Creek (Lake Benson) [AU# 27-43-(5.5)b]

Swift Creek (Lake Benson) [AU# 27-43-(5.5)b; WS-III; NSW; CA] from the backwaters of Lake Benson to the dam at Lake Benson (472 Acres) is Not Rated due to insufficient data to make a

use support determination (10 sample minimum is required at the time of this basin report in order to make assessment; see use support methods at [http://h2o.enr.state.nc.us/tmdl/General\\_303d.htm](http://h2o.enr.state.nc.us/tmdl/General_303d.htm)). Lake Benson was sampled seven times between May and August 2005. Nutrient concentrations in 2005 were generally moderate to high for total phosphorus, total Kjeldahl nitrogen and total organic nitrogen indicating a potential for high biological productivity. Total phosphorus concentrations ranged from 0.03 mg/L to 0.06 mg/L, total Kjeldahl nitrogen from 0.43 mg/L to 0.85 mg/L and total organic nitrogen from 0.42 mg/L to 0.82 mg/L. Phytoplankton analyses of samples collected at the most downstream station in the lake indicated mild to severe blooms of blue-green algae during all four months of sampling.

Aquatic weeds were observed and collected in a small area near a dock at the park area at Lake Benson. These plants were identified as Parrot Feather (*Mariophyllum aquaticum*) and Creeping Primrose (*Ludwigia palustris*). These invasive plants can become quite dense and completely colonize small ponds and impede flow. Parrot Feather can also out compete and replace native species that are of more value to fish and wildlife (<http://el.ercd.usace.army.mil/aqua/apis>). In addition, the City of Raleigh has identified *Lyngbya woolei*, a filamentous blue-green algae that forms thick mats, in the lake. The City of Raleigh is taking measures (chemical treatments) to control the weeds and the *Lyngbya*.

The City of Raleigh as started construction on a second drinking water treatment plant at Lake Benson. It is expected to be complete in spring 2010. This facility will help the City of Raleigh meet additional drinking water demands during drought as well as meet the area's future water needs. The facility will draw up to 20 million gallons a day from the Swift Creek reservoirs (Lake Benson and Lake Wheeler).

#### Swift Creek [AU# 27-43-(8)]

Swift Creek [AU# 27-43-(8); C; NSW] from dam at Lake Benson to Neuse River (32.7 miles) is Supporting for aquatic life and recreation based on Good and Good-Fair benthic ratings at JB54 and JB55 as well as due to no exceedances at the ambient monitoring sites JA25 and JA26. Sedimentation was noted as a problem at both of the benthic sites with most of the pools filled with sand. Stream banks were also noted as moderately eroded with diverse trees, shrubs and grasses.

This segment of Swift Creek below Lake Benson is known to support 11 rare, threatened or endangered aquatic animals: 1 fish and 10 mussel species, including the federally endangered dwarf wedgemussel (*Alasmidonta heterodon*).

Indian Creek Overlook treatment plant (NC0060771) is a minor discharger to this segment of Swift Creek. It has had several BOD violations over the last several years as well as an occasional fecal coliform violation. This facility may install UV sterilization in the near future.

Swift Creek AU# 27-43-(1)a and 27-43-(1)b will remain on the 303(d) list for impaired biological integrity; 27-43-(1)d and 27-43-(5.5)a will be added to the 2008 303(d) list of impaired waters based on the benthic data collected during this assessment period.

#### Recommendations

Recommendations on how to protect and reduce water quality impacts from existing and future urbanization of the watershed can be found in Chapter 12 of the *Supplemental Guide to North*

Carolina's Basinwide Planning document  
(<http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>).

DWQ recommends implementing the NCEEP local watershed plan which has identified over 100 BMP sites ([http://www.nceep.net/services/lwps/Swift\\_Creek/Swift%20Creek.pdf](http://www.nceep.net/services/lwps/Swift_Creek/Swift%20Creek.pdf)) and the DWQ TMDL for the Headwaters of Swift Creek Watershed ([http://h2o.enr.state.nc.us/tmdl/TMDL\\_list.htm](http://h2o.enr.state.nc.us/tmdl/TMDL_list.htm)).

### **2.3.12 Little Creek [AU# 27-43-12]**

#### 2002 Recommendations

Little Creek watershed is under high development pressure. Sedimentation and erosion control plans should be followed during construction to minimize impacts to Little Creek and its tributaries. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Little Creek.

#### Current Status

Little Creek [AU# 27-43-12; C; NSW] from source to Swift Creek (11.4 miles) is Impaired for aquatic life based on a Fair benthic bioclassification at site JB39. A co-occurring fish sample at site JF25 was found to have a Good bioclassification rating. The instream substrate was almost entirely composed of sand, with sparse habitats of shifting sandy runs and snag pools. The riparian zone was composed of sparse mixed vegetation. This site has consistently received a Fair benthic rating since the first sample in 1991. The benthic ratings remained Fair in 2000 and 2005 despite the rerouting of the Clayton WWTP to the Neuse River prior to 2000, which indicates that non-point urban runoff may be a problem. This was the first fish sample collected in Little Creek. The trophic structure of the fish community was skewed towards a majority of insectivores (91 percent). The lack of habitat diversity may be contributing to this trophic imbalance.

Little Creek will remain on the 303(d) list for impaired biological integrity.

#### Recommendations

Recommendations on how to protect and reduce water quality impacts from existing and future urbanization of the watershed can be found in Chapter 12 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (<http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>).

## **2.4 Status and Recommendations for Waters with Noted Impacts**

The surface waters discussed below are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Nonpoint source program agency contacts are listed in Appendix IV.

## **2.4.1 Neuse River [AU# 27-(20.7), 27-(22.5), 27-(36), 27-(38.5), 27-(41.7) & 27-(49.5)a]**

### Neuse River [AU# 27-(20.7)]

Neuse River [AU# 27-(20.7); WS-IV; NSW] from the dam at Falls Lake to a point 0.5 miles upstream of Town of Wake Forest proposed water supply intake (old Burlington Mills intake) (3.0 miles) is Supporting for aquatic life and recreational use based on No Criteria Exceeded at ambient monitoring station JA8.

### Neuse River [AU# 27-(22.5)]

Neuse River [AU# 27-(22.5); C; NSW] from the Town of Wake Forest proposed water supply intake to mouth of Beddingfield Creek (22.6 miles) is Supporting for aquatic life due to a Good-Fair benthic bioclassification rating at sites JB44 and JB45 and due to No Criteria Exceeded at ambient stations JA10, JA11, JA18 and JA127. Dissolved oxygen levels of less than 5 mg/l was seen in 12 percent of the samples collected at JA11 and 16 percent at JA127. The turbidity was elevated above the state standard of 50 NTUs in 8 percent of the samples at JA10 and 10 percent at JA18.

Site JB44 has consistently been rated Good-Fair at this site in 1987. The land cover surrounding this site is residential and forested. Site JB45 has been rated Good-Fair since the decline from Good after Hurricane Fran in 1996. The land cover surrounding this site is a mixture of residential, commercial and forested. Areas of stream bank erosion were present even though the riparian zone was broad on both sides of the stream with no breaks. Even though the rating remained Good-Fair, the overall data indicated a drop in water quality in the area as determined by a change in the biotic index as well as a drop in the EPT richness and abundance values from the prior sampling dates in 2000.

This segment of the Neuse River is Supporting for recreational use because the fecal coliform bacteria screening criteria was not exceeded at these ambient monitoring stations.

Raleigh's Neuse River WWTP (NC0029033) is located in this segment and has not had any discharge permit related violations over the last several years. This facility previously applied biosolid sludge to the fields surrounding the facility (~1030 acres). Due to errors in the estimated load; over application of sludge occurred between 1980 and 2001. The City of Raleigh was fined \$73,937 for biosolid application permit violations. The City ceased biosolid application in 2002. Groundwater wells around the southeastern portion of the plant were found to be contaminated with elevated nitrate levels. Dr. William Showers at NCSU and the USGS are currently working on a research projects to assess the impact of the excess groundwater nitrogen on the Neuse River. Research has found that there is a significant groundwater/surface water interaction occurring at this facility. Streams at the facility have nitrate concentrations that range between 5 to 80 mg/l nitrate (groundwater standard for nitrate is 10 mg/l) (Showers et al., 2007). They have found that the majority of the nitrogen getting to the Neuse River is occurring via the small tributaries flowing through the fields and draining across the riparian buffer. The stream chemistry is controlled by groundwater characteristics. Stream nitrate concentrations are lower in the summer when the groundwater table is low, and increases in the winter when it is high. The amount of nitrate reaching the Neuse River from the groundwater contamination is about half of the facilities out put over the four year monitoring period. The research indicates that the amount of nitrogen released to the environment by this point source has been seriously underestimated. If the mechanism for contaminated groundwater transportation is via surface streams, then wetlands could possibly be constructed (offline) to eliminate a large percentage of the biosolid nitrogen and protect the Neuse River's water quality. This is a new source of

nitrogen affecting the Neuse River watershed that has not been previously described. Land application sites throughout the Neuse River watershed could be having similar effects (personnel communication, DWQ Aquifer Protection Section, Land Applications Unit (assessment of permitted land application sites have indicated elevated levels of nitrogen below several municipal and industrial permitted land application sites)).

The City of Raleigh Public Utility Department (CORPUD) has recently requested a NPDES permit variance which would allow the City to use natural attenuation (the natural degradation process) to correct the nitrate contamination problem that extends outside of their compliance boundary. State regulations do not allow for natural attenuation beyond the compliance boundary, therefore a variance from this regulation is required. The NPDES permit has been modified to include the nitrate concentrations from groundwater discharge into surface waters as part of the total nitrogen allocation for this facility. The requested variance is currently under review and will be presented to the Environmental Management Commission for their consideration.

A fish consumption advisory for Neuse River from just below Crabtree Creek to Auburn-Knightdale Road was recently added by Department of Health and Human Services (DHHS) for polychlorinated biphenyls (PCBs). DHHS advises the general public to limit fish consumption of carp and catfish to no more than one meal per month. This advisory went into affect on April 2, 2008. This notice was past the date to be included on the 2008 303(d) impaired waters list, so this segment of the Neuse River will be added to the 2010 impaired waters list for fish consumption impairment. Swimming, boating and other recreational activities present no known significant health risk from PCBs. Consumption of fish beyond what is recommended may increase a person's risk of developing cancer, infection, skin problems such as cracked fingernails and may cause learning deficits in infants from maternal exposure. For more information regarding fish consumption advisories, call (919) 707-5900 or visit the NC DHHS Division of Public Health website at <http://www.schs.state.nc.us/epi/fish/current.html>.

#### Neuse River [AU# 27-(36)]

Neuse River [AU# 27-(36); WS-V; NSW] from the mouth of Beddingfield Creek to a point 0.2 miles downstream of Johnston County SR 1700 (4.3 miles) is Supporting for aquatic life and recreation based on No Criteria Exceeded at ambient monitoring station JA20. However, turbidity and fecal coliform bacteria levels were elevated in 9 and 17 percent of the samples respectively.

#### Neuse River [AU# 27-(38.5)] – (From Section 2.3.9)

Neuse River [AU# 27-(38.5); WS-IV; NSW] from a point 0.2 miles downstream of Johnston County SR 1700 to a point 1.4 miles downstream of Johnston County SR1908 (9.7 miles) is Impaired for aquatic life due to a turbidity exceedance of 10.1 and 10.0 percent at ambient monitoring station JA21 and JA22 respectively. This segment was discussed above in section 2.3.9. This segment of the Neuse River will be added to the 2008 303(d) list for turbidity standard violations.

#### Neuse River [AU# 27-(39.3), 27-(39.7) & 27-(41.3)]

Neuse River [AU# 27-(39.3), 27-(39.7) & 27-(41.3)] between Johnston County SR1908 and the City of Smithfield's water supply intake were not assessed during this assessment period. They are currently rated as No Date. Given that the waters above and below this segment are impaired for turbidity standard violations, it is likely that the turbidity continues to be a problem throughout this stretch of the river as well.

Neuse River [AU# 27-(41.7)] – (From Section 2.3.9)

Neuse River [AU# 27-(41.7); WS-V; NSW] from the City of Smithfield water supply intake to a point 1.7 miles upstream of Bawdy Creek (26.2 miles) is Impaired for aquatic life due to a turbidity exceedance of 11.9 percent at ambient monitoring station JA23. This segment was discussed above in section 2.3.9. This segment of the Neuse River will be added to the 2008 303(d) list for turbidity standard violations.

Neuse River [AU# 27-(49.5)a]

Neuse River [AU# 27-(49.5)a; WS-IV; NSW] from a point 1.7 miles upstream of Bawdy Creek to subbasin 03-04-12 boundary (7.0 miles) is Supporting aquatic life due to a Good benthic bioclassification at site JB43 and due to No Criteria Exceeded at ambient monitoring station JA34. However, DO levels were below 5 mg/l in 3.5 percent of the samples and the turbidity was elevated above 50 NTUs in 6.7 percent of the samples with a recorded maximum reading of 320 NTUs (Table 10). Conductivity was also elevated and ranged between 60 and 304 µmhos/cm.

This benthic site has consistently received a Good bioclassification since 1991. The land cover at this site is predominantly forested with some residential and agriculture. Stream banks were severely eroded with sparse vegetation and the instream habitat for macroinvertebrate colonization was listed as poor.

This segment of the Neuse River is Supporting for recreational use because the fecal coliform bacteria screening criteria was not exceeded that this ambient monitoring station.

The Clayton WWTP (NC0025453) discharges into this segment of the Neuse River. They have not had any major issue to report over the last several years. The plant is currently undergoing plant upgrades, which include a major biological nutrient removal (BNR) project and a wastewater reuse system.

Table 10 Percentage of samples in which turbidity standard violations occurred (> 50 NTU) and DO levels were below 5 mg/l within the Neuse River proper in subbasin 03-04-02.

Station ID Map / DWQ #	9/1/2000 - 8/31/2005 Assessment		Current Assessment 1/1/2002 - 12/31/2006	
	Turbidity Standard Violations (%)	DO < 5 mg/l (%)	Turbidity Standard Violations (%)	DO < 5 mg/l (%)
JA8 / J1890000	0	0	0	0
JA10 / J2330000	3.1	2	8.3	2.4
JA11 / J2360000	0	19.2	0	12.2
JA127 / J2363000	NA	NA	0	16.2
JA18 / J4050000	6.7	2	10	1.2
JA20 / J4130000	5.9	0	8.9	0
JA21 / J4170000 – DWQ	12.1	0	11.9	0
JA21 / J4170000 – LNBA	3.3	2.3	8.3	1.2
<b>Co-located – combined data</b>	<b>7.6</b>	<b>1.4</b>	<b>10.1</b>	<b>0.7</b>
JA22 / J4190000	6.7	0	10	0
JA23 / J4370000	10.5	0	11.9	0
JA34 / J5250000	5	5.9	6.7	3.5

### Subbasin 03-04-02 Neuse River Summary

High levels of sediment/turbidity affected most of the Neuse River proper within this subbasin. The turbidity during this assessment period ranged from no violations of the standard at Falls Lake dam to elevated levels resulting in standard violations in up to 12 percent of the samples (Table 10). The majority of the sites ranged between 7 and 12 percent exceedance of the standard with the highest recorded turbidity of 380 NTUs at JA10. Low dissolved oxygen is also seen in the area above and directly below the Milburnie dam. The streams and rivers in this subbasin are likely impacted by the large amount of development that is occurring throughout Wake and Johnston Counties.

### Recommendations

DWQ would recommend that all wastewater treatment facilities consider wastewater recycling/reuse systems to further reduce the nitrogen and phosphorus load to the Neuse River system. DWQ would also recommend that municipalities consider adopting a water and sewer conservation policy that would discourage the use of potable water for irrigation and encourage the use of reuse/recycle systems.

DWQ recognizes that better Sediment and Erosion Control measures need to be in place. Wake County passed new Sediment and Erosion Control ordinances in June 2007. These new measures need to be strictly enforced. It is evident by the increase in the number of turbidity standard violations that there is a significant need for better stormwater controls as well as better site design and development planning techniques used to minimize the negative impacts of new development on the water quality within this watershed.

Recommendations on how to protect and reduce water quality impacts from existing and future urbanization of the watershed can be found in Chapter 12 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (<http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>).

## **2.4.2 Rocky Branch [AU# 27-34-6]**

### 2002 Recommendations

The watershed is in a heavily urbanized area of west Raleigh and runs through NCSU campus. Stream habitat is degraded, and the benthic macroinvertebrate community is heavily impacted from urban runoff. The stream is currently undergoing a large-scale restoration project funded in part by CWMTF.

### Current Status

The Rocky Branch watershed is in a heavily urbanized area of west Raleigh and runs through NCSU main campus and Dorothea Dix State Hospital property and eventually flows into Walnut Creek. There have been multiple stressors noted for this urban watershed including organics, sedimentation from channel instability and bank erosion from high runoff from impervious surfaces and unspecified toxicants. In the 1970's this stream was practically devoid of macroinvertebrates. In 1978, DWQ classified Rocky Branch as the state's most polluted urban stream.

Rocky Branch [AU# 27-34-6a; C; NSW] from source to Hunt Drive (2.1 miles) is Not Rated for aquatic life due to three macroinvertebrate samples collected at JB48, JB49 and JB50. The three stream sites did not meet the necessary criteria to assign bioclassifications (watershed area less than three square miles).

Rocky Branch [AU# 27-34-6b; C; NSW] from Hunt Drive to Walnut Creek (2.0 miles) is Supporting aquatic life due to a Good-Fair fish bioclassification at station JF30 (at South Saunders St.). This was the first time there was a fish community assessment completed on this stream. The specific conductivity was elevated and ranged from 308 to 397  $\mu\text{mhos/cm}$  during the study. Excessive periphyton growth was seen throughout the stream. There was low quality stream habitat characteristics including simplified instream habitat, moderately embedded substrate, infrequent riffles, a deeply entrenched channel with easily erodible and unstable, vertical, sparsely vegetated banks, and narrow riparian zones. The fish community was lacking in intolerant species and the trophic structures were skewed towards tolerant insectivores. The stream did support, for its size, an abundant and diverse assemblage of fish, which were healthy, free of disease, and representing multiple age groups and size classes. Even with all of the habitat problems, the rating for this area of Rocky Branch was Good-Fair.

A three phase stream restoration project is underway by NCSU and the NC Sea Grant Program. This project is being funded by CWMTF, USEPA, NCDOT, NCSU, and the FEMA. Upon completion, restoration efforts will have included the area between Gorman Street downstream to Pullen Park and will include 6000 feet of greenway path that will connect with the Pullen Park and City of Raleigh Greenway System. The goals of the project are to:

1. Stabilize the creek,
2. Improve water quality,
3. Improve aquatic and wildlife habitat, and
4. Integrate the creek into the campus environment and provide an outdoor teaching laboratory.

Phase I, from Gorman St. to Dan Allen Dr., was completed in spring 2002 (\$1,934,000) and included 3300 feet of creek restoration, 3000 feet of greenway path, retrofit of 16 stormwater outfalls with innovative energy dissipaters, a bioretention basin, four rain gardens and the replacement of two road culverts with floodplain culverts that provide a more hydrologically efficient passage for stormwater flows. Phase II, from Morrill Dr. to Pullen Rd., was completed in February 2006 (\$1,217,000) and included creek restoration, floodplain excavation, 13,000 square foot floodplain wetland, and a large bottomless arch culvert which allows for pedestrian and wildlife passage under a major thoroughfare. Phase III, the connecting segment from Dan Allen to Morrill Dr. is currently in the design (~ \$1,733,000) phase and proposes to “day-light” 235 feet of stream, create a streambed and a small floodplain.

NCSU is assessing the macroinvertebrate community throughout this project. At this point the data collected suggests very poor water quality, with minor improvements in the biological health of the stream following restoration. Tolerant taxa dominate all locations assessed. The lack of biological improvement may be associated with an increase in development in the headwaters around Gorman Street. Even under the most optimal conditions, it generally takes several years to see improvement in the benthic community post a stream restoration project. So, given that Rocky Branch runs through the NCSU campus and is still influenced by a large volume of stormwater it could take many years to see a minor improvement.

A fish consumption advisory for Rocky Branch was recently added by Department of Health and Human Services (DHHS) for polychlorinated biphenyls (PCBs). DHHS advises the general public to limit fish consumption of carp and catfish to no more than one meal per month and to limit consumption of all other fish to no more than one meal per week. This advisory went into affect on April 2, 2008. This notice was recorded past the date to be included on the 2008 303(d)

impaired waters list, so Rocky Branch will be added to the 2010 impaired waters list for fish consumption impairment. Swimming, boating and other recreational activities present no known significant health risk from PCBs. Consumption of fish beyond what is recommended may increase a person's risk of developing cancer, infection, skin problems such as cracked fingernails and may cause learning deficits in infants from maternal exposure. For more information regarding fish consumption advisories, call (919) 707-5900 or visit the NC DHHS Division of Public Health website at <http://www.schs.state.nc.us/epi/fish/current.html>.

### **2.4.3 Marks Creek [AU# 27-38]**

#### Current Status

Marks Creek [AU# 27-38; C; NSW] from source to Neuse River (10.3 miles) is Supporting aquatic life due to a Good-Fair benthic and a Good fish community bioclassification at sites JB40 and JF26 respectively. The land immediately surrounding this site is completely forested, while the land cover for the majority of this watershed is largely agriculture with some suburban areas. The instream habitats for both macroinvertebrates and fish were fairly good. The ratings have been consistent for both trophic levels for the past 15 years, so based on the data, no major changes in water quality have been observed on Marks Creek. However, with the easy access to the new Hwy 64 by-pass, potential 540 connector and downtown Raleigh, Knightdale, Wendell, and Clayton, the watershed is rapidly suburbanizing. Over 5000 new houses are planned to be developed in this watershed in the next few years. Wake County and Triangle Land Conservancy, and the Trust for Public Land have been working hard to protect water quality in this area through the Marks Creek Partnership.

#### Recommendations

In order to maintain the water quality in Marks Creek, DWQ recommends that local agencies work with landowners to install best management practices (BMPs).

Counties and non-profit groups should continue their efforts to preserve and protect lands in this watershed.

#### Water Quality Initiatives

The following BMPs were installed in this watershed from 2000-2006: 68 acres of sod based rotation, 1,239 feet of diversions, and 1 stormwater management unit. These BMPs affected 125 acres, saved 764 Tons of soil per year, saved 868 pounds of nitrogen per year, and saved 72 pounds of phosphorus per year at a cost to the NC ACSP of \$8,172.

Marks Creek Partnership: Triangle Land Conservancy, Wake County, and the Trust for Public Land have partnered to protect lands in the Marks Creek Watershed. As of 2007, over 1000 acres of land has been protected in this watershed. The partnership has developed an assessment of the area which identifies key conservation land and strategies protecting water quality and is working with local landowners to help protect critical wildlife habitats, cultural resources, open space, and water quality.

### **2.4.4 Unnamed Tributary to Swift Creek (Yates Mill Pond) [AU# 27-43-5-(1.5)]**

#### Current Status

Unnamed tributary to Swift Creek (Yates Mill) [AU#27-43-5-(1.5); WS-III; NSW] from dam at Silver Lake to a point 0.5 miles upstream of mouth (6.2 miles) is Supporting due to a Good-Fair benthic and fish community bioclassification at JB65 and JF33. The functional fish habitat was

scarce and the total habitat score was the lowest of the 9 fish sites sampled in the subbasin. The fish trophic structure was unbalanced with a majority being insectivores (95 percent), nor were there any intolerant species seen during this assessment. The largely tolerant benthic community suggests nutrient inputs and organic enrichment as well as habitat loss may be playing a large role in structuring the benthos.

There are two small animal operations above route 401 which may be introducing some nutrients to this watershed.

## **2.5 Additional Water Quality Issues within Subbasin 03-04-02**

The previous sections discussed water quality concerns for specific stream segments. The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes, or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

This section also discusses water quality initiatives that are occurring within this basin to preserve, protect and improve water quality.

### **2.5.1 Mercury Contamination – Fish Tissue Assessment**

The Division conducted fish tissue surveys at four stations within the Neuse River Basin from 1999 to 2004. These surveys were conducted as part of the mercury contaminant assessments in the eastern part of the state and during statewide pesticide assessments.

Tissue samples collected from the Neuse River at Goldsboro contained organic contaminants at undetectable levels or at levels less than the US EPA, US FDA, and State of North Carolina criteria. The Goldsboro samples consisted of composites of largemouth bass.

Elevated mercury concentrations (greater than the EPA and NC level of 0.4 ppm) were detected in fish samples collected from all four stations within the Neuse Basin. These included the Eno River near Durham, Neuse River at Goldsboro, Neuse River at Kinston, and Contentnea Creek at Snow Hill. Elevated levels were most often detected in largemouth bass, a species at the top of the food chain and most often associated with mercury bioaccumulation in North Carolina. Presently, there are no site-specific fish consumption advisories for mercury in the Neuse River basin; however, an advisory for the consumption of bowfin, and chain pickerel east of Interstate 85 was issued by NCDHHS in 2002 and a statewide advisory for the consumption of largemouth bass in 2006.

Because fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Contamination of aquatic resources has been documented for heavy metals, pesticides, and other complex organic compounds. Once these contaminants reach surface waters, they may be available for bioaccumulation, either directly or through aquatic food webs, and may accumulate in fish and shellfish tissues. Results from fish tissue monitoring can serve as an important indicator of further contamination of sediments and surface water.

## 2.5.2 Ward Transformer Facility Superfund Site

The Ward Transformer facility built, repaired, reconditioned and sold transformers at this facility between 1964 and 2005. As a result of the operations, polychlorinated biphenyls (PCBs) were released into the environment. This site was included on the National Priorities List or Superfund List in April 2003. EPA conducted an investigation between April 2003 and April 2007. The investigation covered the facility property and surrounding properties, together with more than 30 miles of waterways including unnamed tributaries to Little Brier Creek, a segment of Little Brier Creek, Brier Creek Reservoir, Brier Creek, Lake Crabtree and some tributaries, Crabtree Creek and some tributaries and a 0.5 mile segment of the Neuse River. The EPA signed an agreement in September 2005 to implement a removal action which includes removal of contaminated soil/sediment at the Ward Transformer facility and some immediate surrounding areas including Reach A of Little Brier Creek (See Figure 11). Clean-up measures for the remaining areas (areas downgradient of the facility and Reach A) are currently being developed. Remediation recommendations were presented to the public at a meeting in Raleigh in August 2007. EPA took public comments until October 2007 to help them determine the best course of action.

As part of the remedial investigation, soil, sediment, surface water, groundwater, and fish samples were collected. PCBs were detected above 1 mg/l level in at least one sediment sample collected from Little Brier Creek Reaches B, C and D. Sediment samples collected downgradient from Reach D did not exceed 1 mg/l. PCBs were at non-detectable levels in the sediment from Crabtree Creek and Neuse River.

Whole body fish samples were collected and analyzed to assess human health. Based on the results, the State of North Carolina Department of Health and Human Services (NC DHHS) issued fish advisories for Little Brier Creek (downstream of Brier Creek Parkway), Brier Creek Reservoir, Lake Crabtree and Crabtree Creek. Little Brier Creek and Brier Creek Reservoir fish consumption advisory recommends that fish should not be consumed. The Lake Crabtree advisory recommends that catfish and carp should not be eaten and that no more than one meal per month of other fish species should be eaten. The advisory for Crabtree Creek recommends that consumption of carp, catfish and largemouth bass be limited to no more than one meal per month. Fish tissue data from Crabtree Creek shows PCBs in fish below Crabtree Lake. Although the sediment samples from Crabtree Creek did not contain detectable concentrations of PCBs, their presence in fish samples indicates uptake and bioaccumulation of PCBs via the food chain.

The EPA developed five remedial alternative plans for the areas downgradient of the facility and Reach A. These ranged from no action to excavation of sediment in all areas with detectable PCB levels. The objectives for the remediation is to 1) Eliminate or minimize any potential risks to human health or the environment due to consumption of contaminated fish from Brier Creek, Brier Creek Reservoir, Lake Crabtree and lower Crabtree Creek by reducing PCB concentrations in fish to regulatory or risk-based levels, 2) Eliminate or minimize any potential risks to human health or the environment due to direct contact with contaminated sediments in Reaches B, C, and D, and lower Brier Creek by reducing PCB concentrations in sediment to regulatory or risk-based levels, and 3) Minimize any potential downstream migration of PCB-contaminated sediment.

The EPA presented the five alternative plans to the public in August 2007. EPA used a comparative analysis of alternatives to determine that Alternative 4 was the best remediation plan to recommend. Alternative 4 is described as excavation and off-site disposal of sediment in Reaches B, C, D, and lower Brier Creek; monitored natural recovery (MNR) in Brier Creek Reservoir, Lake Crabtree and lower Crabtree Creek and institutional controls.

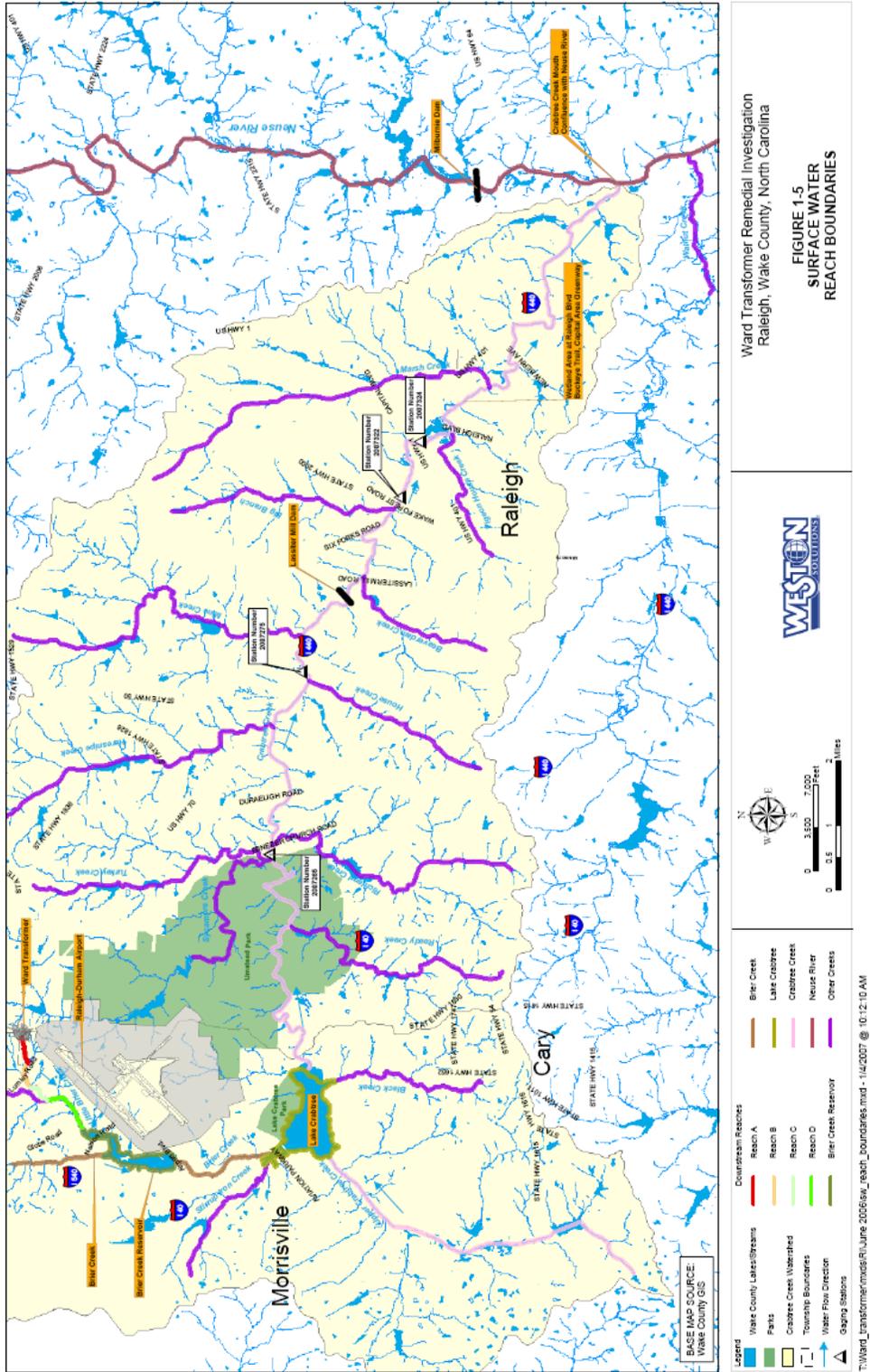
EPA determined that Alternative 5 which included sediment removal from Brier Creek Reservoir and Lake Crabtree would have a large negative impact on the habitat and aquatic organisms as well as due to the increase complexity of the project wouldn't result in a shorter recovery time for this area. The estimated time required to complete the remediation work is 3 to 5 months for Alternative 4. The estimated time required to attain acceptable PCB concentrations in fish tissue at Brier Creek Reservoir is approximately 14 years. The time required to attain acceptable PCB concentrations in fish tissue at Lake Crabtree is approximately 9 years. Alternative 4 was estimated to cost \$4,989,000 to complete. The NCDENR agreed with the EPA's preferred alternative for this project. EPA's final remedy decision will be documented in a Record of Decision once complete. For more detail information on the EPA alternatives go to <http://www.epa.gov/region4/waste/npl/nplnc/wardtransformerproposedplanfactsheet.pdf>.

On September 29, 2008, the EPA signed a Record of Decision (ROD) selecting alternative 4 as the clean up plan of the Ward Transformer Superfund Site. The plan was modified bases on public comments to include more pre-excavation sampling and floodplain removal. The total estimated cleanup cost is now \$6,130,000. The selected cleanup plan includes the following components:

- Conduct pre-excavation sampling of sediment and floodplain soil;
- Conduct a pre-excavation endangered mussel evaluation study;
- Excavate PCB contaminated sediment/soil from Reaches B, C, D, and lower Brier Creek, and transport sediment/soil off-site for appropriate landfill disposal;
- Restore site and stream to pre-excavation conditions;
- Implement Monitored Natural Recovery (MNR) in Brier Creek Reservoir, Lake Crabtree and Lower Crabtree Creek (PCB concentrations in sediments from these areas are well below the excavation limit of 1 part per million (ppm));
- Conduct periodic monitoring of sediment and aquatic biota;
- Implement institutional controls;
- Continue or enhance existing North Carolina fish consumption advisories and signs;
- Implement educational and community outreach programs; and
- Conduct five-year reviews.

The final EPA ROD is available at [http://www.epa.gov/region4/waste/sf/ward\\_transformer.pdf](http://www.epa.gov/region4/waste/sf/ward_transformer.pdf)

Figure 11 EPA Site Assessment Map for PCBs.



### **2.5.3 Water & Sewer Conservation**

Counties and municipalities should adopt water and sewer conservation policies. These would discourage the use of potable water for irrigation purposes and encourage the use of reuse/recycle systems. These policies could go as far as encouraging the use of drought tolerant grasses and native plants, use of rainwater retention systems and water-saving devices on home, businesses and municipal facilities. With the persistent droughts that effect the State of North Carolina, the Division of Water Quality is encouraging water conservation ordinances be in place when the state declares a region to be in drought status. These will prevent the overuse of surface water from the onset of drought, helping to reduce surface water withdrawals. Reduced stream flows ultimately affect the aquatic habitat and the ability for the aquatic organisms to survive during these extreme events as well.

### **2.5.4 City of Raleigh's Stormwater Program Initiatives**

The City of Raleigh received grant funds from the EPA's Section 319 Grant Program and NC Clean Water Management Trust Fund to construct a wetland in Fred Fletcher Park in downtown Raleigh. This wetland will treat runoff for an approximate 60 acre watershed around the park, which is about 40 percent impervious. The wetland will treat the 1 inch-24hr storm for this area before it flows into Pigeon House Branch reducing much of the nutrient, fecal, and sediment load to this segment of the stream. Construction of the wetland at Fred Fletcher Park began in spring 2008 and completed in fall 2008.

The City is also involved in several other projects to reduce impacts to Pigeon House Branch. Two bioretention areas have been installed to serve City maintenance facilities located directly adjacent to the main channel of Pigeon House Branch near downtown Raleigh. The first bioretention area is approximately 6,000 square feet and treats runoff from a 100% impervious watershed approximately 1 acre in size. The second bioretention area is approximately 1,000 square feet and treats runoff from a 100% impervious watershed of approximately 0.4 acre. These projects were completed in the summer and early fall of 2008.

Three additional stream enhancement projects are planned for Pigeon House Branch beginning in early 2009. Each stream enhancement project is aimed at improving water quality by stabilizing existing stream bank erosion, preventing future stream bank erosion, and improving habitat while protecting large mature trees within the existing stream buffer. The three stream enhancement projects total 2,250 linear feet of stream. See section 2.3.4 for additional water quality information on Pigeon House Branch.

The City of Raleigh is planning for stream enhancement projects within the Mine Creek watershed, a tributary of Crabtree Creek. Three stream enhancement projects and one stream restoration project are currently under design and planned to begin construction in late 2009 or early 2010.

Raleigh also stabilizes eroding streams on private properties through application of its Drainage Petition Program. This Council adopted policy has been in place for many years and provides for City funding of the design and construction of stream stabilization projects on private property. The City currently funds 80% or more of the cost of such projects.

A nearly 5,000 square foot extensive green roof is planned to be constructed in 2009 on the existing roof of Raleigh Fire Station No. 9 as well as a 15,000 square foot extensive green roof is

planned for the roof of the Raleigh Municipal Building in downtown Raleigh. The City of Raleigh has planned for the installation of two rainwater harvesting systems at existing park facilities in 2009, Green Road Park and Sanderford Road Park. The City of Raleigh is planning for the design of rainwater harvesting systems at nine different Raleigh fire stations in 2009 with plans to install the systems in 2010.

Raleigh has also initiated a “stream naturalization” program across the City for the purpose of allowing vegetation to grow and mature along stream banks on publicly owned properties. The ultimate goal of this program is to allow functional riparian buffers to develop in areas which were previously intensively maintained through mowing and use of herbicides.

Finally, Raleigh has an on-going program to identify, preserve, and enhance the water quality components of privately owned lakes and ponds that have been determined to provide significant water quality benefits. While the preservation and enhancement of lakes and ponds is not currently recognized by State stormwater regulators and assigning any kind of credit for such in-stream treatment, these existing impoundments may provide a great deal of existing nutrient reduction that would be lost and result in increased pollutant loads downstream if the City allowed these lakes and ponds to be removed by their owners.