Neuse River Basinwide Water Quality Plan

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This document was approved and endorsed by the NC Environmental Management Commission on July 9, 2009 to be used as a guide by the NC Division of Water Quality in carrying out its Water Quality Program duties and responsibilities in the Neuse River basin. This plan is the fourth five-year update to the Neuse River Basinwide Water Quality Plan approved by the NC Environmental Management Commission in July 2009.

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Neuse River Basin Description

The Neuse River originates in north central North Carolina in Person and Orange counties and flows southeasterly until it reaches tidal waters near Streets Ferry upstream of New Bern (Figure *i*). At New Bern, the river broadens dramatically and changes from a free-flowing river to a tidal estuary that eventually flows into the Pamlico Sound. The Neuse River basin is the third largest river basin in North Carolina (6,235 square miles) and is one of only four major river basins whose boundaries are located entirely within the state.

There are 3,389 freshwater stream miles, 17,902 acres of freshwater reservoirs and lakes, 143 saltwater stream miles, and 370,779 estuarine/saltwater acres in the Neuse River basin (Table *i*). There are also numerous miles of unmapped small perennial, intermittent and ephemeral streams. Extensive wetland communities are also found in the lower Neuse River basin.

The Neuse River basin encompasses all or portions of 18 counties and 77 municipalities. The population of these 18 counties increased by 27 percent from 1990 to 2000 and is expected to increase by 44 percent between 2000 and 2020. The population is projected to grow by more than 867,000 with the total number of people living within the Neuse River basin to be over 2,000,000 by 2020.

Water Quality Monitoring & Assessment Summary

Biological, chemical and physical monitoring data presented in this basinwide water quality plan is based on data collected in calendar years 2002 through 2006. This is the same data window used for the 2008 Integrated Report (303(d) and 305(b) listings). The routine biological monitoring in the Neuse River basin took place in 2005. Several ambient and biological monitoring special studies also took place in the Neuse River basin during this assessment period. Each subbasin has its own characteristics and water quality concerns. Maps of each subbasin are included in each of the subbasin chapters (Chapters 1-14).

In the entire Neuse River basin, 459 freshwater stream miles (14 percent of the total miles), 13,538 freshwater acres (76 percent), 35 saltwater stream miles (25 percent), and 57,648 saltwater acres (16 percent) were impaired for one or more surface water quality standards. Table *i* presents the totals of all the monitored streams, lakes and estuarine waters and gives a summary of miles and acres impaired and supporting. Table *ii* (found at the end of this summary) lists the Neuse River basin's impaired waters from the 2008 Integrated Report (IR).

Figure i General Map of the Entire Neuse River Basin

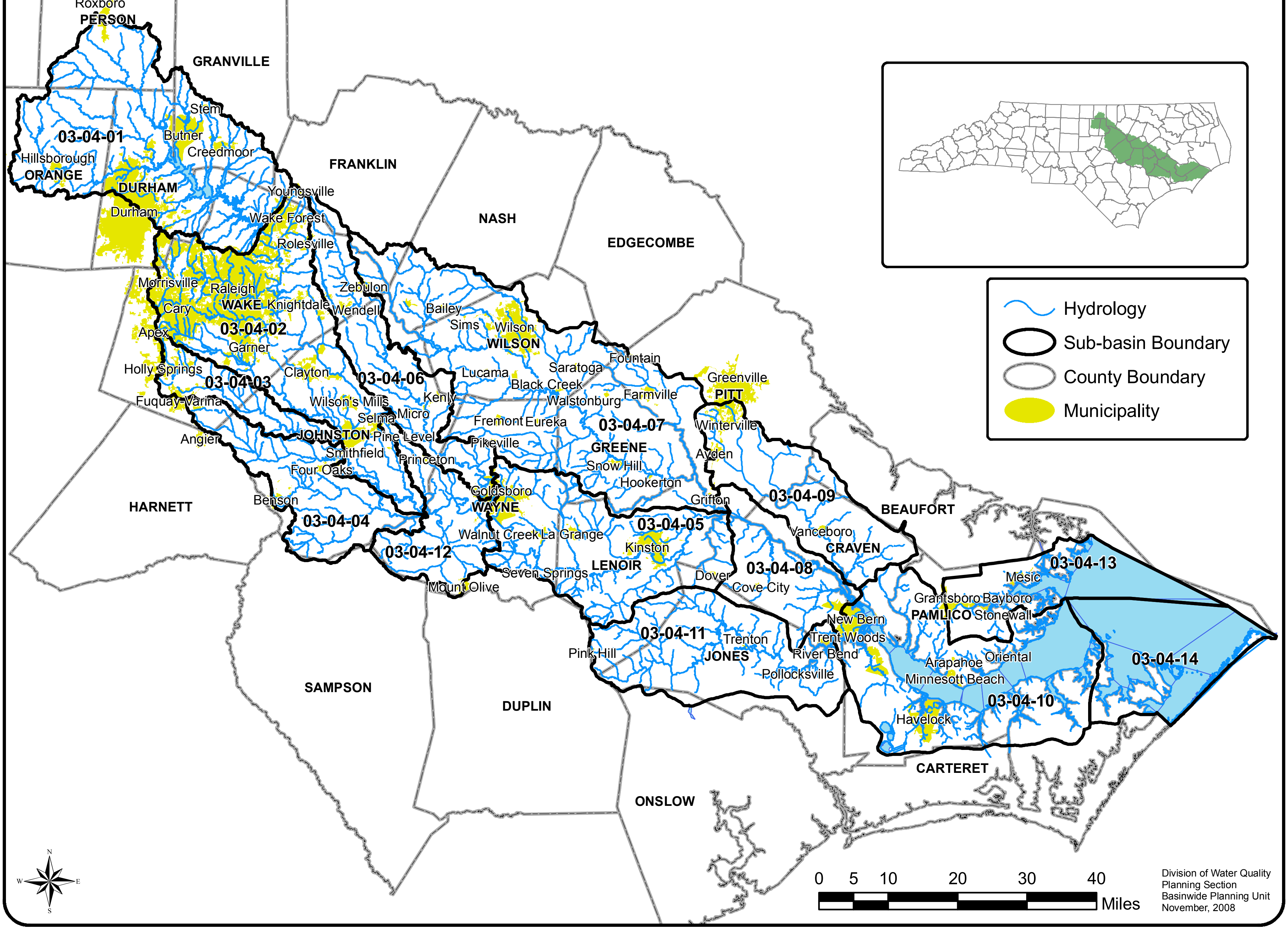


Table i Summary of Monitored and Unmonitored Waters in the Neuse River Basin.

Water Type	Total	Total Monitored Waters		Total Supporting Waters			Total Impaired Waters			Total Not Rated Waters			Total No Data Waters	
	Miles/Acres	Miles/Acres	Percent of Total Waters	Miles/Acres	Percent of Total Waters	Percent of Monitored	Miles/Acres	Percent of Total Waters	Percent of Monitored	Miles/Acres	Percent of Total Waters	Percent of Monitored	Miles/Acres	Percent of Total Waters
Freshwater Acres (impoundments)	17,901	15,732	88	1,683	9	11	13,538	76	86	511	3	3	2,170	12
Freshwater Miles (streams)	3,389	1,483	44	846	25	57	459	14	31	178	5	12	1,906	56
Estuarine Acres	370,779	365,688	99	308,040	83	84	57,648	16	16	0	0	0	5,091	1
Estuarine Miles	143	46	33	11	8	24	35	25	76	0	0	0	96	68

The majority of the freshwater stream miles in the Neuse River basin are impaired due to impaired biological integrity (BI), low dissolved oxygen levels and elevated turbidity (Figure *ii*). The majority of the fresh and saltwater acres are impaired as a result of elevated chlorophyll *a* and high pH (due to elevated nutrients), turbidity and bacteria (fecal coliform and enterococci) levels (Figure *iii*).

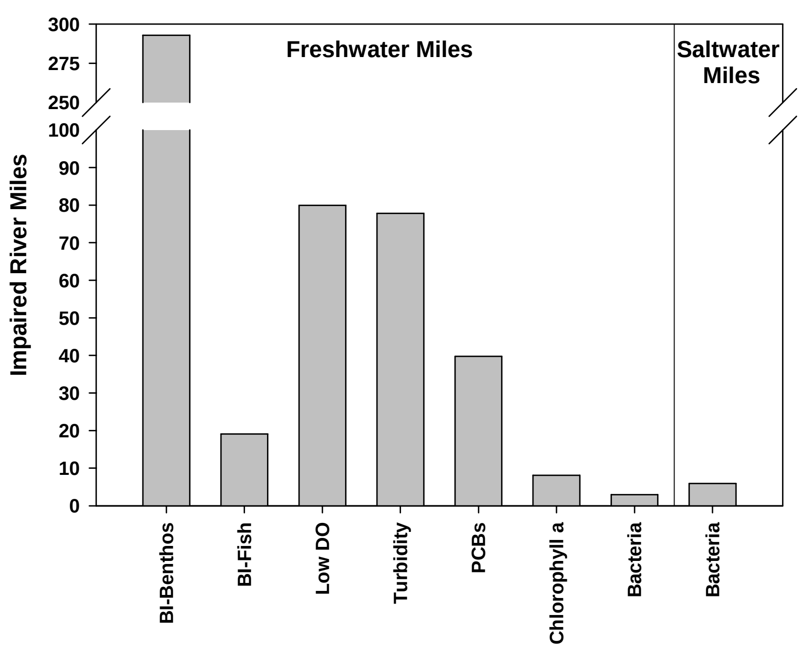


Figure *ii*. Neuse River Basin Impaired River Miles by Parameter.

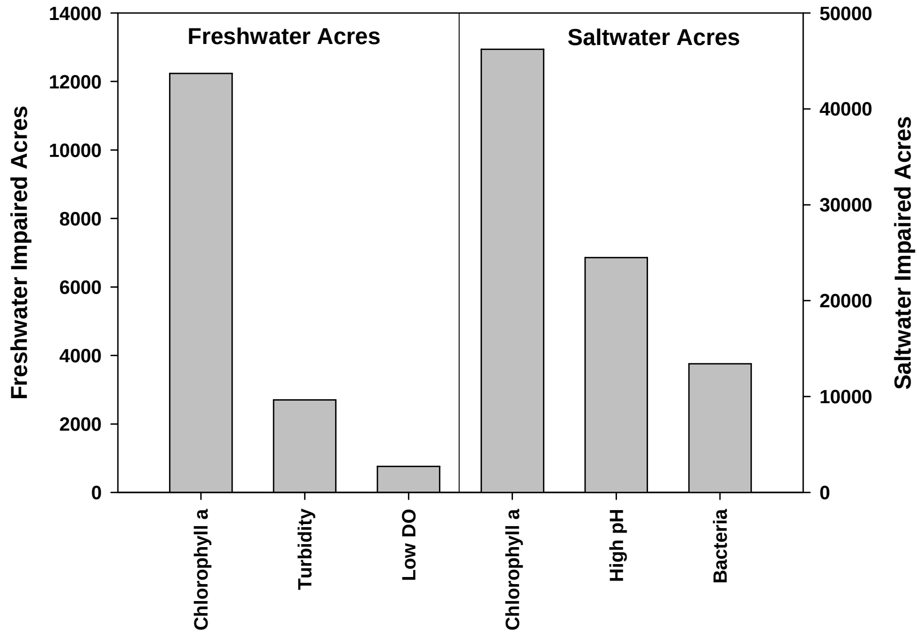


Figure *iii*. Neuse River Basin Impaired Acres by Parameter.
(Note: scales are different for each water type.)

Nonpoint source runoff from a variety of land use practices is identified as the primary source of impacted surface waters in the Neuse River Basin (Table *iii*; see Chapters 1-14 and 17 for more details). Runoff from rain events carries sediment, nutrients and toxicants that affect the aquatic ecosystem and fecal coliform bacteria that result in impairment of the recreation and shellfish harvesting use support categories.

Urban development within the Neuse River basin is altering the watershed hydrology, resulting in downstream flooding, streambank erosion, channel incision, increased turbidity and degrading aquatic habitat and biological health (see Chapter 17 or the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm) on how urban development affects the watershed).

Excessive nutrient loading is ultimately the primary stressor in the Neuse River basin resulting in the chlorophyll *a* impairment of Falls Lake and the Neuse River Estuary, as seen in figure *iii*. While great strides have been made in the reduction of nitrogen contribution from both point and nonpoint sources to the Neuse River Basin, many challenges remain in developing a thorough understanding of the complex nutrient delivery system and the management strategies that will be most effective to achieve timely water quality improvements.

Table *iii* Estimated Freshwater Stream Miles Potentially Impacted* by Nonpoint Source Runoff (based on best professional judgment and land use activities).

Nonpoint Sources of Runoff/Stormwater	Impacted Freshwater (Miles)**	Total Miles
Urban Nonpoint Source Stormwater/Runoff		
MS4^ NPDES Stormwater	428	
Non - MS4 Stormwater	406	
Construction	94	
Land Clearing	77	
Total – Urban Runoff		1005 miles
Other Nonpoint Source Runoff		
General Agriculture	534	
Row Crop Agriculture	143	
Forest Harvesting	14	
Total – Other Runoff		691 miles
Total Urban and Other NPS Runoff		**1,696 miles+**

* Impacted waters – Waters determined to have a ≥ 7 % standard violation of an ambient monitored parameter, biological bioclassification assessment of Good-Fair or less and/or best professional judgment when visual observations at a particular stream segment indicated such conditions.
**Data is from the NC 2008 Integrated Report.
^ MS4 – Municipal Separate Storm Sewer System.
+ Total number of freshwater stream miles in the Neuse River Basin is 3,389 miles (at least 50% of the streams lengths are impacted by nonpoint source runoff, this number is likely much higher).

Water Quality Improvements

There were several water quality improvements noted in the Neuse River basin during this assessment period (Table *iv*). Eighty-five freshwater stream miles were removed from the North Carolina 2008 Impaired Waters list due to specific water quality improvement; 34 miles for dissolved oxygen and 51 miles for newly supporting biological integrity.

Many of these improvements are likely due to concerted efforts made in these watersheds by the point source contributors and the agricultural community. Twenty-seven miles of the Nahunta Swamp and 15 miles of Core Creek were removed from the 2008 303(d) impaired waters list due to improved biological integrity. The macroinvertebrate community ratings went from fair to good-fair in 2005. It appears that the agricultural BMPs implemented through funding by the Clean Water Management Trust Fund and the Agriculture Cost Share Program was successful in reducing the water quality impacts to the biological community from the agricultural practices within these watersheds. More information can be found in Chapter 7, section 7.3.6 and Chapter 8, section 8.3.1 for Nahunta Swamp and Core Creek, respectively.

The most upstream portion of the Neuse River Estuary (2,790 saltwater acres) was also removed from the 2008 Impaired Waters list (Table *iv*). This segment of the estuary did not exceed the state chlorophyll *a* standard of 40 µg/l in more than 10 percent of the samples assessed. This is the first complete evaluation of the estuary (headwater to mouth) and represents only the current status that existed during this assessment period (1/1/2002-12/31/06). This is does not necessarily represent a change in the water quality status in this area. The data collected during the next assessment period will give a better indication as to the changes that are taking place in the estuary. It is likely that the spatial extent of the chlorophyll *a* impairment will shift up and down in the estuary depending on several factors like major climatic events, river flows and nutrient contribution.

Table iv Water quality improvements resulting in delisting off the North Carolina 2008 Impaired Waters list.

Assessment Unit	Subbasin	Stream Name	Length	Unit	Listing Year	Parameter*	Delisting Reason
27-43-15-(1)a	03-04-03	Middle Creek	1	FW Miles	2004	DO	No Criteria Exceeded
27-45-(14)	03-04-04	Black Creek	2	FW Miles	2004	DO	No Criteria Exceeded
27-57-(20.2)a	03-04-06	Little River	9	FW Miles	2004	DO	No Criteria Exceeded
27-57-(8.5)b	03-04-06	Little River (Tarpleys Pond)	12	FW Miles	2004	DO	No Criteria Exceeded
27-68	03-04-05	Walnut Creek (Lake Wackena, Spring Lake)	7	FW Miles	2004	DO	No Criteria Exceeded
27-86-14	03-04-07	Nahunta Swamp	27	FW Miles	1998	Benthos	Biological Improvement
27-86-2-4	03-04-07	Little Creek (West Side)	4	FW Miles	1998	DO	No Criteria Exceeded
27-90b	03-04-08	Core Creek	15	FW Miles	1998	Benthos	Biological Improvement
27-97-(0.5)a2	03-04-09	Swift Creek	5	FW Miles	1998	Benthos	Biological Improvement
27-97-5b	03-04-09	Clayroot Swamp	3	FW Miles	1998	Benthos	Biological Improvement
27-(96)a	03-04-08	Neuse R. Estuary	427	SW Acres	2004	Chlorophyll *a*	No Criteria Exceeded
27-(96)b1	03-04-10	Neuse R. Estuary	2,363	SW Acres	2004	Chlorophyll *a*	No Criteria Exceeded
		Water Quality Improvements Totals					
		DO	**34**	**FW Miles**			
		Biological	**51**	**FW Miles**			
		Chlorophyll a	**2,790**	**SW Acres**			

* Parameters - DO – Dissolved Oxygen
Benthos – Biological Integrity, Macroinvertebrate Organisms

Water Quality Management Strategies and Activities

Falls of the Neuse Reservoir

The Falls of the Neuse Reservoir (Falls Lake) has been placed on the 2008 303(d) list of impaired waters due to chlorophyll *a* standard violations for the entire lake and turbidity standard violations in the upper portion of the lake (Table *ii*). In addition, a Nutrient Management Strategy to be implemented through rules is under development for the lake per the 2005 Senate Bill 981. DWQ is working with a Technical Advisory Committee of local governments, environmental interests and resource agencies to develop a lake and watershed model to support a comprehensive nutrient management strategy. This comprehensive strategy will be developed with broader stakeholder participation and is anticipated to require additional reductions in nutrients from all sources in the watershed.

Neuse River Estuary

The impairment due to chlorophyll *a* standard violations in the Lower Neuse River Estuary has been extended to below Cherry Point (total area is 45,196 saltwater acres; Table *ii*). A large section of the Neuse River Estuary is also impaired due to high pH standard violations (24,493 saltwater acres; Table *ii*). These impairments are directly linked to the elevated presence of algae in the estuary.

Since the full spatial extent of the chlorophyll *a* impairment was not assessed until this data window, DWQ can not determine if the chlorophyll *a* impairments have expanded or not due to the lack of sufficient data for comparison.

Due to historical nuisance algal blooms and fish kills, the lower Neuse River Estuary is classified as Nutrient Sensitive Waters (NSW) and has a NSW Management Strategy in place; as well as a legislative requirement to meet a 30% reduction in nitrogen loading (Session Law 1995, Section 572). The Neuse River NSW Management Strategy became effective as permanent rules on August 1, 1998. In 1999 and 2002, a Total Maximum Daily Load (TMDL) for nitrogen and phosphorus was developed based on the NSW Management Strategy and additional environmental modeling. Rules to support the management strategy and TMDL were fully implemented by 2003. The Neuse River NSW management strategy and TMDL are described in detail in Chapter 24.

Since full implementation of the nutrient reduction strategy, nitrogen loads from point sources have been reduced by 65 percent and the agriculture community has reduced their estimated nitrogen loss from cropland and pastureland by approximately 45 percent. Over 1,850 fertilizer applicators have received nutrient management training and the 15 local governments covered under the Neuse Stormwater Rule have adopted and implemented local stormwater programs to limit nitrogen inputs from stormwater runoff resulting from new development.

At this point the data do not seem to indicate any significant decrease in actual nutrient loading to the estuary. Thus the goal of a 30 percent reduction in total nitrogen loading at Fort Barnwell and the reduction of chlorophyll *a* standard violations within the Neuse River Estuary have not yet been achieved (Chapter 24). Reductions in nutrient inputs may take time to detect in measured loading, due to year-to-year variability in precipitation and flow. Based on the results of recent trend analysis (see Chapter 24), it is evident that it will take more than five years to discern a 30 percent decrease in load to the estuary.

DWQ is pursuing further analysis of current data and will be reassessing our monitoring and research needs to ensure that sufficient information is being collected to fully characterize all inputs. It is important to note that at this time, DWQ is not reassessing the TMDL or suggesting that the current NSW rules be modified.

DWQ Recommendations

The long-range mission of basinwide planning is to provide a means of addressing the complex problem of planning for increased development and economic growth while maintaining, protecting and enhancing water quality in the Neuse River basin's surface waters.

The following are the more overarching recommendations and research needs identified in this management plan. The actions DWQ plans to take to implement these recommendations are laid out in Table v. More site-specific recommendations can be found in the individual chapters.

<u>Source Assessment and Trends</u>

- Coordinate efforts with the Division of Air Quality to assess atmospheric nitrogen contributions to the watershed and develop recommendations on better ongoing characterization of atmospheric nitrogen deposition and emission source regulatory considerations.
    - Specifically address better characterization of the contribution of ammonia emissions from CAFO operations.
- Develop a more detailed analysis of current and historic data in order to better quantify the status of nutrient loading to the estuary; conduct additional trend and loading analysis upstream of the Neuse River Estuary focusing on smaller watersheds with dominant land use types; this will allow staff to better gauge the effectiveness and progress of strategy implementation.
- Identify the need for additional monitoring locations and parameters to better characterize basin nutrient sources and relative contributions.
- Lead in the development of the Falls of the Neuse Reservoir Nutrient Management Strategy per legislative timeline.
- Complete the CAFO monitoring plan rulemaking process.
- Review Neuse Buffer compliance tracking and assessment needs. Use Compliance data to assess impacts to the basin.

<u>Stormwater Needs</u>

- Develop a full assessment and recommendations on stormwater programmatic coverage gaps and need to meet nutrient strategy goals on new development activities. Include recommendations on most appropriate regulatory approach.
    - Designate new Phase II stormwater communities where criteria are appropriate.

        - Require Phase II stormwater permit holders to initiate nutrient controls upon permit renewal or designated as Phase II if appropriate.

        - Assessment of stormwater Phase II and Neuse Stormwater permitting programs. Make recommendations on how to strengthen the current program to be more environmentally protective.

        - Audit local stormwater programs for effectiveness and work with local governments to strengthen their implementation.

    - Evaluate the magnitude of nitrogen loading in runoff from existing development areas and develop recommendations on the need to address this source under the strategy.

    - Review stormwater and sediment and erosion control compliance activities; assess need for additional staff for inspection and enforcement needs.

Additional Issues

- Lead the interagency workgroup established to improve accounting of land use changes and net progress toward strategy goals.

- Evaluate regulatory issues associated with nutrient loading potential from high rate infiltration wastewater systems in the basin.

- Work with the Division of Coastal Management to assess the cumulative impacts of marinas on nutrient and bacterial related water quality.

Voluntary Actions

- Implement the 2003 UNRBA Upper Neuse Watershed Management Plan and other local watershed plans.

- Require stormwater best management practices for existing and new development.

- Develop, strengthen and enforce riparian buffer ordinances.

- Implement comprehensive land use planning that assesses and reduces the impact of development on natural resources.

- Develop and enforce local erosion control ordinances.

- Implement pet waste and residential fertilizer reduction ordinances.

- Work with local resource agencies to install appropriate BMPs in order to reduce the contribution of nutrient, sediment, bacteria and toxicants as well as addresses stormwater volume and velocity issues.
  - Community Conservation Assistance Program
  - Agriculture Cost Share Program
  - Conservation Reserve Enhancement Program

- Cultivate local champions in impaired watersheds toward initiating voluntary watershed projects. [Basinwide – URW program]

<u>Research Needs Identified</u>

- Develop monitoring to better characterize the nature, magnitude and trends in atmospheric and groundwater derived nutrient contributions to the Neuse River Estuary.

- Characterize the location, geographic extent and functionality of tile drains under agricultural fields.

- Quantify the potential magnitude of nutrient loading from spray fields, directly from animal housing and holding, and waste storage facilities on confined animal feeding operations (CAFOs).

- Characterize the geographic extent and quantify the potential magnitude of nutrient loading from dry litter poultry facilities, animal housing and waste storage.

- Characterize the potential for groundwater contamination and transport of nutrients from biosolids and wastewater land application fields to the surface waters of the Neuse Basin.

- Quantify the nitrogen contributions from conventional on-site wastewater treatment systems to surface waters of the Neuse Basin.

- Better quantification of BMP effectiveness (agricultural and stormwater BMPs); improve accounting tools.

- Improve upon current stormwater impact assessment methods and develop better tools to reduce the environmental impacts from stormwater.

- Characterize nutrient loading from various pasture management practices which leads to a better understanding of pasture's nutrient contributions and the value of different management options.

Research Initiated to Fulfill Research Needs Described Above

- Under a FY2008 319 grant for $150,000, DWQ APS and USGS are on a three-year project which will use USGS gauging stations and DWQ ambient monitoring data to determine base flow (groundwater discharge rate) and overall nutrient export from selected watersheds in the Neuse River basin. The final report from this study will is expected in 2011.

- In association with the above FY2008 319 grant, during 2009-2010 DWQ APS will also conduct nutrient sampling during baseflow from a small number of headwater streams adjacent to non-point sources of nutrients (including wastewater and residuals application fields) to provide additional measures of the degree to which nutrients applied to the land discharge to streams via groundwater.

- In association with the above FY2008 319 grant, during 2009-2010 DWQ APS will compile estimates of the total land-applied nitrogen load at residuals and wastewater application fields in selected watersheds in the Neuse Basin. This compilation will serve as a baseline from which to calculate potential nutrient loads to surface waters from these facilities.

- As part of its Groundwater Resource Evaluation Program, DWQ APS has recently completed a pilot study of poultry litter impacts to groundwater and soils in Wilkes County. The report on this study is in preparation and should be released in 2009.

- During 2009-2011, under a FFY2007 319 grant for $204,325, researchers at NCSU and USDA will complete a statistically valid survey of agriculture producers in the Neuse Basin to provide field-scale data consisting of information on animal numbers, nutrient management, agricultural crops, and best management practices (including tile drains and water control structures). The results of this survey will be utilized in the state supported nutrient tracking tools NLEW and PLAT.

- Under a FY2008 319 grant for $99,974, researchers in the NCSU BAE department are currently evaluating the performance of level spreaders associated with riparian buffers to help determine overall water quality benefit gained and a better understanding of sediment and nutrient reduction achieved from properly designed level spreader / riparian buffer systems. The final report from this study will is expected in 2010.

Without proactive land use planning initiatives and local water quality strategies, population growth and development in the basin increases the risk of surface water impairment. Balancing economic growth and water quality protection will continue to be an immense challenge. This basinwide plan presents many water quality initiatives and accomplishments that are underway throughout the basin. These actions provide a foundation on which future initiatives can be built.

Table v Division of Water Quality Neuse River Basin Action Plan.

Recommendation/Goals	Responsible Parties	Action	Date
Source Assessment and Trends			
Coordinate efforts with the Division of Air Quality to assess atmospheric nitrogen contributions to the watershed and develop recommendations on better ongoing characterization of atmospheric nitrogen deposition and emission source regulatory considerations.	Planning Section - NPS Unit & BPU Unit	Initiated workgroup with DWQ & DAQ.	Late 2008
Identify the need for additional monitoring locations and parameters to better characterize basin nutrient sources and relative contributions; develop a more detailed analysis of current and historic data in order to better quantify the status of nutrient loading to the estuary; conduct additional trend and loading analysis upstream of the Neuse River Estuary focusing on smaller watersheds with dominant land use types.	Planning & Env. Sciences Sections	Initiate discussion within DWQ to pursue monitoring and funding options. Contract out for analysis	2009/2010 (funding dependent)
Complete development of the Falls of the Neuse Reservoir (Falls Lake) Nutrient Management Strategy Rules.	Planning Section – NPS Unit	Stakeholder process to develop rules, public hearings for comment, EMC adoption.	Target completion based on legislative requirements under consideration
Complete the CAFOs monitoring plan rulemaking process.	Aquifer Protection Section	Rule development, public comment, EMC decision	Target completion 2009/2010
Evaluate Neuse Buffer compliance tracking and assessment needs.	Wetlands and Stormwater Branch – NPS Assistance & Compliance Unit	Establish a DWQ workgroup to evaluate tracking methods and database needs.	Workgroup 2009 Recommendations 2010

Recommendation/Goals	Responsible Parties	Action	Date
Stormwater Needs			
Develop a full assessment and recommendations on stormwater programmatic coverage gaps and need to meet nutrient strategy goals on new development activities. Include recommendations on most appropriate regulatory approach.	Planning Section – NPS & Wetlands and Storm-water Branch – Stormwater Permitting	Establish a DWQ working group to evaluate programs and nutrient control issues.	Workgroup 06/2009 Recommendations 06/2010
• Designate new Phase II stormwater communities where criteria are appropriate.			Identify Candidates by Sept. 2009 Designations by early 2010
• Review Phase II stormwater permit holders to evaluate nutrient controls upon permit renewal or designation as Phase II if appropriate. Permittees will also be required to assess nutrient control during application process.			Renewals – early 2010 Designations – as appropriate within required timelines
• Assessment of stormwater Phase II and Neuse Stormwater permitting programs. Make recommendations on how to strengthen the current program to be more environmentally protective.			2010
Audit local stormwater programs for effectiveness and work with local governments to strengthen their implementation.	Planning Section – NPS & Wetlands and Storm-water Branch – Stormwater Permitting Unit & NPS Assistance & Compliance Unit	Evaluate potential improvements to reporting and pursue additional audit opportunities pending available funding. Audit 2 programs per year as current resources allow within statewide audit responsibilities.	2010
Evaluate the magnitude of nitrogen loading in runoff from existing development areas and develop recommendations on the need to address this source under the strategy.	Planning Section – NPS	Calculate nutrient loading estimates from existing development.	2009

Recommendation/Goals	Responsible Parties	Action	Date
Stormwater Needs Continued			
Review stormwater control compliance activities; assess need for additional staff for inspection and enforcement needs.	Wetlands and Stormwater Branch – NPS Assistance & Compliance Unit	Review existing and develop needs assessment.	2010
Review sediment and erosion control compliance activities; assess need for additional staff for inspection and enforcement needs.	Wetlands and Stormwater Branch – NPS Assistance & Compliance Unit	Continue the workgroup between DWQ & DLR.	2010
Additional Issues			
Lead the interagency workgroup established to improve accounting of land use changes and net progress toward strategy goals.	Planning Section – NPS Unit	Reconvene land accounting workgroup.	2009
Evaluate regulatory issues associated with nutrient loading potential from high rate infiltration wastewater systems in the basin.	Planning Section - BPU	Continue DWQ workgroup.	Recommendations Late 2009
Work with the Division of Coastal Management to assess the cumulative impacts of marinas on nutrient and bacterial related water quality.	Planning Section – NPS Unit & BPU	Coordinate ongoing efforts between DWQ, DCM & DEH. Assist with procuring funds to support the DCM Clean Marina Coordinator position.	2010

Table *ii*. Neuse River 2008 Draft Impaired Waters List.
(Note: From the 2008 DRAFT Impaired Waters List - 11/10/08. See Appendix XI for the most up to date version.)

Assessment Unit	**2006 Subbasin #**	**Future Subbasin #**	**Stream Name**	**Stream Classification**	**Length/ Area**	**Miles/ Acres**	**Impairment**
27-(1)	03-04-01	03020201	NEUSE RIVER (Falls Lake below normal pool elevation)	WS-IV;NSW,CA	2,703.6	FW Acres	Turbidity, Chlorophyll a
27-(5.5)	03-04-01	03020201	NEUSE RIVER (Falls Lake below normal pool elevation)	WS-IV,B;NSW,CA	9,530.3	FW Acres	Chlorophyll a
27-11-(0.5)	03-04-01	03020201	Lick Creek	WS-IV;NSW	6.5	FW Miles	Benthos
27-11-(1.5)	03-04-01	03020201	Lick Creek	WS-IV;NSW,CA	0.7	FW Miles	Benthos
27-15-(1)	03-04-01	03020201	Upper Barton Creek	WS-IV;NSW	4.9	FW Miles	Benthos
27-3-(8)	03-04-01	03020201	Flat River	WS-IV;NSW	1.1	FW Miles	Low Dissolved Oxygen
27-3-(9)	03-04-01	03020201	Flat River (including the Flat River Arm of Falls Lake)	WS-IV;NSW,CA	0.6	FW Miles	Low Dissolved Oxygen
27-4-(6)	03-04-01	03020201	Knap of Reeds Creek	WS-IV;NSW	5.6	FW Miles	Benthos
27-4-(8)	03-04-01	03020201	Knap of Reeds Creek	WS-IV;NSW,CA	0.6	FW Miles	Benthos
27-5-(0.3)	03-04-01	03020201	Ellerbe Creek	C;NSW	6.1	FW Miles	Fish
27-5-(0.7)	03-04-01	03020201	Ellerbe Creek	WS-IV;NSW	5.9	FW Miles	Fish
27-5-(2)	03-04-01	03020201	Ellerbe Creek	WS-IV;NSW,CA	0.5	FW Miles	Benthos
27-9-(0.5)	03-04-01	03020201	Little Lick Creek	WS-IV;NSW	7.2	FW Miles	Benthos, Turbidity, Low Dissolved Oxygen
27-9-(0.5)ut2	03-04-01	03020201	UT2 to Little Lick Creek	WS-IV;NSW	2.4	FW Miles	Low Dissolved Oxygen
27-9-(2)	03-04-01	03020201	Little Lick Creek (including portion of Little Lick Creek Arm of Falls Lake)	WS-IV;NSW,CA	0.6	FW Miles	Benthos, Turbidity, Low Dissolved Oxygen
27-9-(2)ut2	03-04-01	03020201	UT2 to Little Lick Creek (including portion of Little Lick Creek Arm of Falls Lake)	WS-IV;NSW,CA	0.9	FW Miles	Low Dissolved Oxygen
27-(38.5)	03-04-02	03020201	NEUSE RIVER	WS-IV;NSW	9.7	FW Miles	Turbidity
27-(41.7)	03-04-02	03020201	NEUSE RIVER	WS-V;NSW	26.2	FW Miles	Turbidity

Assessment Unit	2006 Subbasin #	Future Subbasin #	Stream Name	Stream Classification	Length/ Area	Miles/ Acres	Impairment
27-23-(2)	03-04-02	03020201	Smith Creek	C;NSW	5.8	FW Miles	Fish
27-24a1	03-04-02	03020201	Toms Creek (Mill Creek)	C;NSW	1.6	FW Miles	Benthos
27-24b	03-04-02	03020201	Toms Creek (Mill Creek)	C;NSW	1.5	FW Miles	Benthos
27-25-(1)	03-04-02	03020201	Perry Creek (Greshams Lake)	B;NSW	2.4	FW Miles	Benthos
27-25-(2)	03-04-02	03020201	Perry Creek	C;NSW	2.5	FW Miles	Benthos
27-33-(1)	03-04-02	03020201	Crabtree Creek	C;NSW	5.1	FW Miles	Benthos
27-33-(10)a	03-04-02	03020201	Crabtree Creek	C;NSW	2.0	FW Miles	Fish Consumption-PCB
27-33-(10)b	03-04-02	03020201	Crabtree Creek	C;NSW	10.9	FW Miles	Benthos, Turbidity, Fish Consumption-PCB
27-33-(10)c	03-04-02	03020201	Crabtree Creek	C;NSW	2.8	FW Miles	Fish Consumption-PCB
27-33-(3.5)a	03-04-02	03020201	Crabtree Creek (Crabtree Lake)	B;NSW	6.8	FW Miles	Benthos, Turbidity, Fish Consumption-PCB
27-33-(3.5)b	03-04-02	03020201	Crabtree Creek (Crabtree Lake)	B;NSW	5.4	FW Miles	Turbidity, Fish Consumption-PCB
27-33-11	03-04-02	03020201	Richlands Creek	C;NSW	4.7	FW Miles	Benthos
27-33-12-(1)	03-04-02	03020201	Hare Snipe Creek (Lake Lynn)	B;NSW	2.0	FW Miles	Benthos
27-33-12-(2)	03-04-02	03020201	Hare Snipe Creek	C;NSW	2.5	FW Miles	Benthos
27-33-14a	03-04-02	03020201	Mine Creek	C;NSW	3.3	FW Miles	Benthos
27-33-14b	03-04-02	03020201	Mine Creek	C;NSW	1.5	FW Miles	Benthos
27-33-18	03-04-02	03020201	Pigeon House Branch	C;NSW	2.9	FW Miles	Benthos, Recreation-Fecal, Copper
27-33-20	03-04-02	03020201	Marsh Creek	C;NSW	6.0	FW Miles	Benthos

Assessment Unit	2006 Subbasin #	Future Subbasin #	Stream Name	Stream Classification	Length/ Area	Miles/ Acres	Impairment
27-33-4	03-04-02	03020201	Brier Creek	C;NSW	6.5	FW Miles	Fish Consumption-PCB
27-33-4-1	03-04-02	03020201	Little Brier Creek	C;NSW	5.3	FW Miles	Fish Consumption-PCB
27-33-5	03-04-02	03020201	Black Creek	C;NSW	3.6	FW Miles	Benthos
27-33-8	03-04-02	03020201	Reedy Creek (Reedy Creek Lake)	B;NSW	28.8	FW Acres	Aquatic Weeds
27-33-9	03-04-02	03020201	Sycamore Creek (Big Lake)	B;NSW	61.8	FW Acres	Aquatic Weeds
27-34-(1.7)	03-04-02	03020201	Walnut Creek	C;NSW	1.4	FW Miles	Fish
27-34-(4)a	03-04-02	03020201	Walnut Creek	C;NSW	6.4	FW Miles	Benthos
27-34-(4)b	03-04-02	03020201	Walnut Creek	C;NSW	3.7	FW Miles	Turbidity
27-43-(1)a	03-04-02	03020201	Swift Creek	WS-III;NSW	2.6	FW Miles	Benthos
27-43-(1)b	03-04-02	03020201	Swift Creek	WS-III;NSW	5.5	FW Miles	Benthos
27-43-(1)d	03-04-02	03020201	Swift Creek	WS-III;NSW	2.4	FW Miles	Benthos
27-43-(5.5)a	03-04-02	03020201	Swift Creek (Lake Benson)	WS-III;NSW,CA	0.9	FW Miles	Benthos
27-43-12	03-04-02	03020201	Little Creek	C;NSW	11.4	FW Miles	Benthos
27-43-2	03-04-02	03020201	Williams Creek	WS-III;NSW	2.6	FW Miles	Benthos
27-43-15-(1)b1	03-04-03	03020201	Middle Creek	C;NSW	3.0	FW Miles	Benthos
27-43-15-(4)a	03-04-03	03020201	Middle Creek	C;NSW	7.2	FW Miles	Turbidity
27-45-(2)	03-04-04	03020201	Black Creek	C;NSW	22.6	FW Miles	Low Dissolved Oxygen
27-52-6a	03-04-04	03020201	Hannah Creek	C;NSW	10.3	FW Miles	Benthos
27-52-6a	03-04-04	03020201	Hannah Creek	C;NSW	10.3	FW Miles	Low Dissolved Oxygen
27-(56)b	03-04-05	03020201	NEUSE RIVER	C;NSW	21.5	FW Miles	Fish Consumption-Mercury
27-(75.7)b	03-04-05	03020202	NEUSE RIVER	C;NSW	6.5	FW Miles	Low Dissolved Oxygen
27-62	03-04-05	03020202	Stoney Creek	C;NSW	10.7	FW Miles	Benthos

Assessment Unit	2006 Subbasin #	Future Subbasin #	Stream Name	Stream Classification	Length/ Area	Miles/ Acres	Impairment
27-68	03-04-05	03020202	Walnut Creek (Lake Wackena, Spring Lake)	C;NSW	6.9	FW Miles	Aquatic Weeds
27-72-(0.1)	03-04-05	03020202	Bear Creek	C;Sw,NSW	12.4	FW Miles	Benthos
27-57-(1)b	03-04-06	03020201	Little River (Moores Pond, Mitchell Mill Pond)	WS-II;HQW,NSW	2.9	FW Miles	Low Dissolved Oxygen
27-57-16-(2)	03-04-06	03020201	Buffalo Creek	B;NSW	5.8	FW Miles	Benthos
27-86-(1)a	03-04-07	03020203	Contentnea Creek (Buckhorn Reservoir)	WS-V;NSW	758.2	FW Acres	Low Dissolved Oxygen
27-86-(7)b1	03-04-07	03020203	Contentnea Creek	C;Sw,NSW	15.1	FW Miles	Benthos
27-86-2	03-04-07	03020203	Moccasin Creek (Bunn Lake)	C;NSW	22.8	FW Miles	Low Dissolved Oxygen
27-86-26	03-04-07	03020203	Little Contentnea Creek	C;Sw,NSW	34.9	FW Miles	Benthos
27-86-3-(1)a2	03-04-07	03020203	Turkey Creek	C;NSW	2.0	FW Miles	Low Dissolved Oxygen
27-86-8	03-04-07	03020203	Hominy Swamp	C;Sw,NSW	9.9	FW Miles	Benthos
27-90a2	03-04-08	03020202	Core Creek	C;Sw,NSW	3.0	FW Miles	Benthos
27-97-(0.5)a1	03-04-09	03020202	Swift Creek	C;Sw,NSW	19.3	FW Miles	Benthos
27-97-(0.5)b	03-04-09	03020202	Swift Creek	C;Sw,NSW	14.4	FW Miles	Benthos
27-97-(6)	03-04-09	03020202	Swift Creek	SC;Sw,NSW	8.0	S Miles	Benthos
27-97-5-3	03-04-09	03020202	Creeping Swamp	C;Sw,NSW	8.1	FW Miles	Chlorophyll a
27-97-5a	03-04-09	03020202	Clayroot Swamp	C;Sw,NSW	9.5	FW Miles	Benthos
27-(104)a	03-04-10	03020204	NEUSE RIVER Estuary	SB;Sw,NSW	13,736.0	S Acres	Chlorophyll a, High pH
27-(104)b	03-04-10	03020204	NEUSE RIVER Estuary	SB;Sw,NSW	10,756.9	S Acres	Chlorophyll a, High pH
27-(118)a1	03-04-10	03020204	NEUSE RIVER Estuary	SA;HQW,NSW	17,135.4	S Acres	Chlorophyll a
27-(118)a1a	03-04-10	03020204	NEUSE RIVER Estuary at Camp Don Lee	SA;HQW,NSW	1.0	S Acres	Chlorophyll a, Recreation-Enterococcus

Assessment Unit	2006 Subbasin #	Future Subbasin #	Stream Name	Stream Classification	Length/ Area	Miles/ Acres	Impairment
27-(118)b	03-04-10	03020204	NEUSE RIVER Estuary	SA;HQW,NSW	96.2	S Acres	Shellfish-PRO
27-(118)c	03-04-10	03020204	NEUSE RIVER Estuary	SA;HQW,NSW	61.7	S Acres	Shellfish-PRO
27-(118)e	03-04-10	03020204	NEUSE RIVER Estuary	SA;HQW,NSW	210.0	S Acres	Shellfish-CAO
27-(118)f	03-04-10	03020204	NEUSE RIVER Estuary	SA;HQW,NSW	93.5	S Acres	Chlorophyll a
27-(118)f	03-04-10	03020204	NEUSE RIVER Estuary	SA;HQW,NSW	93.5	S Acres	Shellfish-PRO
27-(118)g	03-04-10	03020204	NEUSE RIVER Estuary	SA;HQW,NSW	8.2	S Acres	Shellfish-PRO
27-(118)h	03-04-10	03020204	NEUSE RIVER Estuary	SA;HQW,NSW	1.7	S Acres	Recreation-Adv
27-(96)b2	03-04-10	03020202	NEUSE RIVER Estuary	SC;Sw,NSW	3,473.6	S Acres	Chlorophyll a
27-101-(31)b	03-04-10	03020204	Trent River	SB;Sw,NSW	509.7	S Acres	Chlorophyll a
27-101-(39)	03-04-10	03020204	Trent River	SB;Sw,NSW	500.1	S Acres	Chlorophyll a
27-119	03-04-10	03020204	Cherry Branch	SA;HQW,NSW	1.2	S Miles	Shellfish-PRO
27-122	03-04-10	03020204	Sassafras Branch	SA;HQW,NSW	1.1	S Miles	Shellfish-PRO
27-123	03-04-10	03020204	Clubfoot Creek	SA;HQW,NSW	562.6	S Acres	Shellfish-PRO
27-123-1	03-04-10	03020204	Harlowe Canal	SA;HQW,NSW	0.6	S Miles	Shellfish-PRO
27-123-2	03-04-10	03020204	Mortons Mill Pond	SA;HQW,NSW	30.6	S Acres	Shellfish-PRO
27-123-2-1	03-04-10	03020204	West Prong Mortons Mill Pond	SA;HQW,NSW	1.4	S Miles	Shellfish-PRO
27-123-2-2	03-04-10	03020204	East Prong Mortons Mill Pond	SA;HQW,NSW	0.6	S Miles	Shellfish-PRO
27-123-3	03-04-10	03020204	Gulden Creek	SA;HQW,NSW	34.9	S Acres	Shellfish-Fecal
27-123-3	03-04-10	03020204	Gulden Creek	SA;HQW,NSW	34.9	S Acres	Shellfish-PRO
27-123-4	03-04-10	03020204	Mitchell Creek	SA;HQW,NSW	117.5	S Acres	Shellfish-PRO
27-123-4-1	03-04-10	03020204	Big Branch	SA;HQW,NSW	1.6	S Acres	Shellfish-PRO
27-123-4-2	03-04-10	03020204	Snake Branch	SA;HQW,NSW	0.9	S Miles	Shellfish-PRO
27-125-(6)a	03-04-10	03020204	Dawson Creek	SA;HQW,NSW	121.2	S Acres	Shellfish-PRO, Shellfish-Fecal, Recreation-Enterococcus
27-125-2	03-04-10	03020204	Fork Run	SC;NSW	2.6	S Miles	Benthos

Assessment Unit	2006 Subbasin #	Future Subbasin #	Stream Name	Stream Classification	Length/ Area	Miles/ Acres	Impairment
27-128-1.5	03-04-10	03020204	Jerry Bay	SA;HQW,NSW	52.2	S Acres	Shellfish-PRO
27-128-1a	03-04-10	03020204	Adams Creek Canal (Intracoastal Waterway)	SA;HQW,NSW	12.5	S Acres	Shellfish-CAC
27-128-1b	03-04-10	03020204	Adams Creek Canal (Intracoastal Waterway)	SA;HQW,NSW	126.3	S Acres	Shellfish-PRO
27-128-2	03-04-10	03020204	Isaac Creek	SA;HQW,NSW	39.1	S Acres	Shellfish-PRO
27-128-3a	03-04-10	03020204	Back Creek (Black Creek)	SA;HQW,NSW	259.5	S Acres	Shellfish-PRO, Recreation-Fecal
27-128-3b	03-04-10	03020204	Back Creek (Black Creek)	SA;HQW,NSW	2.1	S Acres	Shellfish-PRO
27-128-4	03-04-10	03020204	Kearney Creek	SA;HQW,NSW	4.0	S Acres	Shellfish-PRO
27-128-7a	03-04-10	03020204	Dumpling Creek	SA;HQW,NSW	20.0	S Acres	Shellfish-PRO
27-128c	03-04-10	03020204	Adams Creek	SA;HQW,NSW	317.0	S Acres	Shellfish-PRO
27-130	03-04-10	03020204	Whittaker Creek	SA;HQW,NSW	96.1	S Acres	Shellfish-PRO
27-133a	03-04-10	03020204	Pierce Creek	SA;HQW,NSW	48.9	S Acres	Shellfish-PRO
27-134-1	03-04-10	03020204	Bright Creek	SA;HQW,NSW	10.9	S Acres	Shellfish-PRO
27-134-2	03-04-10	03020204	Pasture Creek	SA;HQW,NSW	20.3	S Acres	Shellfish-PRO
27-134a	03-04-10	03020204	Orchard Creek	SA;HQW,NSW	37.1	S Acres	Shellfish-PRO
27-134b	03-04-10	03020204	Orchard Creek	SA;HQW,NSW	20.4	S Acres	Shellfish-PRO
27-135-1	03-04-10	03020204	West Fork South River	SA;HQW,NSW	35.5	S Acres	Shellfish-PRO
27-135-10	03-04-10	03020204	Eastman Creek	SA;HQW,NSW	95.6	S Acres	Shellfish-PRO, Shellfish-Fecal
27-135-11	03-04-10	03020204	Little Creek	SA;HQW,NSW	6.2	S Acres	Shellfish-CAO
27-135-12	03-04-10	03020204	Royal Creek	SA;HQW,NSW	10.1	S Acres	Shellfish-CAO
27-135-13	03-04-10	03020204	Coffee Creek	SA;HQW,NSW	6.1	S Acres	Shellfish-CAO
27-135-14	03-04-10	03020204	Dixon Creek	SA;HQW,NSW	2.3	S Acres	Shellfish-CAO

Assessment Unit	2006 Subbasin #	Future Subbasin #	Stream Name	Stream Classification	Length/ Area	Miles/ Acres	Impairment
27-135-15	03-04-10	03020204	Old House Creek	SA;HQW,NSW	3.2	S Acres	Shellfish-CAO
27-135-16	03-04-10	03020204	Mulberry Creek	SA;HQW,NSW	6.4	S Acres	Shellfish-CAO
27-135-17a	03-04-10	03020204	Big Creek	SA;HQW,NSW	59.6	S Acres	Shellfish-PRO
27-135-17b	03-04-10	03020204	Big Creek	SA;HQW,NSW	58.4	S Acres	Shellfish-CAO
27-135-18	03-04-10	03020204	Hardy Creek	SA;HQW,NSW	24.2	S Acres	Shellfish-PRO, Shellfish-Fecal
27-135-19	03-04-10	03020204	Horton Bay	SA;HQW,NSW	101.3	S Acres	Shellfish-CAO
27-135-2	03-04-10	03020204	East Fork South River	SA;HQW,NSW	14.3	S Acres	Shellfish-PRO
27-135-2-1	03-04-10	03020204	Rich Island Gut	SA;HQW,NSW	0.1	S Miles	Shellfish-PRO
27-135-3	03-04-10	03020204	Miry Gut	SA;HQW,NSW	0.1	S Acres	Shellfish-PRO
27-135-4	03-04-10	03020204	Elisha Creek	SA;HQW,NSW	2.2	S Acres	Shellfish-PRO
27-135-5	03-04-10	03020204	Neal Creek	SA;HQW,NSW	2.9	S Acres	Shellfish-PRO
27-135-6	03-04-10	03020204	Duck Creek	SA;HQW,NSW	2.6	S Acres	Shellfish-PRO
27-135-7	03-04-10	03020204	Buck Creek	SA;HQW,NSW	6.4	S Acres	Shellfish-PRO
27-135-8	03-04-10	03020204	Doe Creek	SA;HQW,NSW	4.9	S Acres	Shellfish-PRO
27-135-9	03-04-10	03020204	Southwest Creek	SA;HQW,NSW	151.3	S Acres	Shellfish-PRO, Shellfish-Fecal
27-135a	03-04-10	03020204	South River	SA;HQW,NSW	415.1	S Acres	Shellfish-PRO
27-135b	03-04-10	03020204	South River	SA;HQW,NSW	2,064.8	S Acres	Shellfish-CAO
27-137	03-04-10	03020204	Turnagain Bay	SA;HQW,NSW	1,556.8	S Acres	Shellfish-CAO
27-137-1	03-04-10	03020204	Sanborns Gut	SA;HQW,NSW	3.7	S Acres	Shellfish-CAO
27-137-2	03-04-10	03020204	Big Gut	SA;HQW,NSW	70.0	S Acres	Shellfish-CAO
27-137-3	03-04-10	03020204	Deep Gut	SA;HQW,NSW	51.0	S Acres	Shellfish-CAO
27-137-4	03-04-10	03020204	Broad Creek	SA;HQW,NSW	49.2	S Acres	Shellfish-CAO
27-137-4-1	03-04-10	03020204	Pitman Creek	SA;HQW,NSW	2.0	S Acres	Shellfish-CAO

Assessment Unit	2006 Subbasin #	Future Subbasin #	Stream Name	Stream Classification	Length/ Area	Miles/ Acres	Impairment
27-137-4-2	03-04-10	03020204	Parsons Creek	SA;HQW,NSW	26.7	S Acres	Shellfish-CAO
27-137-5	03-04-10	03020204	Abraham Bay	SA;HQW,NSW	96.9	S Acres	Shellfish-CAO
27-137-6	03-04-10	03020204	Tump Gut	SA;HQW,NSW	20.9	S Acres	Shellfish-CAO
27-137-7	03-04-10	03020204	Mulberry Point Creek	SA;HQW,NSW	15.7	S Acres	Shellfish-CAO
27-141-1	03-04-10	03020204	Ship Creek	SA;HQW,NSW	5.4	S Acres	Shellfish-PRO
27-141-2	03-04-10	03020204	Gideon Creek	SA;HQW,NSW	26.0	S Acres	Shellfish-PRO
27-141-3	03-04-10	03020204	Brown Creek	SA;HQW,NSW	122.4	S Acres	Shellfish-PRO
27-141-3-1	03-04-10	03020204	Spice Creek	SA;HQW,NSW	4.7	S Acres	Shellfish-PRO
27-141-3-2	03-04-10	03020204	Coffee Creek	SA;HQW,NSW	7.1	S Acres	Shellfish-PRO
27-141-4	03-04-10	03020204	Tar Creek	SA;HQW,NSW	44.3	S Acres	Shellfish-PRO
27-141a	03-04-10	03020204	Broad Creek	SA;HQW,NSW	202.3	S Acres	Shellfish-PRO
27-101-15	03-04-11	03020204	Beaver Creek	C;Sw,NSW	12.3	FW Miles	Benthos
27-101-17	03-04-11	03020204	Musselshell Creek	C;Sw,NSW	5.8	FW Miles	Benthos
27-(56)a	03-04-12	03020201	NEUSE RIVER	C;NSW	5.8	FW Miles	Fish Consumption-Mercury
27-150-(9.5)a1	03-04-13	03020204	Bay River	SA;HQW,NSW	672.0	S Acres	Shellfish-PRO, Shellfish-Fecal
27-150-(9.5)b1	03-04-13	03020204	Bay River	SA;HQW,NSW	100.0	S Acres	Shellfish-PRO
27-150-(9.5)b2	03-04-13	03020204	Bay River	SA;HQW,NSW	16.5	S Acres	Recreation-Adv
27-150-(9.5)b2	03-04-13	03020204	Bay River	SA;HQW,NSW	16.5	S Acres	Shellfish-PRO, Recreation-Enterococcus
27-150-10	03-04-13	03020204	Harper Creek	SA;HQW,NSW	32.5	S Acres	Shellfish-PRO
27-150-11	03-04-13	03020204	Tempe Gut	SA;HQW,NSW	0.9	S Acres	Shellfish-PRO
27-150-12	03-04-13	03020204	Moore Creek	SA;HQW,NSW	28.3	S Acres	Shellfish-PRO
27-150-12-1	03-04-13	03020204	Chappel Creek	SA;HQW,NSW	1.5	S Acres	Shellfish-PRO
27-150-13	03-04-13	03020204	Newton Creek	SA;HQW,NSW	3.8	S Acres	Shellfish-PRO

Assessment Unit	2006 Subbasin #	Future Subbasin #	Stream Name	Stream Classification	Length/ Area	Miles/ Acres	Impairment
27-150-20-1	03-04-13	03020204	Simpson Creek	SA;HQW,NSW	8.6	S Acres	Shellfish-PRO
27-150-20a	03-04-13	03020204	Ball Creek	SA;HQW,NSW	32.4	S Acres	Shellfish-PRO, Shellfish-Fecal
27-150-28-1	03-04-13	03020204	Bennett Creek	SA;HQW,NSW	15.7	S Acres	Shellfish-PRO
27-150-28-2	03-04-13	03020204	Win Creek	SA;HQW,NSW	1.2	S Acres	Shellfish-PRO
27-150-28a	03-04-13	03020204	Bear Creek	SA;HQW,NSW	199.9	S Acres	Shellfish-PRO, Shellfish-Fecal
27-150-28b1	03-04-13	03020204	Bear Creek	SA;HQW,NSW	18.2	S Acres	Shellfish-PRO
27-150-3	03-04-13	03020204	South Prong Bay River	SC;Sw,NSW	27.4	S Acres	Shellfish-PRO, Shellfish-Fecal
27-150-3-1	03-04-13	03020204	Neal Creek	SC;Sw,NSW	1.3	S Acres	Shellfish-PRO
27-150-31-1a	03-04-13	03020204	Intracoastal Waterway	SA;HQW,NSW	2.0	S Acres	Shellfish-PRO
27-150-31a	03-04-13	03020204	Gale Creek	SA;HQW,NSW	29.4	S Acres	Shellfish-PRO, Shellfish-Fecal
27-150-31b1	03-04-13	03020204	Gale Creek	SA;HQW,NSW	16.7	S Acres	Shellfish-PRO
27-152-1	03-04-13	03020204	Intracoastal Waterway	SA;HQW,NSW	7.0	S Acres	Shellfish-PRO
27-152-2	03-04-13	03020204	Henry Creek	SA;HQW,NSW	1.5	S Acres	Shellfish-PRO
27-152-3	03-04-13	03020204	Bills Creek	SA;HQW,NSW	8.1	S Acres	Shellfish-PRO, Shellfish-Fecal
27-152a	03-04-13	03020204	Jones Bay	SA;HQW,NSW	17.3	S Acres	Shellfish-PRO, Shellfish-Fecal
27-147.5c	03-04-14	03020204	PAMLICO SOUND	SA;HQW,NSW	12.5	S Acres	Shellfish-PRO
27-147.5c	03-04-14	03020204	PAMLICO SOUND	SA;HQW,NSW	12.5	S Acres	Shellfish-PRO
27-148-1-2	03-04-14	03020204	Golden Creek	SA;HQW,NSW	9.7	S Acres	Shellfish-PRO, Shellfish-Fecal
27-148-1-6-1a	03-04-14	03020204	Old Canal	SA;HQW,NSW	6.4	S Acres	Shellfish-CAO
27-148-2a	03-04-14	03020204	West Thorofare Bay	SA;HQW,NSW	1.8	S Acres	Shellfish-PRO

Assessment Unit	2006 Subbasin #	Future Subbasin #	Stream Name	Stream Classification	Length/ Area	Miles/ Acres	Impairment
27-149-1	03-04-14	03020105	Thorofare Bay	SA;ORW,NSW	1,674.5	S Acres	Shellfish-CAO
27-149-1-1	03-04-14	03020105	Thorofare	SA;HQW,NSW	34.9	S Acres	Shellfish-PRO
27-149-1-2	03-04-14	03020105	Merkle Hammock Creek	SA;NSW,ORW	186.0	S Acres	Shellfish-CAO
27-149-1-3	03-04-14	03020105	Barry Bay	SA;ORW,NSW	606.6	S Acres	Shellfish-CAO
27-149-4-1	03-04-14	03020105	Great Pond	SA;ORW,NSW	3.0	S Acres	Shellfish-PRO, Shellfish-Fecal
99-(5)	03-04-14	03020204	Atlantic Ocean	SB;NSW	18.6	Coast Miles	Fish Consumption-Mercury

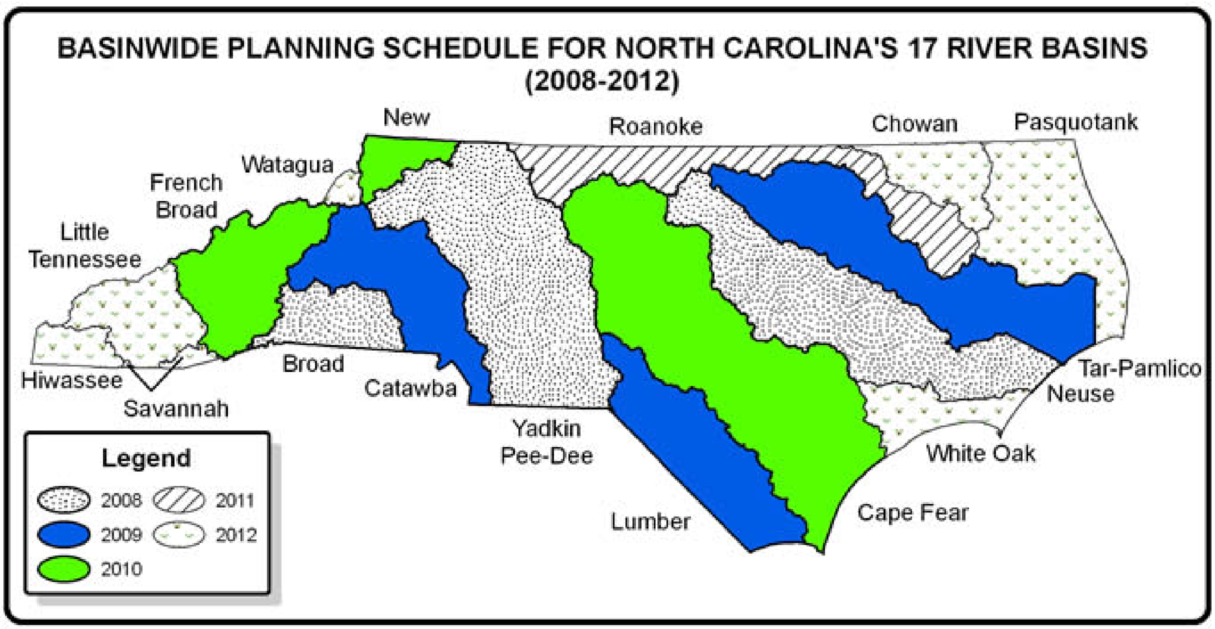
Note: This list is from the 2008 DRAFT Impaired Waters List as of November 10, 2008. These could change before the list is finalized. Other parameters could be added. Please See Appendix XI for the most up to date version.

Benthos – Macroinvertebrate assessment
Shellfish-PRO – Prohibited shellfish harvesting area
Shellfish-CAO – Conditionally approved open shellfish harvesting area
Shellfish-CAC – Conditionally approved closed shellfish harvesting area
Recreations-Adv – Recreations beach advisory closings

What is Basinwide Water Quality Planning?

Basinwide water quality planning is a nonregulatory watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. The NC Division of Water Quality (DWQ) prepares Basinwide water quality plans for each of the seventeen major river basins in the state (Figure 1 and Table 1). Preparation of a basinwide water quality plan is a five-year process, which is broken down into three phases (Table 2). While these plans are prepared by DWQ, their implementation and the protection of water quality entail the coordinated efforts of many agencies, local governments and stakeholder groups throughout the state. The first cycle of plans was completed in 1998. Each plan is updated at five-year intervals.

Figure 1 Basinwide Planning Schedule (2008 to 2012)



Goals of Basinwide Water Quality Planning

The goals of basinwide planning are to:

- Identify water quality problems and restore full use to Impaired waters.
- Identify and protect high value resource waters.
- Protect unimpaired waters yet allow for reasonable economic growth.

DWQ accomplishes these goals through the following objectives:

- Collaborate with other agencies to develop appropriate management strategies. This includes providing agencies information related to financial and funding opportunities.
- Assure equitable distribution of waste assimilative capacity for discharges.
- Evaluate cumulative effects of pollution.
- Improve public awareness and involvement.

- Regulate point and nonpoint sources of pollution where other approaches are not successful.

Benefits of Basinwide Water Quality Planning

Basinwide planning and management benefits water quality by:

- Focusing resources on one river basin at a time.
- Using sound ecological planning and fostering comprehensive NPDES permitting by working on a watershed scale.
- Ensuring better consistency and equitability by clearly defining the program's long-term goals and approaches regarding permits and water quality improvement strategies.
- Fostering public participation to increase involvement and awareness about water quality.
- Integrating and coordinating programs and agencies to improve implementation of point and nonpoint source pollution reduction strategies.

How You Can Get Involved

To assure that basinwide plans are accurately written and effectively implemented, it is important for citizens and local stakeholders to participate in all phases of the planning process. You may contact the basinwide planner responsible for your basin anytime during the plan's development. Upon request, the basin planner can also present water quality information and basin concerns to local stakeholder groups.

To make the plan more inclusive, DWQ is coordinating with the local Soil and Water Conservation Districts (SWCD), council of governments, NC Cooperative Extension Service, the county Natural Resources Conservation Service (NRCS), and stakeholder groups to develop language and identify water quality concerns throughout the basin. Citizens and local communities can also be involved during the planning process by contacting their county extension service or local SWCD.

During the public comment period, the draft plan is available online and by request for a period of at least 30 days. DWQ welcomes written comments and questions during this phase of the planning process and will incorporate comments and suggestions when appropriate.

Division of Water Quality Functions and Locations

For more information on the basinwide planning process, DWQ activities, or contacts, visit http://h2o.enr.state.nc.us/basinwide/ or call (919) 733-5083 and ask for the basin planner responsible for your basin of interest. You can also contact the appropriate Regional Office (Figure 2) for additional information. For general questions about the Department of Environment and Natural Resources, contact the Customer Service Center at 1-877-623-6748.

Table 1 Basinwide Planning Schedule (2009 to 2014)

Basin	DWQ Biological Data Collection	Draft Out For Public Review	Final Plan Receives EMC Approval	Begin NPDES Permit Issuance
Chowan	Summer 2010	5/2012	7/2012	11/2012
Pasquotank	Summer 2010	5/2012	7/2012	12/2012
Neuse	Summer 2010	7/2012	9/2012	7/2013
Broad	Summer 2010	1/2013	3/2013	7/2013
Yadkin-Pee Dee	Summer 2011	5/2013	7/2013	9/2013
Lumber	Summer 2011	3/2009	5/2009	7/2009
Tar-Pamlico	Summer 2012	5/2014	7/2014	9/2014
Catawba	Summer 2012	7/2014	9/2014	12/2014
French Broad	Summer 2012	3/2010	5/2010	9/2010
New	Summer 2013	9/2010	11/2010	3/2011
Cape Fear	Summer 2013	9/2010	11/2010	4/2011
Roanoke	Summer 2009	7/2011	9/2011	1/2012
White Oak	Summer 2009	1/2012	3/2012	7/2012
Savannah	Summer 2009	1/2012	3/2012	8/2012
Watauga	Summer 2013	1/2012	3/2012	9/2012
Hiwassee	Summer 2009	1/2012	3/2012	8/2012
Little Tennessee	Summer 2009	1/2012	3/2012	10/2012

Note: A basinwide plan was completed for all 17 basins during the second cycle (1998 to 2003).

Table 2 Five-Year Planning Process for Development of an Individual Basinwide Plan

Years 1 – 2 **Water Quality Data Collection and Identification of Goals and Issues**	• Identify sampling needs • Conduct biological monitoring activities • Conduct special studies and other water quality sampling activities • Coordinate with local stakeholders and other agencies to continue to implement goals within current basinwide plan
Years 2 – 3 **Data Analysis and Collect Information from State and Local Agencies**	• Gather and analyze data from sampling activities • Develop use support ratings • Conduct special studies and other water quality sampling activities • Work with state and local agencies to establish goals and objectives • Identify and prioritize issues for the next basin cycle • Develop preliminary pollution control strategies • Coordinate with local stakeholders and other state/local agencies
Years 3 – 5 **Preparation of Draft Basinwide Plan, Public Review, Approval of Plan, Issue NPDES Permits, and Begin Implementation of Plan**	• Develop draft basinwide plan based on water quality data, use support ratings, and recommended pollution control strategies • Circulate draft basinwide plan for review and present draft plan for public review • Revise plan (when appropriate) to reflect public comments • Submit plan to Environmental Management Commission for approval • Issue NPDES permits • Coordinate with other agencies and local interest groups to prioritize implementation actions • Conduct special studies and other water quality sampling activities

Other Reference Materials

There are several reference documents and websites that provide additional information about basinwide planning and the basin's water quality. These include:

- *Supplemental Guide to North Carolina's Watershed Planning: Support Document for Basinwide Water Quality Plans* (January 2007). This document includes general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality. Visit the website at http://h2o.enr.state.nc.us/basinwide/ to download this document.
- *Neuse Basinwide Assessment Report* (April 2006). This technical report presents physical, chemical, and biological data collected in the Neuse River basin. This report can be found on the DWQ Environmental Sciences Section (ESS) website at http://h2o.enr.state.nc.us/esb/Basinwide/Neuse06BasinReportFinal.pdf.
- *Neuse River Basinwide Water Quality Plan* (March 1993; December 1998; July 2002). These first basinwide plans for the Neuse River basin present water quality data, information, and recommended management strategies for the first three five-year cycles.
- *North Carolina's Basinwide Approach to Water Quality Management: Program Description* (Creager and Baker, 1991). NC DWQ Water Quality Section. Raleigh, NC.

How to Read the Basinwide Plan

Chapters 1 - 14: Subbasin and Watershed Information

- **Summarizes information and data by subbasin, including:**
- **Recommendations from the previous basin plan.**
- **Achievements, current priority issues and concerns.**
- **Impaired waters and water with notable impacts.**
- **Goals and recommendations for the next five years by subbasin.**

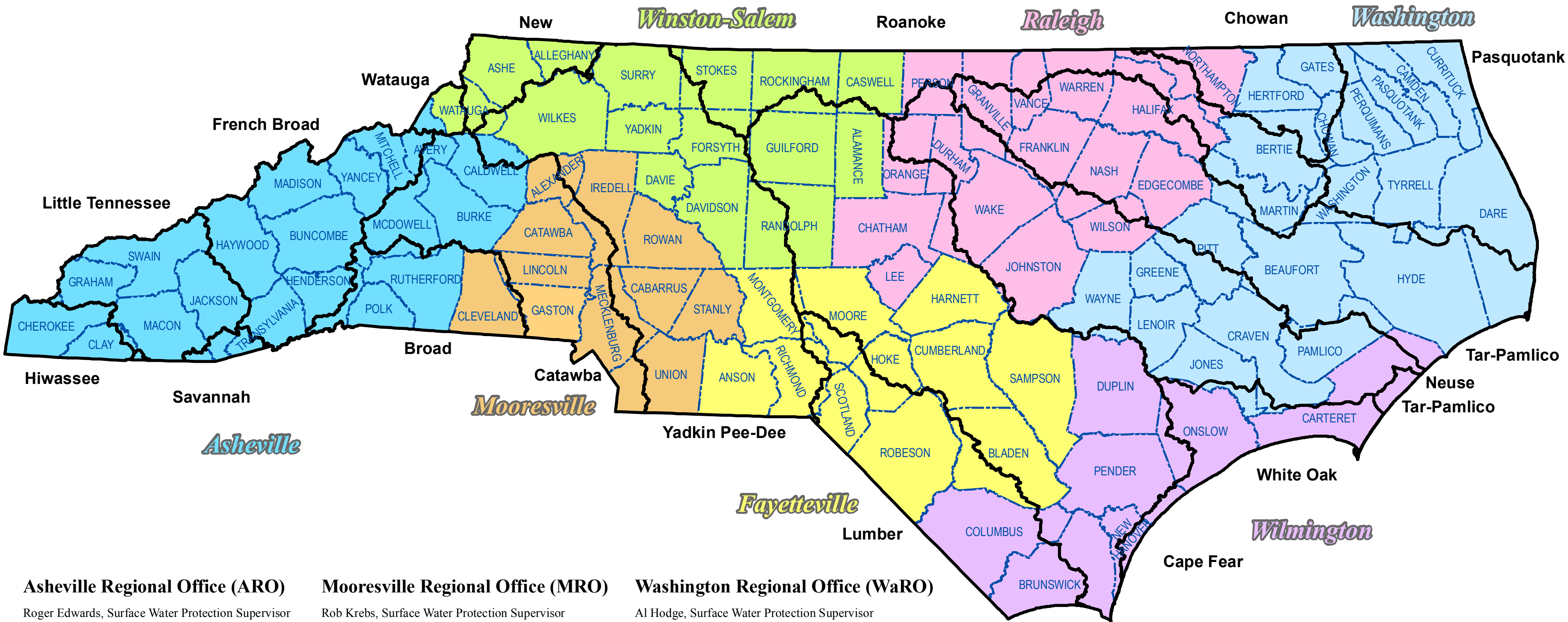
Chapter 15 – 24

- **Presents information on various topics of interest to the protection and restoration of water quality in the basin, including:**
- **Stream classifications.**
- **Water quality stressors.**
- **Population and land cover changes.**
- **Agricultural, forestry and permitting activities in the basin.**
- **Water and natural resources.**
- **Local, State and Federal initiatives.**
- **Managing Impaired waters and theTMDL process.**

Appendices

- **Water quality data collected by DWQ, use support methodology.**
- **NPDES dischargers and general stormwater permits.**
- **Points of contact.**
- **Glossary of terms and acronyms.**

North Carolina Department of Environment and Natural Resources
Division of Water Quality Regional Offices



Asheville Regional Office (ARO)

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Landon Davidson, Aquifer Protection Supervisor
2090 US Highway 70
Swannanoa, NC 28778
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Fax: (828) 299-7043

Avery	Haywood	Polk
Buncombe	Henderson	Rutherford
Burke	Jackson	Swain
Caldwell	Macon	Transylvania
Cherokee	Madison	Yancy
Clay	McDowell	
Graham	Mitchell	

Mooresville Regional Office (MRO)

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Andrew Pitner, Aquifer Protection Supervisor
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Cabarrus	Mecklenburg
Catawba	Rowan
Cleveland	Stanly
Gaston	Union
Iredell	

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Beaufort	Gates	Pamlico
Bertie	Greene	Pasquotank
Camden	Hertford	Perquimans
Chowan	Hyde	Pitt
Craven	Jones	Tyrell
Currituck	Lenoir	Washington
Dare	Martin	Wayne

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Alleghany	Guildford	Wilkes
Ashe	Randolph	Yadkin
Caswell	Rockingham	
Davidson	Stokes	
Davie	Surry	

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Harnett	Sampson
Hoke	Scotland
Montegomery	

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Chatham	Johnston	Vance
Durham	Lee	Wake
Edgecombe	Nash	Warren
Franklin	Northampton	Wilson
Granville	Orange	
Halifax	Person	

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Phone: (910) 796-7215
Fax: (910) 350-2004

Brunswick	New Hanover
Carteret	Onslow
Columbus	Pender
Duplin	

N
W E
S

Planning Section
Basinwide Planning Unit
July, 2009

Chapter 1
Neuse River Subbasin 03-04-01
Including: Eno River, Little River, Flat River and the entire Falls Lake watershed

1.1 Subbasin Overview

Subbasin 03-04-01 at a Glance

Land Cover (percent)

Forest/Wetland:	72.6
Water:	2.7
Urban:	7.3
Cultivated Crop:	3.4
Pasture/ Managed Herbaceous:	13.7

Counties
Durham, Franklin, Granville, Orange, Person and Wake

Municipalities
Hillsborough, Butner, Creedmoor, Stem, Durham, Roxboro and Raleigh

Stream Statistics

Total Streams:	468.85 mi/14,576.3 ac
Total Supporting:	172.5 mi
Total Impaired:	43.7 mi
Total Not Rated:	12 mi/0.0 ac
Total No Data:	240.3 mi

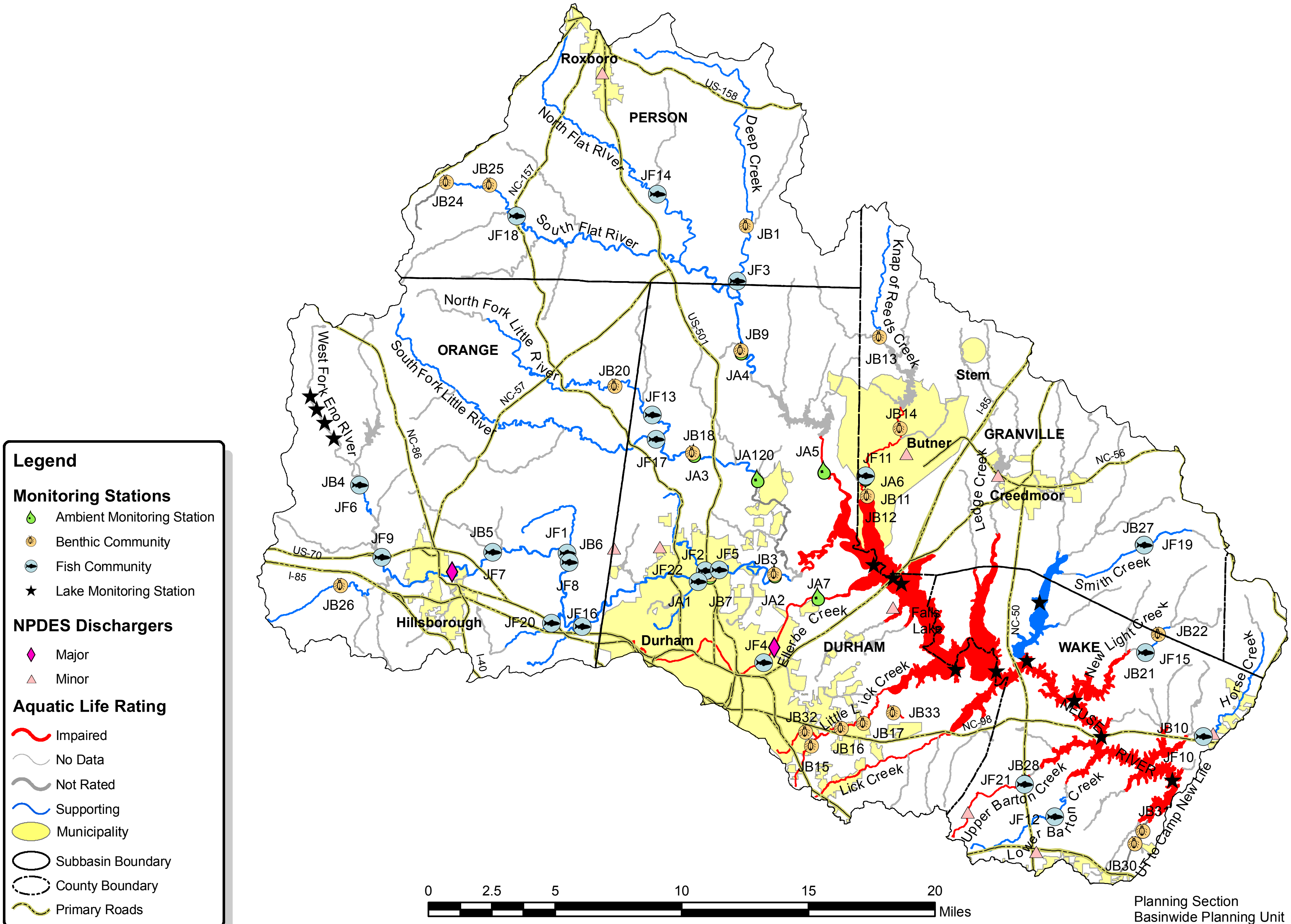
This subbasin is the 770 square mile watershed of Falls Lake and is often referred to as the Upper Neuse River Basin. It covers part of 6 counties and is the home to about 190,000 people. A 50 percent increase in population is projected in the Falls Lake watershed by 2025. Most of the expected growth will occur in Wake, Durham and Granville Counties. There are 9 public drinking water supply reservoirs that serve over 500,000 people. These include: Lake Michie, Little River Reservoir, Lake Holt, Lake Orange, West Fork Eno Reservoir, Corporation Lake, Lake Ben Johnson, Lake Rogers and Falls Lake. The upper portion of the watershed is comprised of three major tributaries, the Flat River, Little River and the Eno River. The Neuse River and Falls Lake is formed by the confluence of the Flat and Eno Rivers. Falls Lake covers almost 12,500 acres and stretches 28 miles from the confluence near Durham to the dam located just outside of Raleigh. Falls Lake serves many functions: a drinking water reservoir for many surrounding communities, a flood control reservoir for downstream communities, habitat for wildlife and a recreational area for outdoor enthusiasts.

Most of the streams in this watershed have some type of water supply (WS) classification: WS-II, WS-III, or WS-IV. WS-II waters have the most protective regulations, and have the same management strategy as a High Quality Water classification. WS-II waters in this subbasin include the Eno River and tributaries above Hillsborough and the Little River and its tributaries above Little River Reservoir. The Eno River Corridor contains some of the most scenic and biologically important natural areas in the entire eastern piedmont. Deep Creek and Rocky Fork Branch in the Flat River watershed were recently reclassified to Outstanding Resource Waters (ORW) in order to protect the exceptional water quality in this area.

Land use in this northern half of the subbasin is mostly agricultural and forest. The major land cover types within this subbasin are forest (61 percent), agriculture (16 percent) and urban and suburban developed lands (17 percent). There is an estimated 60,000 acres or about 12 percent of this watershed preserved as open space. The Upper Neuse River Basin Association (UNRBA) projects that by 2025 about 50,000 acres of the remaining undeveloped land will be converted to developed lands bringing the total developed land to 140,000 acres or 28 percent of the watershed. Because Falls Lake receives drainage from the entire watershed in this subbasin it is highly susceptible to the cumulative impacts from the upstream degradation.

The UNRBA has developed a watershed management plan, that when implemented by local governments will help protect all waters in this subbasin from the increasing potential for

Figure 3 Neuse River Basin 03-04-01



Planning Section
Basinwide Planning Unit
April, 2008

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category

Watershed (WBD-10 Number) 0302020101 Flat River

Subwatershed (WBD-12 Number) 030202010101 North Flat River

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-3-2 From source to Flat River WS-III;NSW	**North Flat River**	03-04-01	16.4 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1

Subwatershed (WBD-12 Number) 030202010102 South Flat River

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-3-3a From source to SR 1009 WS-III;NSW	**South Flat River**	03-04-01	3.0 FW Miles	3a		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2004		3a
27-3-3b From SR 1009 to Flat River WS-III;NSW	**South Flat River**	03-04-01	14.2 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2004		1

Subwatershed (WBD-12 Number) 030202010103 Deep Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-3-4 From source to Flat River WS-III;NSW	**Deep Creek**	03-04-01	16.3 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1

Subwatershed (WBD-12 Number) 030202010104 Lake Michie-Flat River

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(1) From source (confluence of Eno River Arm of Falls Lake and Flat River Arm of Falls Lake) to I-85 bridge WS-IV;NSW,CA	**NEUSE RIVER (Falls Lake below normal pool elevation)**	03-04-01	2,703.6 FW Acres	5	**Chlorophyll a** **Nutrient Impacts** General Agriculture/Pasture Land Clearing MS4 NPDES WWTP NPDES **Turbidity** General Agriculture/Pasture Land Clearing MS4 NPDES WWTP NPDES	Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2008	5
						Aquatic Life	Impaired	Standard Violation	Chlorophyll a	2006	2008	5
						Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1

Table 3 ***Subbasin (WBD-8 Number)*** *03020201* ***DWQ Subbasin*** **03-04-01**

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-3-(1)	**Flat River**	From source to a point 2.0 miles downstream of Durham County SR 1614	WS-III;NSW	03-04-01	9.1 FW Miles	**2**		Aquatic Life	Not Rated	Data Inconclusive	Iron	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
								Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
27-3-(8)	**Flat River**	From dam at Lake Michie to a point 0.2 miles upstream of Durham County SR 1004	WS-IV;NSW	03-04-01	1.1 FW Miles	**5**	**Low Dissolved Oxygen** Impoundment	Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	2008	5
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
								Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
27-3-(9)	**Flat River (including the Flat River Arm of Falls Lake)**	From a point 0.2 miles upstream of Durham County SR 1004 to Falls Lake, Neuse River	WS-IV;NSW,CA	03-04-01	0.6 FW Miles	**5**	**Low Dissolved Oxygen** Impoundment	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
								Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	2008	5
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
								Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1

Watershed (WBD-10 Number) 0302020102 Little River

Subwatershed (WBD-12 Number) 030202010201 North Fork Little River

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-2-21-3b	**North Fork Little River**	From SR 1519 to Little River	WS-II;HQW,NSW	03-04-01	12.8 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
								Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1

Subwatershed (WBD-12 Number) 030202010202 South Fork Little River

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-2-21-(1)	**Little River**	From source to a point 0.1 mile upstream of Durham County SR 1461	WS-II;HQW,NSW	03-04-01	2.3 FW Miles	**2**		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
								Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
27-2-21-2	**South Fork Little River**	From source to Little River	WS-II;HQW,NSW	03-04-01	18.5 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1

Subwatershed (WBD-12 Number) 030202010203 Mountain Creek-Little River

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-2-21-(3.5)	**Little River (Little River Reservoir)**			**2**		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
From a point 0.1 mile upstream of Durham County SR 1461 to dam at Little River Reservoir						Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
WS-II;HQW,NSW,CA		03-04-01	32.4 FW Acres			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
27-2-21-(6)	**Little River**			**3a**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards 1n3	2006		1
From dam at Little River Reservoir to a point 0.9 mile upstream of mouth						Aquatic Life	Not Rated	Data Inconclusive	Water Quality Standards Aquatic Life	2006		3a
WS-IV;NSW		03-04-01	6.5 FW Miles			Recreation	Not Rated	Potential Standards Violation	Fecal Coliform (recreation)	2006		3a
						Water Supply	Not Rated	Data Inconclusive	Water Quality Standards Water Supply	2006		3a
Watershed (WBD-10 Number) 0302020103 Eno River												
Subwatershed (WBD-12 Number) 030202010301 Lake Orange-Eno River												
27-2-2a	**West Fork Eno River**			**2**		Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
From source to Reservoir dam												
WS-II;HQW,NSW		03-04-01	204.0 FW Acres									
Subwatershed (WBD-12 Number) 030202010302 Sevenmile Creek-Eno River												
27-2-(1)	**Eno River**			**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
From source to a point 0.4 mile upstream of Dry Run						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2006		1
WS-II;HQW,NSW		03-04-01	2.2 FW Miles									
27-2-(7)	**Eno River**			**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
From dam at Lake Ben Johnston to Orange County SR 1561												
C;NSW		03-04-01	8.2 FW Miles									
27-2-6-(0.5)	**Sevenmile Creek**			**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
From source to a point 0.4 mile upstream of I-85												
WS-II;HQW,NSW		03-04-01	5.8 FW Miles									
Subwatershed (WBD-12 Number) 030202010303 Stony Creek-Eno River												

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-2-(10)	**Eno River**	From Orange County SR 1561 to U. S. Highway 501	WS-IV,B;NSW	03-04-01	16.2 FW Miles	**2**		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
								Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2003		1
								Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2006		1
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
								Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
27-2-12	**Buckwater Creek**	From source to Eno River	WS-IV;NSW	03-04-01	4.7 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
27-2-13-(2)	**Stony Creek**	From a point 0.4 mile upstream of Orange County SR 1710 to Eno River	WS-IV;NSW	03-04-01	3.0 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1

Subwatershed (WBD-12 Number) 030202010304 Crooked Creek-Eno River

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-2-(19)	**Eno River**	From U. S. Highway 501 to a point 0.5 mile upstream of City of Durham emergency pumping facility raw water intake (Lat: 36 04' 40" Long: 78 53' 00")	WS-IV;NSW	03-04-01	1.6 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2003		1
								Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2006		1
								Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
27-2-(19.3)	**Eno River**	From a point 0.5 mile upstream of Durham emergency pumping facility raw water intake to Durham emergency pumping facility raw water intake	WS-IV;NSW,CA	03-04-01	0.4 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2006		1
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
								Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-2-(19.5)	**Eno River (including the Eno River Arm of Falls Lake)**	From City of Durham emergency pumping facility raw water intake to a point 0.5 mile upstream of Little River	WS-IV;NSW	03-04-01	4.3 FW Miles	**2**		Aquatic Life	Not Rated	Data Inconclusive	Iron	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	2006		1
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
								Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
27-2-14	**Rhodes Creek**	From source to Eno River	WS-IV;NSW	03-04-01	3.3 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
27-2-17	**Jumping Run**	From source to Eno River	WS-IV;NSW	03-04-01	3.4 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
27-2-18	**Crooked Creek**	From source to Eno River	WS-IV;NSW	03-04-01	5.2 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1

Watershed (WBD-10 Number) 0302020104 Upper Falls Lake

Subwatershed (WBD-12 Number) 030202010401 Upper Knap of Reeds Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-4-(1)	**Knap of Reeds Creek**	From source to a point 0.3 mile upstream of mouth of Camp Creek	WS-II;HQW,NSW	03-04-01	5.2 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2004		1

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-4-(6) **Knap of Reeds Creek** From dam at Lake Butner to a point 1.9 miles downstream of Granville County SR 1120 WS-IV;NSW 03-04-01 5.6 FW Miles	**4c**	**Antimony** WWTP NPDES **Chlorine** WWTP NPDES **Fecal Coliform Bacteria** Animals General Agriculture/Pasture MS4 NPDES **Habitat Degradation** Impoundment MS4 NPDES **Low Dissolved Oxygen** Impoundment **Nutrient Impacts** Landfills MS4 NPDES WWTP NPDES	Aquatic Life	Not Rated	Potential Standards Violation	Zinc	2006		3m
			Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
			Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
			Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2004		1
			Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2004	1998	4c
			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
			Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1

Subwatershed (WBD-12 Number) 030202010402 Lower Knap of Reeds Creek

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-4-(8) **Knap of Reeds Creek** From a point 1.9 miles downstream of Granville County SR 1120 to Falls Lake, Neuse River WS-IV;NSW,CA 03-04-01 0.6 FW Miles	**5**	**Fecal Coliform Bacteria** Animals MS4 NPDES **Habitat Degradation** Impoundment MS4 NPDES WWTP NPDES **Low Dissolved Oxygen** Impoundment **Nutrient Impacts** Landfills MS4 NPDES WWTP NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2004	1998	5

Subwatershed (WBD-12 Number) 030202010403 Ellerbe Creek

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(5.5) **NEUSE RIVER (Falls Lake below normal pool elevation)** From I-85 bridge to dam at Falls Lake WS-IV,B;NSW,CA 03-04-01 9,530.3 FW Acres	**5**	**Chlorophyll a** **Nutrient Impacts** General Agriculture/Pasture Land Clearing MS4 NPDES WWTP NPDES	Aquatic Life	Impaired	Standard Violation	Chlorophyll a	2006	2008	5
			Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-5-(0.3) From source to I-85 Bridge; C;NSW	03-04-01	**Ellerbe Creek** 6.1 FW Miles	5	**Fecal Coliform Bacteria**: MS4 NPDES; **Habitat Degradation**: MS4 NPDES, WWTP NPDES; **Nutrient Impacts**: Landfills, MS4 NPDES, WWTP NPDES; **Turbidity**: MS4 NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity FishCom	2005	1998	5
27-5-(0.7) From I-85 Bridge to a point 0.2 mile upstream of Durham County SR 1636; WS-IV;NSW	03-04-01	**Ellerbe Creek** 5.9 FW Miles	5	**Fecal Coliform Bacteria**: MS4 NPDES; **Habitat Degradation**: MS4 NPDES, WWTP NPDES; **Nutrient Impacts**: Landfills, MS4 NPDES, WWTP NPDES; **Turbidity**: MS4 NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity FishCom	2005	1998	5
27-5-(2) From a point 0.2 mile upstream of Durham County SR 1636 to Falls Lake, Neuse River; WS-IV;NSW,CA	03-04-01	**Ellerbe Creek** 0.5 FW Miles	5	**Fecal Coliform Bacteria**: MS4 NPDES, WWTP NPDES; **Habitat Degradation**: MS4 NPDES; **Nutrient Impacts**: MS4 NPDES, WWTP NPDES; **Turbidity**: MS4 NPDES	Aquatic Life	Not Rated	Potential Standards Violation	Zinc	2006		3m
					Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
					Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
					Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2000	1998	5
					Recreation	Not Rated	Potential Standards Violation	Fecal Coliform (recreation)	2006		3a
					Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1

Watershed (WBD-10 Number) 0302020105 Middle Falls Lake

Subwatershed (WBD-12 Number) 030202010502 Lick Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-11-(0.5) From source to Wake County SR 1809; WS-IV;NSW	**Lick Creek**	03-04-01	6.5 FW Miles	**5**	**Fecal Coliform Bacteria**: Failing Septic Systems, MS4 NPDES; **Habitat Degradation**: MS4 NPDES; **Nutrient Impacts**: Failing Septic Systems, MS4 NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2000	1998	5
27-11-(1.5) From Wake County SR 1809 to Falls Lake, Neuse River; WS-IV;NSW,CA	**Lick Creek**	03-04-01	0.7 FW Miles	**5**	**Fecal Coliform Bacteria**: Failing Septic Systems, MS4 NPDES; **Habitat Degradation**: MS4 NPDES; **Nutrient Impacts**: Failing Septic Systems, MS4 NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2000	2004	5
Subwatershed (WBD-12 Number) 030202010503	**Beaverdam Creek**											
27-12-(0.7) From backwaters of Beaverdam Creek Reservoir to dam at Beaverdam Creek Reservoir (at backwaters of Falls Lake); WS-IV,B;NSW,CA	**Beaverdam Creek (Beaverdam Creek Reservoir below normal pool elevation)**	03-04-01	974.4 FW Acres	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
						Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
27-12-2-(2) From a point 0.5 mile downstream of Granville County SR 1711 to a point 0.4 mile upstream of mouth; WS-IV;NSW	**Smith Creek**	03-04-01	5.7 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
Subwatershed (WBD-12 Number) 030202010504	**Little Lick Creek-Neuse River**											

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-9-(0.5) Little Lick Creek From source to a point 0.4 mile upstream of Durham County SR 1811 WS-IV;NSW 03-04-01 7.2 FW Miles	5	**Fecal Coliform Bacteria** Failing Septic Systems MS4 NPDES **Habitat Degradation** Construction MS4 NPDES Natural Conditions **Low Dissolved Oxygen** **Nutrient Impacts** Failing Septic Systems MS4 NPDES **Toxic Impacts** MS4 NPDES **Turbidity** MS4 NPDES	Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	1998	5
			Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2008	5
			Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2000	1998	4s
27-9-(0.5)ut2 UT2 to Little Lick Creek From source to Little Lick Creek WS-IV;NSW 03-04-01 2.4 FW Miles	5	**Habitat Degradation** MS4 NPDES **Low Dissolved Oxygen** **Nutrient Impacts** Failing Septic Systems MS4 NPDES **Toxic Impacts** MS4 NPDES **Turbidity**	Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	2008	5
			Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2005		3a

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources

Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category

27-9-(2) **Little Lick Creek (including portion of Little Lick Creek Arm of Falls Lake)** — Overall Category: **5**

From a point 0.4 mile upstream of Durham SR 1811 to Falls Lake, Neuse River

WS-IV;NSW,CA | 03-04-01 | 0.6 FW Miles

Potential Stressors / Sources:

- **Fecal Coliform Bacteria**
  - Failing Septic Systems
  - MS4 NPDES
- **Habitat Degradation**
  - MS4 NPDES
- **Low Dissolved Oxygen**
- **Nutrient Impacts**
  - Failing Septic Systems
  - MS4 NPDES
- **Toxic Impacts**
  - MS4 NPDES
- **Turbidity**
  - Construction
  - MS4 NPDES

Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2000	1998	4s
Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	2008	5
Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2008	5

27-9-(2)ut2 **UT2 to Little Lick Creek (including portion of Little Lick Creek Arm of Falls Lake)** — Overall Category: **5**

From a source to Falls Lake Little Lick Creek

WS-IV;NSW,CA | 03-04-01 | 0.9 FW Miles

Potential Stressors / Sources:

- **Fecal Coliform Bacteria**
  - Failing Septic Systems
  - MS4 NPDES
- **Habitat Degradation**
  - MS4 NPDES
- **Low Dissolved Oxygen**
- **Toxic Impacts**
  - MS4 NPDES
- **Turbidity**
  - Construction
  - MS4 NPDES

Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	2008	5
Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2005		3a

Watershed (WBD-10 Number) 0302020106 Lower Falls Lake

Subwatershed (WBD-12 Number) 030202010601 New Light Creek

27-13-(0.1) **New Light Creek** — Overall Category: **2**

From source to Wake County SR 1911

WS-IV;NSW | 03-04-01 | 1.8 FW Miles

Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1

Subwatershed (WBD-12 Number) 030202010602 Upper Barton Creek-Neuse River

27-15-(1) **Upper Barton Creek** — Overall Category: **5**

From source to a point 0.5 mile upstream of Wake County SR 1844

WS-IV;NSW | 03-04-01 | 4.9 FW Miles

Potential Stressors / Sources:

- **Fecal Coliform Bacteria**
  - MS4 NPDES
  - WWTP NPDES
- **Habitat Degradation**
  - MS4 NPDES

Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	2008	5

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-16-(1)	**Lower Barton Creek**			**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2004		1
From source to Wake County SR 1834												
WS-IV;NSW		03-04-01	6.1 FW Miles									
Subwatershed (WBD-12 Number) 030202010603	**Horse Creek**											
27-17-(0.7)	**Horse Creek**			**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2004		1
From a point 0.3 mile upstream of Franklin County SR 1139 to a point 0.1 mile downstream of Wake County SR 1923												
WS-IV;NSW		03-04-01	6.0 FW Miles									
Subwatershed (WBD-12 Number) 030202010604	**Honeycutt Creek-Neuse River**											
27-20.5-(2)ut1	**UT1 to Unnamed Tributary at Camp New Life**			**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2006		3a
From source to UT at Camp New Life												
WS-IV;NSW		03-04-01	1.8 FW Miles									
27-20.5-(3)	**Unnamed Tributary at Camp New Life**			**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2006		3a
From a point 0.3 mile upstream of Wake County SR 2002 to Falls Lake, Neuse River												
WS-IV;NSW,CA		03-04-01	0.6 FW Miles									

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 nutrient impacts. The watershed management plan recommends a comprehensive suite of management strategies covering new development, monitoring and enforcement, watershed stewardship and agricultural measures, watershed restoration and point sources (see section 1.5.2 for more details). DWQ recommends local governments implement this 2003 watershed management plan.

Falls Lake has been placed on the 2008 303(d) list of impaired waters due to chlorophyll *a* standard violations in the entire lake and turbidity standard violations in the upper portion of the lake. These are the direct result of high nutrient and sediment loading occurring in the watershed. The Division is in the process of developing a lake and watershed model. The Division is also working with stakeholders to develop a comprehensive nutrient management strategy for Falls Lake and its watershed. These rules will ultimately require reductions in nutrients from the contributing sources in the watershed.

There are 3 major and 13 minor NPDES wastewater discharge permits in this subbasin with a total permitted flow of just over 29.4 MGD. The largest facilities are North Durham WRF (20.0 MGD), South Granville Water and Sewer Authority WWTP (5.50 MGD) and Hillsborough WWTP (3.0 MGD). There are also 35 individual NPDES stormwater permits in the subbasin. Refer to Appendix III for identification and more information on NPDES permit holders. The City of Durham holds a Phase I stormwater permit, and Durham and Wake counties have developed stormwater programs under Phase II requirements. Durham, Orange and Wake counties have also submitted stormwater ordinances as required by the Neuse NSW strategy stormwater rules (Chapter 18). Eleven animal operations in this subbasin hold non-discharge permits issued by the DWQ.

The water quality in this subbasin is mainly assessed using biological indicators (macroinvertebrates and fish). The upper portion of this basin has been found to exhibit good water quality while those waters closest to Falls Lake, in the areas with the highest development densities, have exhibited poor water quality. The biological integrity has decreased at most of the sites since they were last sampled in 2000. With the projected increase in population growth for this area, this trend is likely to continue unless additional proactive measures (e.g. preserve critical areas against further development) to prevent additional degradation are taken. Local governments, land trusts, and watershed groups need to continue to working together to implement a comprehensive suite of watershed management strategies, such as those recommended in the UNRBA’s Upper Neuse Watershed Management Plan.

The major stressors in this subbasin are high nutrient and sediment loading, high chlorophyll *a* levels due to the high nutrients, high fecal coliform, low dissolved oxygen, and habitat degradation. The major sources of these stressors are urban and agricultural runoff, new construction and existing development, and point source dischargers. All of these are contributing to the decreasing water quality in this watershed.

A unique geological zone know as the Triassic Basin runs through a portion of this watershed requiring a unique management strategies due to the erosive soil type and lack of flow during dry periods (Bain and Harvey, 1977). Due to the less than suitable soil type and the low infiltrations rate in the Triassic region, this area is highly impacted by stormwater runoff. On-site sewage treatment using conventional septic systems is often not an option resulting in the use of sand filters for on-site treatment for many of the single family homes in this region. These systems are often not adequately maintained resulting in high fecal coliform and nutrient discharge, which ultimately ends up in the creek and Falls Lake (NC DENR-EEP, 2006;

http://www.nceep.net/services/lwps/little_lick/LittleLick_LWP.pdf). To see a NC Geological map go to http://www.geology.enr.state.nc.us/usgs/geomap.htm.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 3. Table 3 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 for more information about use support methodology.

Waters in the following sections and in Table 3 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.

1.2 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. Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 4 for a summary of use support for waters in subbasin 03-04-01 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

1.3 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 303(d) 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 number. Information regarding 303(d) listing and reporting methodology is presented at http://h2o.enr.state.nc.us/tmdl/General_303d.htm.

Table 4 Summary of Use Support Ratings in Subbasin 03-04-01

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
Freshwater acres (impoundments)	13,445	12,234	84	1,211	8	0	1132	14,576
Freshwater miles (streams)	229	44	9	173	37	12	240	469

% - Percent of total miles/acres.

1.3.1 Ellerbe Creek [AU# 27-5-(0.3), 27-5-(0.7) & 27-5-(2)]

2002 Recommendations

DWQ will establish a biological monitoring station above the WWTP in order to monitor changes in the upper Ellerbe Creek watershed. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Ellerbe Creek. DWQ will continue to support the City of Durham stormwater programs.

The NCEEP has created a Local Watershed Plan (LWP) in the Ellerbe Creek watershed. City of Durham is now working to implement portions of the Ellerbe Creek LWP. This effort will develop detailed recommendations to improve water quality.

The impaired biological community in Ellerbe Creek is typical of streams that run through urban areas.

Current Status

Ellerbe Creek [AU# 27-5-(0.3); C; NSW] from source to I-85 bridge (6.1 miles) and [AU# 27-5-(0.7); WS-IV; NSW] from the I-85 bridge to a point 0.2 miles upstream of Durham County SR 1636 (5.9 miles) is Impaired for aquatic life due to a Poor fish community bioclassification at site JF4. This biological assessment was completed as result of the previous recommendation listed above. There were steep terraced banks, sparse instream habitat consisting mostly of runs and a few side snags as well as an abundance of urban debris. The total number of fish collected at this site in 2005 declined by 87 percent since the last fish collection in 1995. This may be due to the noted stressor such as upstream urban impacts, lack of suitable habitat, an open canopy, and the possible streams proximity to a landfill. The entire 12.5 mile length of Ellerbe Creek [AU# 27-5-(0.3), 27-5-(0.7) and 27-5-(2)] was first listed on the 303(d) list for Impaired Biological Integrity in 1998.

Ellerbe Creek [AU# 27-5-(2); WS-IV; NSW; CA], from a point 0.2 miles upstream of Durham County SR 1636 to Falls Lake, Neuse River (0.5 miles), is impaired for biological integrity due to a benthic sample that was collected at the end of the previous assessment window (8/23/00). Station JB165 at SR1636 received a Fair rating in 2000 and a Poor rating in 1995. This station was not assessed during this assessment period. None of the ambient monitoring data exceeded state standards at station JA7; however turbidity was elevated above the state standard of 50 NTUs in 7 percent of the samples. The maximum recorded turbidity level was 190 NTUs. The conductivity was high and ranged between 104 and 501 μmhos/cm. The nutrient levels were also very high at this ambient monitoring station. The readings ranged between 0.02-1.3 mg/l

NH3, 0.31-6.4 mg/l NO2+NO3, 0.62-2.4 mg/l TKN, and 0.07-4.5 mg/l TP. All of this data indicates that this watershed is highly impacted by both point and nonpoint sources of pollution and is likely having an impact on the water quality of Falls Lake (see Section 1.3.7).

This same section of Ellerbe Creek is Not Rated for recreational uses due to elevated fecal coliform bacteria levels in 21 percent of the samples. DWQ was unable to complete a 5-in-30 (assess 5 samples in 30 days), which is required in order to rate a stream with elevated fecal coliform levels (greater than 20 percent of the samples with a count of 400 CFU/100 ml or a geometric mean greater than 200 CFU/100 ml). DWQ focuses its limited resources on assessing class B waters (primary recreation waters; see http://h2o.enr.state.nc.us/tmdl/General_303d.htm for more information on use support methodology).

The entire length of Ellerbe Creek will remain on the 303(d) list of impaired waters for impaired biological integrity (Figure 3 and 4).

Recommendations

DWQ is strongly recommending that the 2003 UNRBA Upper Neuse Watershed Management Plan be implemented by the UNRBA members and partners as well as implementing the local watershed plan developed by the NC Ecosystem Enhancement Program (EEP).

The following areas are also recommended for protection and acquisition needs within the Ellerbe Creek watershed.

- The upper watershed and headwaters area. Headwater protection is critically needed to improve and protect water quality in Ellerbe Creek.
- The area between Avondale Dr. and Falls Lake. Development is occurring rapidly in this area. There is a need to protect the remaining large, contiguous, undeveloped riparian area through acquisition, conservation easements, deed restrictions and other methods.
- To create a string of interconnected preserved areas from the headwaters to the terminus at Falls Lake. This would help limit impervious surfaces and control stormwater, improving water quality in Ellerbe Creek and Falls Lake as well as provide a place where people can enjoy nature.
- There is a need for improved stormwater management throughout the watershed, with particular emphasis on the highly developed areas between Hillandale and Roxboro Roads.
- Lands identified for acquisition through the Upper Neuse Clean Water Initiative (see section 1.5.3).

Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed 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

A local watershed plan (LWP) was developed through an EEP (previously called Wetlands Restoration Program) stakeholder process which evaluated the varied sources of water quality degradation and recommended a comprehensive set of strategies to address the water quality problems within Ellerbe Creek. Ellerbe Creek was identified as having the highest percentage of impervious surfaces and delivering the highest nutrient loads to Falls Lake. The Ellerbe Creek watershed is predominately urban and currently is estimated to have 22 percent impervious cover while is projected to increase to 27.5 percent by 2025.

The primary strategy of the watershed management plan is to protect and restore the watershed functions. Five major management goals were established, these are:

1. Improve Aquatic Life
2. Reduce Destructive Flooding
3. Create Recreational Opportunities
4. Educate the Local Community about Ellerbe Creek
5. Reduce Nutrient Loads going into Falls Lake Water Supply Reservoir.

The recommendations to attain these goals were:

1. Critical Area Protection
2. Riparian Area Management
3. Stream and Riparian Buffer Restoration
4. Better Site Design for Stormwater Management
5. Code and Ordinance Review and Revision
6. Stormwater Retrofits
7. Reduce Illicit Discharges and Illegal Dumping
8. Stream Monitoring
9. Strengthening Watershed Education and Stewardship
10. Sediment and Erosion Control.

The recommendations need to be implemented by local, regional, and state-level watershed stakeholders. The local watershed plan can be found at http://www.nceep.net/services/lwps/Upper_Neuse/Ellerbe_Creek_Local_Watershed_Plan.pdf.

City of Durham Initiative

The City of Durham has hired a consultant to develop a Watershed Implementation Plan based on the LWP developed by EEP several years ago. The consultant and City staff performed stream condition assessments for 35 miles of the Ellerbe Creek watershed, including South Ellerbe and Goose Creeks. The consultant and City staff also updated the inventory and checked status of 48 BMPs in the Ellerbe Creek Watershed. Opportunities for retrofits to existing structural BMPs, and potential locations for new BMPs, were evaluated during the field reconnaissance. Currently, 27 existing BMPs have been identified for possible retrofits. The City has identified five pilot subwatersheds to evaluate further and prioritize BMP installation based on a number of different criteria including utility conflicts, landowner cooperation/consent, pollutant removal, and educational opportunity. For more information on the City of Durham's Ellerbe Creek Watershed Improvement Projects go to http://www.durhamnc.gov/departments/works/stormwater_ellerbe.cfm.

Upper Neuse River Basin Association Initiative

The UNRBA has developed a watershed management plan that would help protect all waters in subbasin 03-04-01 from the increasing potential for sediment and nutrient impacts. The watershed management plan recommends a comprehensive suite of management strategies covering new development, monitoring and enforcement, watershed stewardship and agricultural measures, watershed restoration and point sources.

UNRBA is in the process of developing a detailed implementation plan describing the roles and responsibilities of UNRBA members and partners and area of the basin where particular management strategies are most urgently needed. Information on the Upper Neuse Watershed

Management Plan can be found in section 1.5.2 or at the UNRBA website http://www.unrba.org/mgmtplan.htm.

Ellerbe Creek Watershed Association Initiative

The Ellerbe Creek Watershed Association received a $411,000 NC Clean Water Management Trust Fund Grant in September 2007 to restore Ellerbe Creek between Albany St. and Interstate 85. In total, the project will restore a half mile of channelized, deeply incised, heavily eroded portion of Ellerbe Creek. The proximity of the restoration to the greenway will enhance visibility of the project, help to promote improved stewardship of the creek and maximize the environmental and recreational assets of this popular site.

Through the use of natural channel design, the project will reduce suspended sediment loads by drastically reducing stream bank erosion from an estimated 8-tons/linear foot/year to near zero following the restoration (Stream Restoration and Stormwater Treatment in the Ellerbe Creek Watershed, NCSU Water Quality Group, 2004). The restoration will decrease storm flow velocity, improve the quality of vegetation on stream banks and in riparian areas, increase low flow levels and help to restore the hydrography of the watershed. These improvements will improve water quality and aquatic habitat and help to address the causes of impaired biological integrity in the creek. The W. Ellerbe Creek Greenway is currently severely threatened by erosion of the highly channelized stream. This project will help stabilize the stream banks and protect the City of Durham's $175,000 paved greenway trail. In addition, the project will help protect future investment in connecting the trail to the city system and ensure the long-term protection of this important and highly valued recreation resource. For more information on the Ellerbe Creek Watershed Associations initiative projects go to http://www.ellerbecreek.org/.

Durham Soil and Water Conservation District Initiative

The Durham Soil and Water Conservation District has partnered with Blue Devil Ventures on a Green Roof Project in Downtown Durham. The Green Roof project is within the Ellerbe Creek Watershed. It will consist of two 3,000 foot sections of green roof that will be used for experimenting with media design, water conservation with cisterns, and water monitoring for runoff. The Durham Soil and Water Conservation District secured a $100,000 grant from Clean Water Management Trust Fund for this project.

1.3.2 Little Lick Creek Watershed: Little Lick Creek [AU# 27-9-(0.5) & 27-9-(2)] & Two Unnamed Tributaries [AU# 27-9-(0.5)UT2 & 27-9-(2)UT2]

2002 Recommendations

DWQ will continue monitoring Lick 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 Little Lick Creek. DWQ will continue to support the City of Durham stormwater programs.

The impaired biological community in Little Lick Creek is typical of streams that run through urban areas

Current Status

In the Little Lick Creek watershed, eleven sampling sites were assessed for physical and chemical parameters between March and June 2005, seven of these were assessed using a continuous monitoring device (datasonde) and five benthic sites were assessed in April 2005. These samples were collected by DWQ for assistance with an EEP local watershed assessment of the Little Lick Creek watershed.

Little Lick Creek is located in east Durham and flows into Falls Lake. The creek contains approximately 73 miles of streams within an area of approximately 21 square miles. The Little Lick Creek watershed lies within the Triassic basin geological region of North Carolina. The Triassic basin soils have high clay content that can provide less base flow to streams than other soil types resulting in lower summer stream flows and lower dissolved oxygen levels. Because of the associated effects from the low flow and DO levels as of 2001 the biological assessment unit is no longer assigning bioclassifications to streams sampled in the Triassic basin. General assumptions can still be made from sampling in these areas especially if there is a healthy/reference stream to make a comparison with in the same area.
Historically, Little Lick Creek from it source to Falls Lake (including the portion of Little Lick Creek arm of Falls Lake) is on the 303(d) list for Impaired biological integrity. The upper portion [AU# 27-9-(0.5)] is also on the 303(d) due to low dissolved oxygen standard violations. The stressors to this area were listed as urban runoff, storm sewers, and runoff from construction sites. During the last assessment period Little Lick Creek received a Poor benthic bioclassification. Historically, Little Lick Creek as been sampled eight times since 1985 and has received either a Poor or Fair bioclassification each time.

Since it is difficult to determine the relative degree to which the Triassic basin characteristics and urban impacts affect the macroinvertebrate communities at these five sites they are classified as Not Rated. However, since all five sites are within the Triassic basin, the difference between the benthic community at the unnamed tributary to Little Lick Creek off Santee Road and the other four sites suggest that urbanization is contributing to the stress indicated by the benthic communities at the more urban four sites (Figure 3).

<u>Little Lick Creek [AU# 27-9-(0.5) & 27-9-(2)]</u>
Little Lick Creek [AU# 27-9-(0.5); WS-IV; NSW] from the source to a point 0.4 miles upstream of Durham County SR 1811 (7.17 miles) and Little Lick Creek [AU# 27-9-(2); WS-IV; NSW; CA] from a pervious segment to Falls Lake, Neuse River (0.57 miles) is Impaired for aquatic life due to ambient monitoring dissolved oxygen and turbidity standard violations. These stations were assessed using a continuous monitoring probe between April and June 2005. The state standard for dissolved oxygen is not less than a daily average of 5.0 mg/l with a minimum instantaneous value of not less than 4.0 mg/l. Since a continuous monitoring probe was used, daily averages were calculated and used for this assessment. However, Little Lick Creek would have been classified as impaired if the lower 4 mg/l dissolved oxygen standards was used as well. The low DO violations ranged between 42 and 67 percent exceedance (percent below the standard) and the turbidity ranged between 8.6 and 55 percent exceedance with the segment closest to Falls Lake with the most extreme violations (station LLCLL10).

All of Little Lick Creek will be added to the 2008 303(d) list for dissolved oxygen and turbidity standard violations and will remain on the list for impaired biological integrity.

<u>Unnamed Tributaries to Little Lick Creek [AU# 27-9-(0.5)ut2 & 27-9-(2)ut2]</u>
Unnamed tributary to Little Lick Creek [AU# 27-9-(0.5)ut2; WS-IV; NSW] from the source to Little Lick Creek (2.4 miles) and [AU# 27-9-(2)ut2; WS-IV; NSW; CA] from the source to Falls Lake Little Lick Creek (0.9 miles) are both Impaired for aquatic life due to dissolved oxygen standard violations of 54 (station LLCUT03) and 29 (station LLCUT11) percent respectively. Both unnamed tributaries also had high turbidity levels; however they did not exceed the standard more than 10 percent of the time.

Both of these tributaries will be added to the 2008 303(d) list of impaired waters for dissolved oxygen standard violations (Figure 3 and 4).

Fecal coliform bacteria levels rose significantly after a storm event at all sites within the study area. Little Lick Creek is Not Rated for recreational uses because a 5-in-30 sampling effort was not done (5 samples collected over a 30 day period required in order to assess for fecal coliform bacteria).

Elevated specific conductivity was also seen in this watershed. This is an indication of polluted waters. The range of specific conductivity in this watershed was between 59-564 µS/cm.
The DWQ biologist noted in their assessment of the Little Lick Creek Watershed that the stream banks were severely eroded and the riparian zones were essentially not intact at most of the benthic sites. The reference site also suffered from erosional areas however the riparian zones were wide and intact. The watershed was noticeably more rural and less disturbed than the other four sites and supported a less impacted macroinvertebrate community. The watershed restoration projects listed in the EEP local watershed plan and the UNRBA Upper Neuse Watershed Management Plan will help address these issues and improve the aquatic life and habitat in this watershed.

The EEP Little Lick Creek Watershed plan reported that the greatest potential water quality threats found in this watershed was from failing septic systems and sewer spills. This creek has the greatest density of sand filter type systems (approximately 444 systems) in the entire Upper Neuse Basin. These wastewater systems exhibit high rates of failure. These failures are going untreated for long periods of time because they discharge the raw, untreated sewage directly into streams. Even properly functioning sand filters systems export high concentrations of nutrients to streams. The level of urban development is projected to more than double in the long run. Restoring Little Lick Creek will be impossible without stronger approaches for preventing impacts from future land use changes like those recommended in this plan (EEP 2006, Little Lick Creek LWP).

Recommendations
DWQ recommends that the 2003 UNRBA Upper Neuse Watershed Management Plan be implemented by the UNRBA members and partners as well as implementing the recommendations from the EEP Little Lick Creek Local Watershed Plan.

Water Quality Initiatives
A local watershed plan funded by the NC Ecosystem Enhancement Program (EEP) for Little Lick Creek was completed in December 2006. This was completed through an extensive stakeholder process which came up with nine comprehensive watershed management strategies for restoring the watersheds water quality and aquatic habitat in the short-term and protecting them in the long term. The recommendations need to be implemented by local, regional, and state-level watershed stakeholders. The nine recommendations where split into three categories and are as follows:

Watershed Restoration Projects
1. Stream Repair Projects
2. Riparian Buffer Restoration
3. Stormwater Retrofits

Strategies to Prevent Future Degradation

4. Critical Lands Protected
5. Better Site Design
6. Improved Enforcement of Existing Rules

Strategies to Increase Watershed Stewardship

7. Watershed Outreach and Education
8. Adopt-a-Stream Program
9. Stream and Watershed Monitoring.

The watershed plan can be found at http://www.nceep.net/services/lwps/little_lick/LittleLick_LWP.pdf and lists specific details for each of the plan recommendations.

Upper Neuse River Basin Association Initiative

The UNRBA has developed a watershed management plan that would help protect all waters in subbasin 03-04-01 from the increasing potential for sediment and nutrient impacts. The watershed management plan recommends a comprehensive suite of management strategies covering new development, monitoring and enforcement, watershed stewardship and agricultural measures, watershed restoration and point sources.

UNRBA is in the process of developing a detailed implementation plan describing the roles and responsibilities of UNRBA members and partners and area of the basin where particular management strategies are most urgently needed. Information on the Upper Neuse Watershed Management Plan can be found in section 1.5.2 or at the UNRBA website http://www.unrba.org/mgmtplan.htm.

1.3.3 Lick Creek [AU# 27-11-(0.5) & 27-11-(1.5)]

2002 Recommendations

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

The impaired biological community in Lick Creek is typical of streams that run through urban areas.

Current Status

The DWQ did not assess Lick Creek during this assessment period. This creek was previously assessed three times (2000, 1995, and 1998) and was found to support a fair benthic community each time. The biologist noted during the last assessment that the habitat was poor with no riffles, severe erosion, a deeply entrenched channel, no effective riparian zone, little instream habitat and the benthic substrate composed mostly of sand. These are indicators of a major stormwater runoff problem in the area. Lick Creek [AU# 27-11-(0.5); WS-IV; NSW] from the source to Wake County SR1809 (6.5 miles) was added to the 303(d) list in 1998 for impaired biological integrity. The biological impairment was extended 0.7 miles down stream to Falls Lake (Lick Creek [AU# 27-11-(1.5); WS-IV; NSW; CA] from Wake County SR1809 to Falls Lake) during the last assessment period and added to the 2004 303(d) list.

The Lick Creek watershed is a relatively undeveloped watershed where the majority (80 percent) of the land use is currently classified as undeveloped (forestry, agriculture or protected lands). It also falls into a unique geological zone know as the Triassic Basin which in turn results in a need for unique management strategies due to the erosive soil type and lack of flow during dry periods (Bain and Harvey, 1977). This watershed at present is impaired, which to the best of our knowledge is likely due to excessive runoff and increase streamflow volumes after rain events. This deposits excess sediment from the landscape as well as results in streambank erosion and scouring of the streambed which has a detrimental impact on the benthic macroinvertebrate communities. Stormwater runoff also carries excess nutrients and pollutants into the creek as well. These can negatively impact both humans and aquatic organisms in the watershed. Given the unique geological formation in this watershed, special ordinances may be required in order to accommodate future growth while protecting and improving water quality.

Due to the less than suitable soil type in this watershed, on-site sewage treatment using conventional septic systems is often not an option. Many of the treatment systems in this watershed are single family home sand filters (approximately 79 sand filter systems in this watershed). These systems are often not adequately maintained resulting in high fecal coliform and nutrient discharge, which ultimately ends up flowing into the creek.

Restoring Lick Creek will be impossible without stronger approaches for preventing impacts from future land use changes.

The Upper Neuse River Basin Association (UNRBA) received a 319 grant ($148,000) in October 2006 to develop a Lick Creek watershed restoration plan. This is a three-year project to develop and commence implementation of a watershed restoration plan to address the biological impairment in Lick Creek by improving water quality and habitat conditions. This process included monitoring of the watershed to help identify sources of the impairment and propose and prioritize management strategies to address those sources. The ambient water quality data collected during this project will be used to make use support ratings during the next assessment period (2008). The project also includes development of recommendations for a long-term monitoring program that may be implemented by the City of Durham Stormwater Services Division.

The Durham SWCD is participating in the Lick Creek Watershed Restoration Plan in association with the Upper Neuse River Basin Association.

The entire length of Lick Creek will remain on the 2008 303(d) list of impaired waters (Figure 3 and 4).

Recommendations

DWQ should assist UNRBA and local governments in implementing the management strategies recommended in the Lick Watershed Restoration Plan UNRBA and the watershed stakeholders are developing. These strategies might include stream and/or watershed restoration projects, retrofits of existing development, and code and/or local ordinance changes. DWQ should also work with the City of Durham's Stormwater Services to utilize their long-term data for use support in the future.

DWQ also recommends that the 2003 UNRBA Upper Neuse Watershed Management Plan be implemented by the UNRBA members and partners.

Water Quality Initiatives
The SWCD has partnered with three local landowners and NCSU on a stream restoration and benthic macroinvertebrate count on a portion of Lick Creek. The District has received a NC Clean Water Management Trust Fund Grant of $539,000 for the project. The restoration site begins at Olive Branch Road and runs east for 4000 ft. One thousand feet of buffers will also be restored. The project started summer of 2007 and upon completion the District will hold a conservation easement on approximately 10-14 acres of buffers adjacent to the restoration. Pre and post benthic macroinvertebrate assessment will be completed by NCSU.

Upper Neuse River Basin Association Initiative
The UNRBA has developed a watershed management plan that would help protect all waters in subbasin 03-04-01 from the increasing potential for sediment and nutrient impacts. The watershed management plan recommends a comprehensive suite of management strategies covering new development, monitoring and enforcement, watershed stewardship and agricultural measures, watershed restoration and point sources.

UNRBA is in the process of developing a detailed implementation plan describing the roles and responsibilities of UNRBA members and partners and area of the basin where particular management strategies are most urgently needed. Information on the Upper Neuse Watershed Management Plan can be found in section 1.5.2 or at the UNRBA website http://www.unrba.org/mgmtplan.htm.

1.3.4 Flat River [AU# 27-3-(1), 27-3-(8) & AU# 27-3-(9)]

2002 Recommendation
DWQ will work with the City of Durham to evaluate low dissolved oxygen releases from the dam. As part of the 303(d) approach, a management strategy will be developed to ensure that low dissolved oxygen from Lake Michie does not adversely impact the biological community in the Flat River. DWQ will continue to monitor the segment below Lake Michie to evaluate any changes in dam operation.

Current Status
Flat River [AU# 27-3-(1); WS-III; NSW (9.1 miles) from the source to a point 2.0 miles downstream of Durham County SR1614 is supporting aquatic life and recreational uses due to a Good benthic bioclassification at station JB9 and due to no criteria exceeded at ambient monitoring station JA4. The dissolved oxygen levels in this segment were below 4 mg/l and 5 mg/l in 3 and 7 percent of the samples tested respectively. The lowest recorded reading was 3.2 mg/l. Turbidity was above the state standard of 50 NTUs in 3 percent of the samples with the highest recorded reading of 120 NTUs. The benthic and ambient monitoring stations are co-located. This segment of the Flat River was rated Good in 2000 and 2005. The habitat at this location was good with fairly stable stream banks and only a few erosional areas seen. The biologist noted that this segment was slightly turbid with low flow conditions during their 2005 benthic collection.

The Flat River [AU# 27-3-(8); WS-IV; NSW (1.1 miles) & AU# 27-3-(9); WS-IV; NSW; CA (0.6 miles)] from the dam at Lake Michie to Falls Lake is Impaired for aquatic life due to low dissolved oxygen levels at ambient monitoring station JA5. DO levels were less than 4 mg/l and 5 mg/l in 27 and 37 percent of the samples respectively. The lowest recorded DO reading was 0.4 mg/l.

The whole segment below Lake Michie will be on the 2008 303(d) impaired waters list for low dissolved oxygen standard violation (Figure 3 and 4).

Recommendations
DWQ recommends that the 2003 UNRBA Upper Neuse Watershed Management Plan be implemented by the UNRBA members and partners.

Water Quality Initiatives
The Durham SWCD initiated a project with a local landowner on a stream restoration of an unnamed tributary flowing into Lake Michie. The project is on a 2000 foot long reach with funding from the Clean Water Management Trust Fund, and buffer reforestation on the adjoining 13 acres with assistance from the Conservation Reserve Enhancement Program. In collaboration with the Triangle Greenway Council (TGC) and NC National Guard the initiative is being expanded to include a conservation easement on 225 acres that will continue agricultural use, protect water quality and avoid land use that would not be compatible with adjoining military training exercises. The Durham SWCD will hold and monitor the conservation easement. Funds for the expanded initiative have been pledged by the partners and are being sought through the Federal Farmland and Ranchland Preservation Program, State Agricultural Development and Farmland Preservation Trust Fund and the Upper Neuse Clean Water Initiative. This is the first project undertaken after the TGC's Riparian Corridor Conservation Plan identified the Flat River as one of several focus areas for attention. The Flat River Plan is currently being updated and refined to promote multiple purpose corridors.

Upper Neuse River Basin Association Initiative
The UNRBA has developed a watershed management plan that would help protect all waters in subbasin 03-04-01 from the increasing potential for sediment and nutrient impacts. The watershed management plan recommends a comprehensive suite of management strategies covering new development, monitoring and enforcement, watershed stewardship and agricultural measures, watershed restoration and point sources.

UNRBA is in the process of developing a detailed implementation plan describing the roles and responsibilities of UNRBA members and partners and area of the basin where particular management strategies are most urgently needed. Information on the Upper Neuse Watershed Management Plan can be found in section 1.5.2 or at the UNRBA website http://www.unrba.org/mgmtplan.htm.

1.3.5 Knap of Reeds Creek [AU# 27-4-(1), 27-4-(6) & 27-4-(8)]

2002 Recommendations
As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Knap of Reeds Creek. DWQ will continue to monitor this segment to evaluate future improvements at the WWTP and upstream water quality. DWQ continues to recommend that Butner WWTP improve plant operations and collection systems as needed to reduce the potential for negative water quality impacts to Knap of Reeds Creek.

Current Status
Knap of Reeds Creek [AU# 27-4-(6); WS-IV; NSW (5.6 miles) & AU# 27-4-(8); WS-IV; NSW; CA (0.6 miles)] from the dam at Butner Lake to Falls Lake, Neuse River is Impaired for aquatic life based on a Fair benthic bioclassification at sites JB11, JB12, and JB14. Sites JB11 and JB12

are above and below the WWTP (South Grandville Water and Sewer Authority (SGWASA)) respectively. Earlier samplings indicated a chronic problem with the discharge from the WWTP, which appears to have been corrected as both the upstream and downstream sites had similar benthic community in recent years. This is the only major discharger into this watershed and is permitted to discharge up to 5.5 MGD. As of January 2006, the Department of Health and Human Services turned over operation of this facility to the SGWASA (permit # NC0026824).

No Criteria were exceeded at ambient monitoring station JA6. The station is located at the WWTP outfall. While no criteria were exceeded, nutrients, conductivity and fecal coliform bacteria levels were elevated. The recorded maximum conductivity at this site was 681 µmhos/cm, nitrate/nitrite nitrogen was 9.4 mg/l, total phosphorus was 4.2 mg/l and the fecal coliform bacteria levels were above 400 CFU/100 ml in 8 percent of the samples. This segment of Knap of Reeds Creek is obviously impacted by point and nonpoint sources of pollution. This is the only ambient monitoring station on this creek.

A TMDL Stressor study was performed in April 2004 to address the 1998 303(d) listing for impaired biological integrity of this area. The potential sources at the time of the initial impairment were listed as unknown.

Site JB14 (SR1004) is approximately 1.1 miles downstream of the Lake Butner dam. It is largely an agricultural area. Largely embedded benthic surfaces, infrequent pools and riffles as well as a reduced riparian zone have resulted in limited instream habitat. Erosional areas upstream of the study area were also evident. This could be a result of water flow over at the dam. The results at this site suggest a moderately tolerant benthic community with some toxic influences.

Site JB11 (above WWTP) is approximately 4.6 miles down stream of the Lake Butner dam. Pools were frequent and varied, but no riffle areas were present. The water clarity was turbid at the time of sampling even though there had been a lack of precipitation in the area. This site appears to be neither declining nor recovering from its degraded condition. A tolerant macroinvertebrate community was dominant at this site.

Site JB12 (below WWTP) is approximately 100 meters downstream of the outfall of the WWTP. The benthic community has continued to improve to the point of mirroring the upstream WWTP site (JB11) possibly due to plant upgrades over the past decade. This area has improved from poor to fair since sampling began in 1982.

At this same time, a sample (JB13) was collected upstream of Lake Butner, below the confluence of Camp Creek [AU# 27-4-(1); WS-II; HQW; NSW]. This area is Supporting aquatic life due to an Excellent benthic bioclassification at this site JB13. This was the first time this site had been sampled by DWQ. The banks appeared stable with erosional areas confined to the outside of bends in the creek. The stream has good flow and did not appear to completely dry out in the summer months. However, excessive periphyton growth was observed in areas of full sunlight.

DWQ found low dissolved oxygen readings below the dam that were potentially caused by stagnate conditions due to the little to no flow coming down stream from the dam, lack of precipitation as well as from a wildlife impoundment. Data provided by NC Division of Water Resources (DWR) indicates that there are currently no minimum flow requirements for the Lake Butner Dam. It was reported that half the years on record contain months with zero flow occurrences, meaning that no water was flowing past the dam. DWR recommends a flow regime in Knap of Reeds Creek, below the dam of 12.3 cubic feet per second (cfs) from March-May and 3 cfs from June to February.

A NCSU research dairy farm present near an upstream, unnamed tributary to Knap of Reeds Creek (SR1004) was found to be a potential source of nutrient into the creek. The cows had direct access to the creek. There have been historical water quality problems because of the dairy farm. This farm has since closed, and cattle are no longer in the creek. Direct water quality improvements should be seen at this location.

The dramatic differences between the benthic community at the upstream site (JB13) and the sites downstream of Lake Holt (Butner Lake) strongly suggest that the Lake Holt dam is one of the primary stressors in this section of the stream. The low flow conditions and resulting low DO levels due to the dam and the wildlife impoundment as well as the nutrient inputs from various sources in the watershed such as the dairy farm, non-point source runoff from the Town of Butner and the WWTP have all likely contributed to the biological impairment. Sedimentation due to impervious surfaces associated with the Town of Butner and the resulting flows after a rainfall as well as materials leaching from the unlined landfill in the headwaters of Picture Creek may also play a role in the biological impairment of Knap of Reeds Creek.

Knap of Reeds Creek will remain on the state's 303(d) list of Impaired waters for impaired biological integrity (Figure 3 and 4).

The Butner WWTP was assigned a total nitrogen allocation of 58,599 lbs/yr under the 1997 Neuse NSW strategy. In October 2003, the Butner purchased 6,113 lbs/yr of estuarine total nitrogen allocations/credits from the Bay River Metropolitan Sewerage District (BRMSD) for $1.68 million dollars. The BRMSD is located approximately 200 miles downstream in the lower Neuse Estuary, with the transportation factor, this allotted Butner an additional nitrogen allocation of 61,130 lb/yr (10 percent of the nitrogen from Falls Lake makes its way to the Neuse Estuary; transportation factor of 10). A great deal of concern surfaced about the ability of Fall Lake to handle the additional nitrogen load. Falls Lake appeared to be suffering from nutrient over enrichment prior to this nitrogen allocation transfer. This prompted DWQ to initiate the Fall Lake modeling study. This will allow DWQ to determine waste load allocations for the entire Fall Lake watershed. The WWTP has since sold 3,668 lbs/yr of the BRMSD total nitrogen allocation to Johnston County and holds the remainder in reserve pending the outcome of the Falls Lake TMDL. See section 1.3.7 for information on Falls Lake water quality.

The South Grandville Water and Sewer Authority (SGWASA) have had pretreatment issues resulting in antimony violations over the last few years. They also experienced total residual chlorine issues in 2003-2004. DWQ assessed a civil penalty for the continued pretreatment non-compliance issues. DWQ will work with the facility to correct these compliance issues.

Recommendations

DWQ will continue to monitor Knap of Reeds Creek and participate in the multiagency partnership dedicated to improving the waters in this area. Further nutrient reductions may be required for all dischargers (point and non-point) to Falls Lake. This information will be determined as result of the Falls Lake modeling study. The Town of Butner should work to reduce stormwater runoff to this creek.

DWQ recommends that the 2003 UNRBA Upper Neuse Watershed Management Plan be implemented by the UNRBA members and partners.

Water Quality Initiatives

The Tar River Land Conservancy (TRLC) is working in partnership with the Town of Butner to protect, through conservation easement, the land immediately upstream from and adjacent to Lake Holt, to include portions of Knap of Reeds Creek. The project will ultimately result in a 1206 acre upland working farm/forest conservation easement along with approximately 450 acres of forested "no touch" riparian area immediately adjacent to Knap of Reeds Creek, several unnamed tributaries, and portions of the shore line of Lake Holt. The 1656 acre conservation easement will be conveyed by the State of North Carolina to the Town of Butner and the South Granville Water and Sewer Authority as co-holders of the easement. The purpose of the conservation easement is to protect water quality in Lake Holt which serves as the primary water supply for Butner and residents in southern Granville County through the South Granville Water and Sewer Authority. Water from Lake Holt also flows into Falls Lake which is the primary water supply for the City of Raleigh and surrounding municipalities.

Upper Neuse River Basin Association Initiative

The UNRBA has developed a watershed management plan that would help protect all waters in subbasin 03-04-01 from the increasing potential for sediment and nutrient impacts. The watershed management plan recommends a comprehensive suite of management strategies covering new development, monitoring and enforcement, watershed stewardship and agricultural measures, watershed restoration and point sources.

UNRBA is in the process of developing a detailed implementation plan describing the roles and responsibilities of UNRBA members and partners and area of the basin where particular management strategies are most urgently needed. Information on the Upper Neuse Watershed Management Plan can be found in section 1.5.2 or at the UNRBA website http://www.unrba.org/mgmtplan.htm.

1.3.6 Upper Barton Creek [AU# 27-15-(1)]

Current Status

Upper Barton Creek [AU# 27-15-(1); WS-IV; NSW] from source to a point 0.5 miles upstream of Wake County SR 1844 (4.9 miles) is Impaired for aquatic life due to a Fair benthic community bioclassification at site JB28. The biologist found the sediment to be predominantly sand (60 percent) most likely due to the increasing development in the watershed. The channel in this section of the stream was more noticeably filled in and had fewer riffles and chutes in comparison to the 2000 basinwide sample. The benthic community structure is changing, suggesting a long-term water quality decline since it received a Good rating in 1991. There has been a reduction or loss of intolerant species and an increase in more tolerant taxa. The fish community has received a Good bioclassification rating over the last three basin cycles at site JF21.

Upper Barton Creek will be added to the 2008 303(d) list of impaired waters for impaired biological integrity (Figure 3 and 4).

The Wake County SWCD installed bank pins and scour chains in July, 2005, for a distance of approximately 4000 feet above Mt. Vernon Church Road. Initial measurements show significant bank loss in the first 18 months ranging from 10 tons/100 linear feet to greater than 75 tons/100 linear feet for various reaches.

Recommendations
DWQ would encourage local resource agencies to consider installing stormwater BMPs to reduce the stormwater volume and velocity as well as stream bank stabilization measures on the creek to reduce to amount of sediment from washing downstream.

DWQ recommends that the 2003 UNRBA Upper Neuse Watershed Management Plan be implemented by the UNRBA members and partners.

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).

Water Quality Initiatives
Wake County received a 319 grant in 2005 to produce a Watershed Management Strategy for Falls Lake. An initial analysis using GIS will be made of all the tributaries within this region. Based on the initial analyses, more detailed analysis will take place in watersheds where problems are known. It is likely that Upper Barton Creek will have a more detailed analysis performed. It is likely that additional monitoring, including physical and biological, perhaps more, will be implemented with the Wake County 319 project.

Upper Neuse River Basin Association Initiative
The UNRBA has developed a watershed management plan that would help protect all waters in subbasin 03-04-01 from the increasing potential for sediment and nutrient impacts. The watershed management plan recommends a comprehensive suite of management strategies covering new development, monitoring and enforcement, watershed stewardship and agricultural measures, watershed restoration and point sources.

UNRBA is in the process of developing a detailed implementation plan describing the roles and responsibilities of UNRBA members and partners and area of the basin where particular management strategies are most urgently needed. Information on the Upper Neuse Watershed Management Plan can be found in section 1.5.2 or at the UNRBA website http://www.unrba.org/mgmtplan.htm.

1.3.7 Falls Lake (Falls of the Neuse Reservoir) [AU# 27-(1) & 27-(5.5)]

2002 Recommendations
The upper part of the reservoir is periodically muddy and nutrient levels are unchanged from previous monitoring. Algal biomass was high in 1999. Low dissolved oxygen in the mid-reservoir and low mean Secchi depths (measure of clarity) indicate that the Falls Lake Reservoir experiences some water quality problems that are related to nutrient loading (algal activity) and sediment loading from the surrounding watershed. DWQ will continue to monitor the lake to evaluate any future degradation in water quality. The City of Raleigh should pursue measures to protect the watershed from land use activity that could increase nutrient and sediment loading.

Current Status

Falls of the Neuse Reservoir (Figure 4) is a multi-purpose impoundment of the Neuse River located in the Upper Neuse River basin. The various uses authorized for the reservoir include: water supply, flood control, recreation, wildlife enhancement and augmentation of low flows for purposes of pollution abatement and water quality control in the Neuse River basin. The reservoir is the primary water supply source for the City of Raleigh with a capacity of 100 MGD allocated for drinking water. The Cities E.M. Johnson Water Treatment Plant generally treats approximately 47 MGD, however an early 2007 summer 30-day average was up to 62.6 MGD. The City of Raleigh is a regional provider of drinking water and wastewater services to the Towns of Garner, Knightdale, Rolesville, Wake Forest, Wendell and Zebulon, in addition to its own service area.

The Falls of the Neuse Reservoir dam was constructed and filled by 1983 and is currently operated by the United States Army Corps of Engineers (USACE). The reservoir extends 28 miles up the Neuse River to just above the confluence of the Eno and Flat Rivers. At normal pool elevation, the lake has a surface area of 11,310 acres. It drains a watershed area of 494,600 acres or approximately 770 square miles including parts of 6 counties (Person, Orange, Franklin, Durham, Wake and Granville). The entire Falls of the Neuse Reservoir watershed is classified nutrient sensitive waters (NSW).

Falls of the Neuse Reservoir was monitored by DWQ a total of 42 times between March 2005 and December 2006. This lake has been sampled numerous times since 1983; however, no samples were taken by the Division between September 2001 and March 2005. Dr. JoAnn Burkholder, a researcher at North Carolina State University, Center for Applied Aquatic Ecology, provided chlorophyll *a* data for the summers of 2004, 2005 and 2006. This data was used in evaluating chlorophyll *a* in the lake based on confidence in Dr. Burkholder’s collection and analysis methodologies.

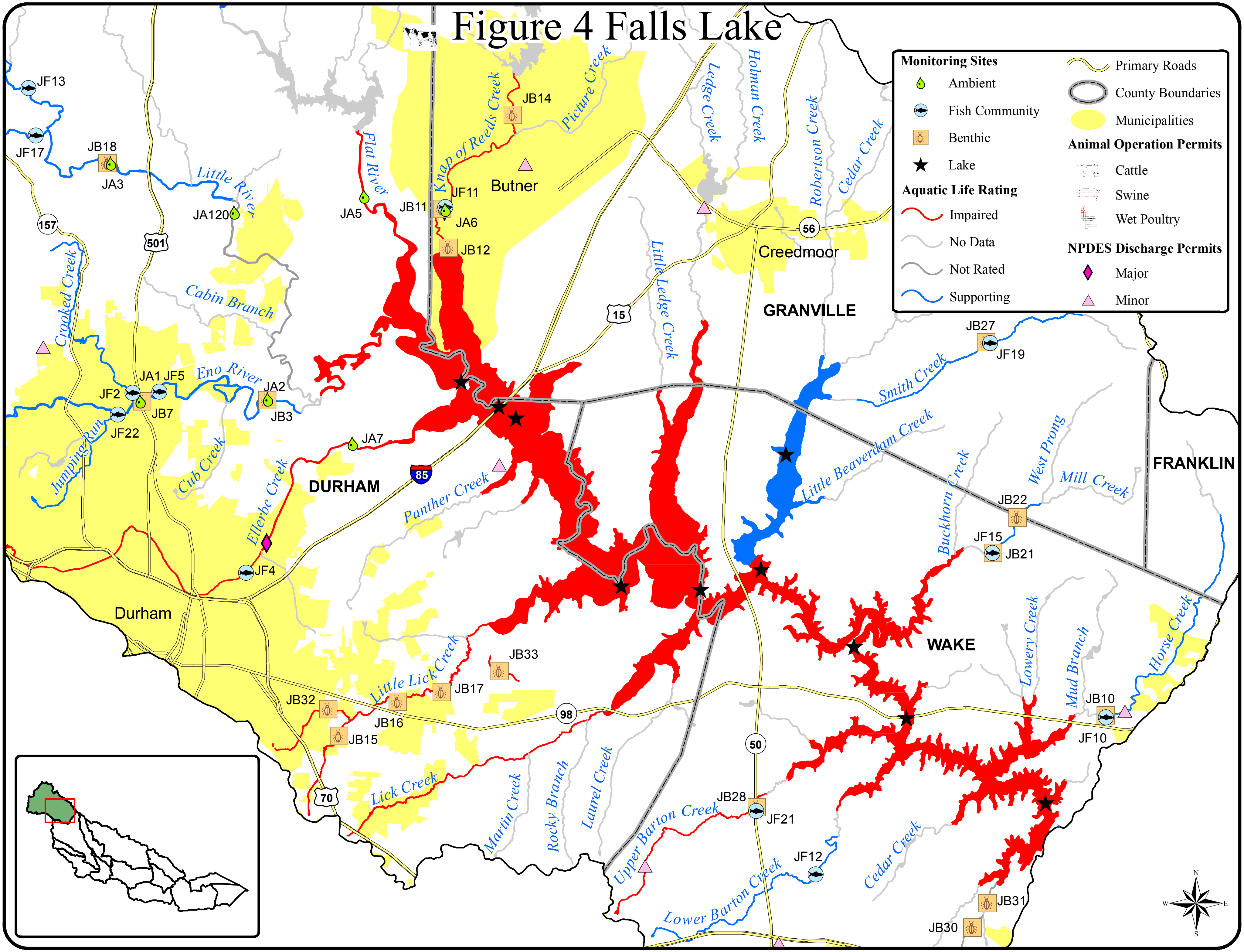
Percent dissolved oxygen saturation values were elevated (>120 percent). These high values indicate biological productivity due to algal photosynthesis; as evidenced by the high phytoplankton populations found in the most upstream section of the reservoir, near Interstate 85.

Three ambient monitoring stations, one on the upper end, one in the middle and one in the lower end, were assessed for phytoplankton. Phytoplankton sampling occurred during March, July and October of 2005. Mild blooms of cryptomonads and the green alga *Ankistrodesmus* were found in March. Cryptomonads and green algae commonly dominate spring flora. *Ankistrodesmus* is a unicellular green alga frequently found in lakes, ponds and reservoirs throughout the state. Although these taxa can form blooms that discolor waters and may cause taste and odors in drinking waters, these algae are generally considered a good food source and pose no known environmental health risks.

The phytoplankton assemblage shifted to small filamentous blue-greens in July and October that formed moderate to severe blooms throughout the lake. Blue-green blooms may also discolor water and cause taste and odor problems. They are common indicators of eutrophication and some taxa, such as *Cylindrospermopsis*, can produce toxins. No known adverse human health effects associated with blue-green algal toxins (cyanotoxins) have been reported in North Carolina waters. Sampling being conducted by the City of Raleigh for cyanotoxins found very low concentrations during summer. These concentrations were below the World Health Organization’s suggested human health criteria for cyanotoxins.

DWQ chlorophyll *a* concentrations were only available for March through mid-April 2005 and October 2005 through December 2006. By mid-April 2005 and early February 2006, chlorophyll *a* concentrations above the I-85 bridge exceeded the standard of 40 µg/l. The chlorophyll *a* concentrations remained high into November of each year. In addition to the DWQ chlorophyll *a* data, data from NCSU were included from July of 2004 and June, July and August of 2005 and 2006. These data were averaged in with DWQ data.

Figure 4 Falls Lake



Nutrient concentrations in 2005 were generally moderate to high for total Kjeldahl nitrogen, total organic nitrogen, and total phosphorus, confirming a potential for high biological productivity. Total Kjeldahl nitrogen ranged from 0.37 mg/l to 1.5 mg/l, total organic nitrogen from 0.36 mg/l to 1.5 mg/l and total phosphorus from <0.02 mg/l to 0.23 mg/l. Additionally, 2005 nitrite + nitrate values were high until the end of April, when they dropped to lower levels through September of 2005. This phenomenon indicated uptake of this nutrient by algae at the start of the growing season. Data from NCSUs study indicated similar concentrations. With the assistance of EPA's Athens Laboratory, algal growth potential tests (AGPT) were conducted at seven stations on the reservoir. AGPT is used to determine the potential of the waterbody to grow algae and the nutrient that is controlling algal growth. In this reservoir only the station above the I-85 bridge had an AGPT without nutrient additions above 10 mg/l (13.3 mg/l). This demonstrates that this location in the reservoir already has more than sufficient nutrients to support severe algal blooms.

High turbidity and corresponding low secchi depths were frequently recorded in the reservoir during 2005 and 2006. Turbidity values exceeded the state standard of 25 NTU for reservoirs in 72 percent of the samples in the upper portion (above I-85) of the reservoir. Below the I-85 bridge all stations values were pooled to get a single sampling trip/daily average. Of these, only a single daily average exceeded the standard, totaling a 2 percent exceedance which occurred on December 7, 2005 with a daily average of 41 NTUs. The turbidity at the upper most station below the I-85 bridge, however exceeded the standard in 62 percent of the samples with an overall average for the 42 samples collected of 33 NTUs. This station was above the standard as a result of mixing with the more turbid upstream waters. The most likely cause of the elevated turbidity appeared to be sediment loading above this portion of the lake.

There are a variety of sampling programs being conducted on Falls of the Neuse Reservoir. They include sampling funded by the City of Raleigh focused on non-regulatory source water characterization to meet the EPA Interim Enhanced Surface Water Treatment Rule, sampling by researchers at the NCSU focused on cyanotoxins and water quality (funded by the Department of Health and Human Services), and sampling being conducted by the USGS for the Upper Neuse River Basin to document surface water supply quality. Sampling by researchers and contractors documented similar turbidity, nutrient and chlorophyll *a* concentrations to those recorded by DWQ. However, the data collected by these researchers and contractors was not submitted to the Division for use in this evaluation.

<u>Upper Falls Lake (above I-85)</u>
The data indicate that Falls Lake [AU# 27-(1); WS-IV, NSW, CA] from the source (confluence of Eno River Arm of Falls Lake and Flat River Arm of Falls Lake) to the I-85 bridge (2,703.6 acres) is Impaired for aquatic life due to elevated chlorophyll *a* and turbidity levels (this also includes the NCSU-CAAE station above I-85).

<u>Lower Falls Lake (below I-85)</u>
The data indicate that Falls Lake [AU# 27-(5.5); WS-IV; B; NSW; CA] from I-85 bridge to the dam at Falls Lake (9,530.3 acres) is Impaired for aquatic life due to elevated chlorophyll *a* levels at the lower lake stations.

Both sections of the lake were added to the 2008 303(d) list of impaired waters; the upper portion for chlorophyll *a* and turbidity standard violations, and the lower portion for chlorophyll *a* standard violations only.

Recommendations
DWQ is strongly recommending that the 2003 UNRBA Upper Neuse Watershed Management Plan be implemented by the UNRBA members and partners.

Water Quality Initiatives
Due to a great deal of public concern over the ability of Fall Lake to handle the additional nitrogen load from the 2003 Butner WWTP nitrogen trade (see section 1.3.5 for more detail), DWQ initiated a special study in 2005 in order to develop a model/TMDL for Falls Lake. The results of this study, as reported above, found Falls Lake to be suffering from nutrient over enrichment and elevated sedimentation. This resulted in placement on the 2008 303(d) list of impaired waters. Implementation of a nutrient management strategy will follow the development of the model. Details on this process can be found in section 1.5.5.

Upper Neuse River Basin Association Initiative
The UNRBA has developed a watershed management plan that would help protect all waters in subbasin 03-04-01 from the increasing potential for sediment and nutrient impacts. The watershed management plan recommends a comprehensive suite of management strategies covering new development, monitoring and enforcement, watershed stewardship and agricultural measures, watershed restoration and point sources.

UNRBA is in the process of developing a detailed implementation plan describing the roles and responsibilities of UNRBA members and partners and area of the basin where particular management strategies are most urgently needed. Information on the Upper Neuse Watershed Management Plan can be found in section 1.5.2 or at the UNRBA website http://www.unrba.org/mgmtplan.htm.

See section 1.5.3, Upper Neuse Clean Water Initiative and section 1.5.4, Riparian Corridor Conservation Program for information on the other water quality protection initiatives in the Falls Lake watershed.

1.4 Status and Recommendations for Waters with Noted Impacts

Based on DWQs most recent use support methodologies, 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 number. Refer to Section 1.1 for more information about AU#. Nonpoint source program agency contacts are listed in Appendix IV.

1.4.1 West Fork Eno River Reservoir [AU# 27-2-2a]

Eno River Watershed Map (Figure 5)

Current Status

West Fork Eno River Reservoir [AU# 27-2-2a; WS-II; HQW; NSW] from source to reservoir dam (204 acres) is currently Not Rated for aquatic life due to insufficient number of samples within the assessment period. West Fork of the Eno River Reservoir is a water supply reservoir for the Town of Hillsborough. Construction of the reservoir began in 1999 and was completed in 2000. The drainage area surrounding this lake consists of forested and rural areas with agricultural fields, pastureland and residences. This reservoir was sampled for the first time by DWQ in 2005. DWQ samples four different stations on eight different dates between May and September. Nutrient concentrations were within the usual range for a Piedmont reservoir. Secchi depths ranged from 0.5 to 2.0 meters, indicating fair to good water clarity. Analysis of phytoplankton samples indicated the presence of mild to moderate algal blooms throughout the summer. Although, West Fork Eno River Reservoir is currently Not Rated it appears to be supporting its designated uses at this time based on the limited number of samples analyzed. DWQ will continue to monitor this reservoir for potential changes related to increasing productivity in the future.

1.4.2 Eno River Watershed [AU# 27-2-(1); 27-2-(3.5); 27-2-(7); 27-2-(10); 27-2-(19); 27-2-(19.3); & 27-2-(19.5)]

Eno River Watershed Map (Figure 5)

Current Status

The Eno River [AU# 27-2-(1); WS-II; HQW; NSW], from the source to a point 0.4 miles upstream of Dry Run (2.2 miles) is Supporting aquatic life due to a Good-Fair benthic bioclassification rating at JB4 and an Excellent fish rating at a concurrent fish site JF6. The benthic rating dropped from Good in the last assessment period while the fish rating remained constant over this same time period. The stream bank erosion was classified as moderate while the riparian zone was wide and intact.

Eno River (Corporation Lake, Lake Ben Johnson) [AU# 27-2-(3.5); WS-II; HQW; NSW; CA] from a point 0.4 miles upstream of Dry Run to the dam at Lake Ben Johnson is rated as No Data since DWQ did not collect any samples on this lake during this assessment period.

Eno River [AU# 27-2-(7); C; NSW] from dam at Lake Ben Johnson to Orange County SR 1561 (8.2 miles) is Supporting aquatic life due to a Good fish community bioclassification at site JF7 and JF9.

The Eno River [AU# 27-2-(10); WS-IV; B; NSW (16.2 miles) and AU# 27-2-(19); WS-IV; NSW (1.6 miles)], from Orange County SR 1561 to a point 0.5 miles upstream of City of Durham emergency pumping facility raw water intake is Supporting aquatic life based on a Good (JB6) and a Good-Fair (JB5 and JB7) benthic and an Excellent fish community bioclassification (JF8 and JF5). The benthic ratings at site JB6 and JB7 are down from an Excellent bioclassification in 2000. Site JB5 was assessed for the first time in 2005 and received a Good bioclassification rating. The rating dropped at this site to a Good-Fair in 2006. This site also had the highest conductivity (129 µmhos/cm) during the 2006 evaluation. The Riparian zones were intact but narrow and the stream bank had a few areas of erosion with diverse trees, shrubs, and grasses that provided partial shading at site JB7.

No Criteria were exceeded at the ambient monitoring station JA1. Turbidity levels were above the standard of 50 NTUs in 2 percent of the samples, pH was below the standard of 6 in 4 percent of the samples and fecal coliform bacteria levels were elevated above the 400 CFU/100ml in 14 percent of the samples. Conductivity was also high, with a maximum recorded reading of 293 µmhos/cm.

These sites are down stream from one major and five minor NPDES dischargers. The Hillsborough WWTP (NC0026433) is located approximately four miles above site JB6, discharging into the Eno River. The Orange-Alamance Water System WTP (NC0082759), a minor discharger, is also located seven miles upstream of this site. This facility has had chronic limit violations for total residual chlorine since May 2005. This could potentially be impacting the benthic community in this stretch of the Eno River.

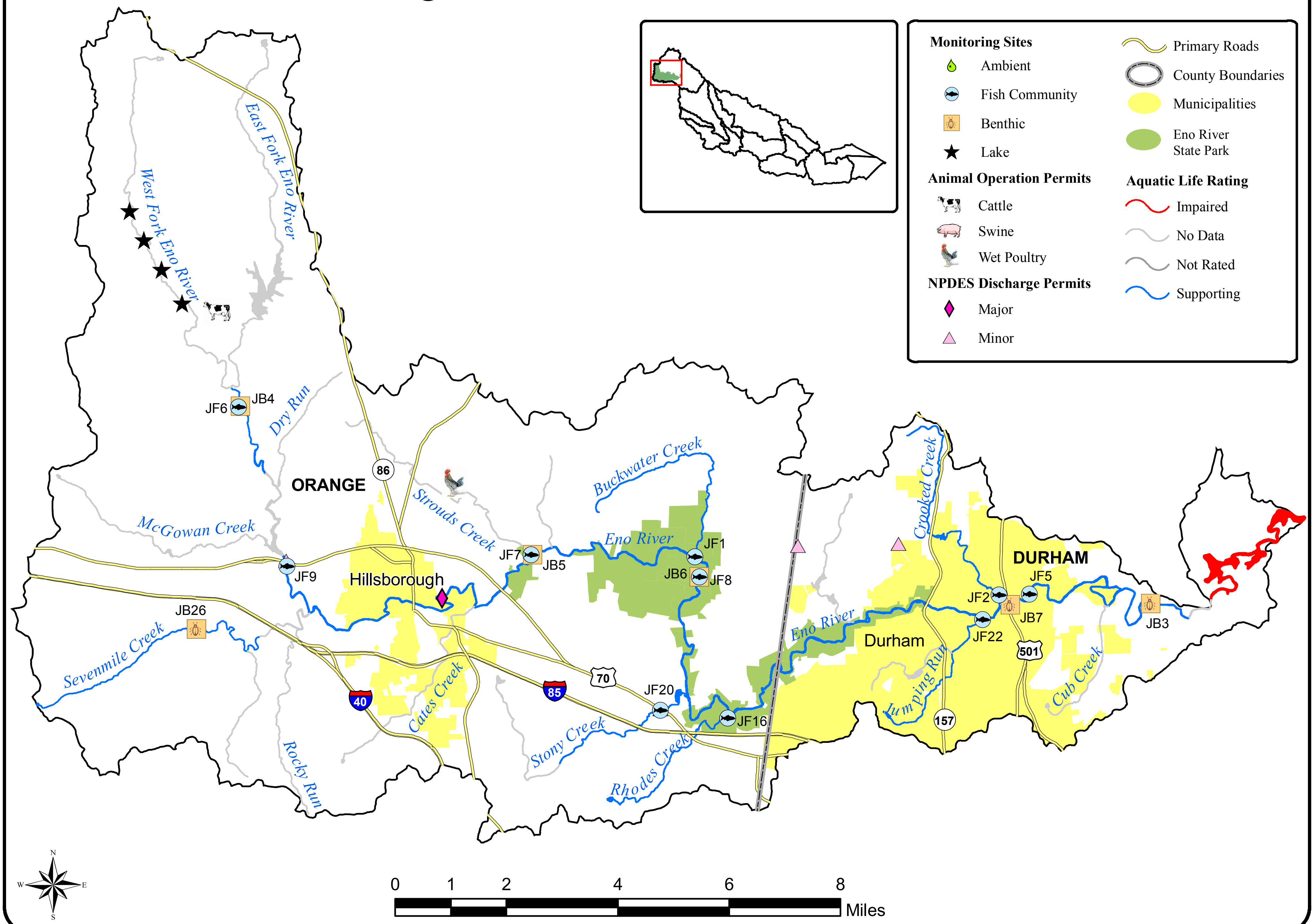
Eno River [AU 27-2-(19.3); WS-IV; CA; NSW] from a point 0.5 miles upstream of Durham emergency pumping facility raw water intake to Durham emergency pumping facility raw water intake (0.4 miles) and the Eno River [AU# 27-2-(19.5); WS-IV; NSW] from the intake to a point 0.5 mile upstream of Little River (4.3 miles) is Supporting aquatic life and recreation due to a Good-Fair benthic community bioclassification at site JB3 and due to No Criteria Exceeded at ambient monitoring station JA2. This site decreased from a Good bioclassification rating during the last assessment period. The Stream banks were stable and the riparian zone appeared to be undisturbed. A more tolerant benthic community was found during this assessment as compared to those found in the past.

Turbidity levels were above the standard of 50 NTUs in 5 percent of the samples, DO was below the standard of 4 mg/l in 2 percent and fecal coliform bacteria were elevated above the 400 CFU/100ml in 16 percent of the samples. Conductivity was also high, with a maximum recorded reading of 450 µmhos/cm.

The second largest sewage spill in the Research Triangle area since 1995 occurred in May 2006 when a 21-inch diameter sewer line failed resulting in 8 million gallons of raw sewage spilling into wetlands and a small creek, which drains into this segment of the Eno River. The spill went undetected for 17 days. DWQ levied a civil penalty on the town for $33,431. It is important for municipalities to perform the required annual inspection on their wastewater systems. This sewer line had not been inspected in nearly two years.

Largemouth bass, sunfish, and catfish samples were collected from the Eno River near Durham during 2003 and analyzed for mercury contamination. These samples were collected as part of an eastern North Carolina mercury assessment. All largemouth bass, (8 of 16 total samples) contained mercury concentrations exceeding the state criteria of 0.4 ppm. Mercury levels in all samples ranged from 0.11 to 1.3 ppm (see the 2006 Basinwide Assessment Report Neuse River http://h2o.enr.state.nc.us/esb/Basinwide/Neuse06BasinReportFinal.pdf for more details). All waters of the state are impaired on an evaluated basis due to a Department of Health and Human Services (DHHS) statewide fish consumption advisory for largemouth bass (see section 1.5.6 for more details).

Figure 5 Eno River Watershed



DWQ biologist ran a special macroinvertebrate study in 2006 and found that every site tested (other than JB6) produced either the lowest or second lowest historic EPT diversity levels, suggesting that the water quality throughout most of the Eno River is declining. This conclusion was particularly pronounced at the lower Eno River locations in central Durham County where historic conductivity trends have been increasing since 1974 and are statistically higher relative to nearby less impacted locations on the Little River (Orange County) and Flat River (northern Durham County) over the same time period (DWQ, Eno River reclassification special study memorandum, July 25, 2006).

Eno River Trend Analysis

DWQ conducted a trends and annual load analysis at several stations throughout the basin. The stations chosen for assessment were those in close proximity to a USGS gauging station. All trends were assessed using flow and seasonal adjustments.

Station JA1 was chosen due to the close proximity of the USGS gauging station (#02085070) at US 501 near Durham. Trends were done on data collected between 1990 and 2000. The analysis included trends on total nitrogen (TN), defined as the sum of total Kjeldahl nitrogen and nitrate-nitrogen, total phosphorus (TP) and temperature. A trend analysis was not possible for TN and TP for the current use support assessment window due to a decrease in nutrient sampling frequency at site JA1 starting in 2001. Care should be taken when interpreting these results since it is not known if this trend has continued, reversed or leveled off after 2000.

The results of the Seasonal Kendell trends analysis indicated that there was a significant decrease in TP concentration in the Eno River at station JA1. The average decrease in TP concentration per year was 0.002 mg/l during the period of 1990 through 2000. This corresponds to a 3.4 percent average decrease in the median TP concentration per year.

No other parameters exhibited a significant trend at this site. Water temperature followed a seasonal cycle, peaking in July and TN concentrations typically peaked in June and November.

Recommendations

Much of the Eno River is being affected by increased stormwater runoff resulting in sedimentation and stream bank erosion as well as increased nutrient loading to the system. The DWQ recommends stream bank protection measures and installation of stormwater BMPs. The new SWCD Community Conservation Assistance Program (CCAP) was developed to focus restoration efforts on stormwater retrofits to existing non-agricultural lands. This program should be utilized in this watershed in order to improve water quality.

The East and West Fork of the Eno were not assessed during this assessment period, however there are two dry litter operations in this area that do not have proper storage for their animal waste. Producers are encouraged to build dry stacks to prevent waste runoff.

Water Quality Initiatives

On the East and West Fork of the Eno, the Orange County SWCD used funds from the NC Foundation of Soil and Water to close one waste impoundment, and six heavy use areas were installed to prevent sediment erosion by the EQIP program. Fifty six acres of cultivated cropland were taken out of production and established into native buffers under the USDA Continuous Conservation Reserve Program (CRP) of CP-33 Upland Bird Habitat Buffers.

The Durham SWCD is partnering with local landowners and the NC Department of Transportation on a bank stabilization project in the Eno River Watershed, north of the river. The District has received a grant for $125,000 to redesign and construct an earthen dam at a neighborhood pond. Flooding and erosion had weakened the pre-existing dam and is a threat to nearby homes and roads. Sediment runoff from the eroded dam was a concern to the Eno River. The project is to be completed spring of 2007.

1.4.3 Sevenmile Creek [AU# 27-2-6-(0.5)]

Current Status

Sevenmile Creek [AU # 27-2-6-(0.5); WS-II, HQW; NSW] from the source to a point 0.4 miles upstream of I-85 (5.8 miles) is Supporting aquatic life due to a Good-Fair benthic community bioclassification at JB26. The rating for this stream remained the same as the 2000 bioclassification. Sevenmile Creek is a tributary to the Eno River just west of Hillsborough (Figure 5). The land cover surrounding this site was mainly forested. The stream banks were stable with diverse trees, shrubs and grasses. The riparian zone was wide and intact.

Water Quality Initiatives

The Orange County SWCD installed 328 linear feet of stock trail, 428 linear feet of livestock exclusion, 1 heavy use area and closed one waste impoundment using funds from the EQUIP program.

1.4.4 Little River Watershed (Little River Reservoir) [AU# 27-2-21-(1), 27-2-21-(3.5) & 27-2-21-(6)]

2002 Recommendations

The Little River Reservoir experiences periodic low dissolved oxygen that may be related to elevated nutrient inputs increasing the potential for algal blooms. DWQ will continue to monitor the lake to evaluate any future degradation in water quality. As the lake is a water supply, Durham should pursue measures to protect the watershed from land use activity that could increase nutrient loading.

Current Status

Little River [AU# 27-2-21-(1); WS-II; HQW; NSW] from source to a point 0.1 mile upstream of Durham County SR 1416 (2.3 miles) and Little River Reservoir [AU# 27-2-21-(3.5); WS-II; CA; HQW; NSW] from SR1416 to the dam at Little River Reservoir (32.4 acres) is Supporting aquatic life and recreational uses due to a Good benthic bioclassification at site JB18 and due to No Criteria Exceedances at ambient monitoring station JA3.

Land cover surrounding the site JB18 was all forest. The instream substrate was moderately embedded. The stream banks were stable with diverse trees, shrubs, and grasses that provided minimal shading with breaks for light penetration. The riparian zone was wide and intact and the instream habitat was limited mostly to rocks and macrophytes.

This site has been rated between Good-Fair and Excellent since it was first sampled in 1989. In 2000, this site received an Excellent bioclassification and in 2005, it received a Good bioclassification. An extremely intolerant stonefly that was common in the 2000 sample was absent in 2005 sample.

No Criteria were exceeded at the ambient monitoring station which is located at the head waters of the reservoir. The Little River Reservoir was noted as having periods of low dissolved oxygen in the past. However, during this assessment period the dissolved oxygen fell below the instantanious state standard of 4 mg/l in 4 percent of the readings with the lowest recorded reading of 3.8 mg/l. Turbidity was elevated in 9 percent of the samples with a maximum recorded value of 120 NTU's. The conductivity was also high with readings ranging from 50 to 160 µmhos/cm.

The fecal coliform bacteria levels were below the state standard; however they were elevated above 400 CFU/100ml in 16 percent of the samples.

Little River [AU# 27-2-21-(6); WS-IV; NSW] from dam at Little River Reservoir to a point 0.9 miles upstream of mouth (6.5 miles) is currently Not Rated. There was only a single sample collected that this location (JA120) during this assessment window. Previously, this segment of the Little River experienced low dissolved oxygen levels.

Little River Trend Analysis
DWQ conducted a trends and annual load analysis at several stations throughout the basin. The stations chosen for assessment were those in close proximity to a USGS gauging station. All trends were assessed using flow and seasonal adjustments.

Station JA3 was chosen due to the close proximity of the USGS gauging station (#0208521324) at SR 1461 near Orange Factory. Trends were done on data collected between 1990 and 2000. The analysis included trends on total nitrogen (TN), defined as the sum of total Kjeldahl nitrogen and nitrate-nitrogen, total phosphorus (TP), total suspended solids (TSS) and temperature. A trend analysis was not possible for TN, TP and TSS for the current use support assessment window due to a decrease in nutrient sampling frequency that site JA3 starting in 2001. Care should be taken when interpreting these results since it is not known if this trend has continued, reversed or leveled off after 2000.

The results indicated that there was a significant decrease in TP concentration in the Little River at station JA3. This trend suggests that the average decrease in TP concentration per year was 0.002 mg/l, which corresponds to an average median TP concentration decrease of 4.8 percent per year during the time period of 1990 through 2000.

In addition to TP, there was also a significant decrease in TSS concentration in the Little River. The average decrease in TSS concentration per year was 0.33 mg/l corresponding to the median TSS concentration decreasing by an average of 4 percent per year during the same time period (1990-2000).

Temperature and TN did not show a significant trend for this time period.

Recommendations
DWQ needs to insure that the sampling frequency at site JA3 (once a month) is maintained so that trend analysis can be done at this station, a minimum of 9 samples/yr are required in order to do tend analysis.

1.4.5 South Flat River [AU# 27-3-3a & 27-3-3b]

2002 Recommendations

DWQ will continue to monitor the South Flat River to evaluate potential impacts from agricultural operations in the watershed as well as from any future development. DWQ will contact Division of Soil and Water Conservation (DSWC) to evaluate the potential for installation of agricultural BMPs that would protect water quality and aquatic habitat in the South Flat River. Because the South Flat River is in a water supply watershed and has noted water quality impacts, the NCWRP has targeted this local watershed. Triangle J Council of Governments has also prioritized this watershed for buffer protection.

Current Status

South Flat River [AU# 27-3-3a; WS-III; NSW] from the source to SR 1009 (3 miles) is Not Rated for aquatic life due to the rating at benthic site JB24. South Flat River [AU# 27-3-3b; WS-III; NSW] from SR 1009 to Flat River (14.2 miles) is Supporting aquatic life due to a Good-Fair benthic (JB25) and a Good fish (JF18) community bioclassification. Site JB24 could not be rated because the watershed drainage area was less than three square miles and can no longer be rated per the current BAUs (Biological Assessment Unit) standard operating procedures. For future basin sampling, site JB25 is replacing JB24. Severe bank failure and erosion characterized occurred at all three sites.

A stressor study was performed in May 2004 and found high nutrient concentrations indicating possible enrichment from fertilizers used on agricultural fields in the area. Analyst noted that there were many agricultural fields observed throughout the small watershed and they appeared to have been freshly planted with crops. Chlorinated pesticides, organophosphate pesticides, and semi-volatile compounds were also found in a sediment sample taken in the headwater of South Flat River. This may also be due to the use of these compounds on agricultural field in the area.

Non-point sources runoff from numerous agricultural fields may also be contributing significant amounts of sediment into the system after rainfall events. All of these stressors can contribute to a lower biological bioclassification or biological impairment.

Recommendations

DWQ would recommend the use of BMP to reduce the amount of runoff from agricultural fields, thereby reducing the amount of nutrients, pesticides and sediment making there way into the stream.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

Water Quality Initiatives

Many agricultural related BMPs have been installed in this watershed over the last several years. These will all help to reduce to amount of nutrients, pesticides and sediment from getting washed into this watershed. See Table 5 for a list of the BMPs installed in this watershed from 2000-2006. These BMPs affected 1,779 acres, saved 7,489 Tons of soil per year, saved 31,464 pounds of nitrogen and 1,093 pounds of phosphorus per year at a cost to the NC ACSP of $130,276. Five acres of Upland Bird Habitat Buffers CP-33 were installed using funds from the USDA Continuous CRP Program.

Table 5 List if Agricultural BMPs installed in the South Flat River watershed between 2000 and 2006.

Number of Acres	Agricultural BMP
42 Acres	3 year conservation tillage
339.2 acres	long term no till
54.6 acres	sod based rotation
90.5 acres	cropland conversion to grass
1,942 feet	diversions
2,297 feet	terraces
15.95 acres	grassed waterway
11.87 acres	field borders
0.1 acre	filter strip
321.8 acres	nutrient management
1	waste impoundment closure

1.4.6 Smith Creek [AU# 27-12-2-(2)]

<u>Current Status</u>

Smith Creek [AU# 27-12-2-(2); WS-III; NSW] from a point 0.5 miles downstream of Granville County SR 1711 to a point 0.4 miles upstream of mouth (5.7 miles) is Supporting aquatic life due to a Good-Fair benthic and fish community bioclassification at sites JB27 and JF19 (Figure 3 and 4). The aquatic communities essentially remained the same since the last assessment done in 2000, suggesting no major change in water quality. There were areas of bank erosion seen, although the riparian zone was broad on both sides of the stream with no obvious breaks.

1.4.7 Beaverdam Reservoir [AU# 27-12-(0.7)]

<u>Current Status</u>

Beaverdam Reservoir [AU# 27-12-(0.7); WS-IV, B; NSW, CA] from the backwaters of Beaverdam Creek Reservoir to the dam at Beaverdam Creek Reservoir (at backwaters of Falls Lake) (974.4 Acres) is Supporting aquatic life based on samples taken at site JL16 (Figure 3 and 4). Beaverdam Lake flows directly into Falls Lake and is used as a back-up water supply for the City of Raleigh. The watershed is composed primarily of urban and forested areas with a state park surrounding much of the reservoir.

Beaverdam Reservoir was monitored by DWQ 42 times at a single location from March 2005 through December 2006. Chlorophyll *a* data was only available between October 2005 and December 2006 (n = 29). This lake was previously monitored by DWQ in 1983.

Of the 29 chlorophyll *a* readings, a single sample was above the state standard of 40 µg/l, however most of the samples collected between March and September 2006 were above 25 µg/l. The overall chlorophyll *a* average for all 29 samples collected was 20.4 µg/l and ranged between 2 and 54 µg/l. Two turbidity reading taken were above and one was at the state standard of 25 NTU in reservoirs. The readings ranged between 6.5 and 31 NTUs, with an average of 14.4 NTU for all 42 samples.

Nutrient concentrations in 2005 were generally high for total phosphorus (range of 0.04 mg/l to 0.08 mg/l), total Kjeldahl nitrogen (range of 0.47 mg/l to 0.92 mg/), and total organic nitrogen (range of 0.46 mg/l to 0.91 mg/l) indicating a potential for biological productivity.

Analyses of phytoplankton samples collected in March, July and October of 2005 indicated low assemblages of diatoms in March. Diatoms are adapted to cooler waters and low light and are generally considered beneficial. Blue-green algae blooms were found in July and October. The blue-green algae blooms were most severe in July and consisted of the blue-green alga *Cylindrospermopsis*. Blue-green algae can discolor water and cause taste and odor problems and are common indicators of eutrophication. Some taxa, including *Cylindrospermopsis* may produce toxins, although there have been no known adverse effects associated with blue-green algal toxins reported in these waters. An increase in euglenoids was also found in October that indicates organic enrichment and stagnant conditions due to the low flow conditions present in the fall of 2005.

Beaverdam Reservoir continues to support its designated uses.

1.4.8 New Light Creek [AU# 27-13-(0.1)]

2002 Recommendations
DWQ will continue to monitor New Light Creek to evaluate potential impacts from agricultural operations in the watershed as well as any future development. DWQ will contact Division of Soil and Water Conservation (DSWC) to evaluate the potential for installation of agricultural BMPs that would protect water quality and aquatic habitat in New Light Creek. New Light Creek is a NCWRP targeted local watershed.

Current Status
New Light Creek [AU# 27-13-(0.1); WS-IV; NSW], from the source to Wake County SR1911 (1.8 miles), is Supporting aquatic life due to a Good-Fair benthic (JB21 and JB22) and Good fish community bioclassification (JF15). The rating at station JB22 decreased from a Good bioclassification rating in 2000 and 2001 to a Good-Fair in 2005. At station JB22 the instream habitat is sparse with only a few riffle areas and eroded stream banks. There is an agricultural field within 12 meters of the left bank and the stream was very turbid in this area. Stations JB21 and JF15 are located in the Falls Lake Gamelands resulting in a better instream habitat, however despite an extensive riparian corridor at this location, the canopy was open in this part of the stream.

Recommendations
DWQ should continue to sample this stream during the next assessment period in order to assess changes occurring in this watershed.

Additional monitoring of New Light Creek including physical and biological, may be implemented with the Wake County 319 project (Fall Lake Watershed Management Plan).

Water Quality Initiatives
A single heavy use area protection BMP was installed within this predominately agricultural watershed. This is an area that is intensively used by animals and has undergone surface stabilization using suitable materials to improve water quality. This was a $2,637 Agriculture Cost Share Program funded project which affected 8 acres and saved 40 tons of soil erosion per

year. Several agricultural BMPs have been installed over the last 20 years. These systems include intensive grazing systems, critical area plantings, waterers, and nutrient management.

1.4.9 Horse Creek [AU# 27-17-(0.7)]

Current Status
Horse Creek [AU# 27-17-(0.7); WS-IV; NSW] from a point 0.3 miles upstream of Franklin County SR 1139 to a point 0.1 miles downstream of Wake County SR1923 (6.0 miles) is Supporting due to a Good-Fair benthic and a Good fish community bioclassification at JB10 and JF10 (Figure 3 and 4). This watershed is mostly forested and has an intact riparian zone that is a minimum of 12 meters wide. The stream channel is deeply entrenched with steep and eroding banks. Horse Creek declined from Good to Fair after Hurricane Fran in 1996, however this benthic site improved to Good-Fair in 2001. The fish assessment was done for the first time in 2004. This site supported a diverse assemblage of fish, represented by 25 different species and the community was rated Good.

Recommendations
DWQ should collect a benthic sample at this location during the next assessment period to assess the changes occurring in this watershed.

Additional monitoring of New Light Creek including physical and biological, may be implemented with the Wake County 319 project (Fall Lake Watershed Management Plan).

1.4.10 Unnamed Tributary at Camp New Life [AU# 27-20.5-(2) UT1 & 27-20.5-(3)

Current Status
Unnamed Tributaries at Camp New Life (UT to Falls Lake) at Bentham Driver [AU# 27-20.5-(2) UT1; WS-IV, NSW] and SR 2002 [AU# 27-20.5-(3); WS-IV, CA, NSW] are currently Not Rated for aquatic life. These streams could not be rated at this time because currently DWQ assessment techniques do not permit assigning a bioclassification to Piedmont streams with a drainage area of less than three square miles (other than Not Impaired or Not Rated). These sites were assessed in August of 2002 and 2005 as well as in January of 2006. The results fluctuated between the 2002 and 2005 assessment but returned to similar 2002 levels in 2006.

The stream at site JB30 (Bentham Dr.) is very shallow and narrow and has a watershed area of 0.98 square miles. This site is above the City of Raleigh's EM Johnson WTP outfall. Sediment from eroding banks filled the channel. There was a high degree of embeddedness and a limited amount of instream habitat. The riparian zone on the western stream bank has been altered. These alterations may have contributed to runoff and the sedimentation problems seen at this site. The macroinvertebrate community has been rather stable, though somewhat pollution tolerant.

Site JB31 (SR2002) is 1.5 mile downstream of the Bentham Drive site JB30 and is also downstream of the unnamed tributary in which the EM Johnson WTP discharges to. The stream at this site is deeper and wider and has an increased flow consistent with the larger drainage area of 1.35 square miles. The banks appear more stable and the riparian zone was very healthy. There was a greater diversity of instream habitat found at this site, however it did not correlate with added benthic diversity or a healthier benthic community. Extremely low densities of aquatic macroinvertebrates were observed here in 2006. This site had many more species and a greater overall density in August of 2005. The dramatic decline in a 5 month period is concerning, however the 2006 values were similar to those in 2002. The decline could possibly have been due to drought conditions experienced in this part of the watershed in the fall and winter of 2005 and early 2006. The habitat scores for both sites were indicative of suburban environments.

Bank pins were installed on this segment of the creek in the summer 2005. Initial data shows evidence of bank erosion, with additional evidence of mass wasting. Early data shows 25 tons per 100 linear feet. It is likely that additional monitoring, including physical and biological, perhaps more, will be implemented with the Wake County 319 project (Falls Lake Watershed Management Plan).

The Raleigh EM Johnson WTP (NC0082376) began monitoring for whole effluent toxicity (WET) in September of 2002. The facility's effluent produced toxicity at its target discharge concentration (90 percent) in 17 of 27 tests through August of 2006. Many failures appeared to have been associated with total residual chlorine. The facility implemented effluent dechlorination in 2004. The facility also identified a polymer associated with operation of its filter press as a source of toxicity. That filter press effluent is now discharged to the sanitary sewer system. The facility has passed its most recent tests, dating from May 2005. As of February 2006, the facility began to recycle its filter backwash. This results in wastewater discharge to this creek for only about two weeks per year. WET testing will occur during these discharges events. It is recommended that a WET test limit be incorporated into the next NPDES permit.

A review of the effluent data indicated an elevated level of manganese in excess of 200 µg/l, which is the water quality standard for water supply waters. It is recommends that a manganese effluent discharge limit be added to the next NPDES permit which will be renewed in 2008. An instream monitoring study in 2002 found that samples collected downstream from the discharge site had a concentration of manganese at 1,400 µg/L, which was 21.5 times higher than the upstream sampling site (65µg/L). If this downstream concentration was readily bioavailable, it could potentially cause chronic toxicity to aquatic organisms. Several other downstream metal concentrations were elevated over upstream values, including copper, calcium, magnesium and sodium.

A sediment study was also done at these two sites in January 2006. This study is a component of DWQs watershed toxicity assessment panel, which includes a suite of toxicity assays employing multiple organisms and endpoints to assess potential toxicity to aquatic organisms in water column and sediment matrices. The results from this study indicate that there is a significant increase in sub-lethal toxicity at the downstream sediment collection site relative to the upstream site. Ambient water column samples did not result in acute toxicity at either of these two sites on this date.

The Raleigh Regional Office did an inspection of the facility in August of 2006 as result of a citizen complaint concerning a substance covering the rocks downstream of the facility. The substance covering the rocks was determined to be a naturally occurring biofilm. This does not necessarily indicate a water quality problem; however it could indicate an unnatural balance of the chemical constituents in the aquatic environment.

Recommendations
As stated above, it is recommended that manganese and WET limits are added to the NPDES permit when renewed in 2008. These will assure the continual improvement of the aquatic organism in the receiving stream.

Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in the in Chapter 12 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

1.5 Additional Water Quality Issues and Information within Subbasin 03-04-01

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 several water quality initiatives that are occurring within this basin to preserve, protect and improve water quality. Surface waters identified as having Excellent bioclassification, are also discussed and are eligible for reclassification to a High Quality Water (HQW) or and Outstanding Resource Water (ORW). These classifications allow for additional water quality protections. For more information about water quality standards and reclassification, see Chapter 15.

1.5.1 Water Quality Threats to Streams in Urbanizing Watersheds

Many of the streams in this subbasin that are not already impaired from urban stormwater runoff are threatened by development pressure throughout this subbasin. In order to prevent aquatic habitat degradation and impaired biological communities, protection measures must be put in place immediately. For recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas see Chapter 12 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

1.5.2 Upper Neuse Watershed Management Plan

The Upper Neuse River Basin Association (UNRBA) has developed a watershed management plan that would help protect all waters in subbasin 03-04-01 from the increasing potential for sediment and nutrient impacts.

The UNRBA is a local partnership which includes 13 of the 14 local governments with land area in the watershed, county Soil and Water Conservation Districts and South Granville Water and Sewer Authority. If implemented, the plan would help protect the quality of the drinking water reservoirs, surface waters, and aquatic habitats in the Upper Neuse Basin.

In order to protect these resources, the plan recommends five types of watershed management techniques:

1. New development site management strategies to control the quality and amount of water running off future development sites.

2. Monitoring and enforcement strategies to ensure proper system performance and gauge how well the management techniques are working.
3. Education and citizen stewardship programs to increase awareness of and participation in watershed management efforts.
4. Management and control of point sources to upgrade existing wastewater treatment facilities and to phase out older facilities.
5. Restoration planning to restore the natural functions and characteristics of impaired water bodies.

UNRBA is in the process of developing a detailed implementation plan describing the roles and responsibilities of UNRBA members and partners and area of the basin where particular management strategies are most urgently needed. For information on the Upper Neuse Watershed Management Plan see website at http://www.unrba.org/mgmtplan.htm.

1.5.3 Upper Neuse Clean Water Initiative

Overview of the Upper Neuse Clean Water Initiative:
The Upper Neuse Clean Water Initiative is a partnership effort to prioritize and, through voluntary actions, protect those lands most critical for the long-term safety and health of all drinking water supplies for the communities in the Upper Neuse River Basin (UNRB). The project prioritized lands that meet water supply protection goals, but also considers local land conservation goals, such as recreation and natural lands protection, as well as stormwater retention.

The Initiative has three major components: comprehensive conservation planning; outreach to landowners, local governments, and the public; and acquisition through the purchase or donation of land or conservation easements from willing sellers of properties identified in the plan as high priority. Land conservation provides a voluntary, non-regulatory option for protecting water supplies and is one of the most cost-effective tools for ensuring safe drinking water.

Conservation Planning Methods and Results:
With funds from the City of Raleigh and other partners, Triangle J Council of Governments (TJCOG), in collaboration with The Trust for Public Land (TPL), used Geographic Information System (GIS) technology and computer modeling to identify properties within the UNRB that offer the greatest protection value for the Basin’s water quality. TPL and TJCOG assembled a Technical Advisory Team of local experts in water quality, water resources management, and GIS to help develop and weight model criteria and identify the highest quality data. The final model included data on land use cover, hydrology, elevation, headwater catchments, parcel data, groundwater wells, vertical hydraulic conductance, critical catchment areas, and soil type. Priority tracts are typically found along streams or water bodies, at headwater areas, and/or contain wetland areas. Because the model considers parcels throughout the 770 square mile Basin and considered all of the Basin’s nine drinking water supplies equally, the priority parcels are scattered throughout the Basin. For more detailed information and specific parcel priorities, contact Conservation Trust for North Carolina at (919) 828-4199 or www.ctnc.org.

Local governments, land trusts, watershed associations and others have been working for years to conserve sensitive lands in the Upper Neuse River Basin. As a result of these efforts, over 50,000 acres of land have been permanently protected (as of 5/06) which are park lands and nature preserves; lands managed for preservation by local/regional land trusts; and privately owned lands protected by conservation agreements. Of UNRB lands not already protected, the model identified approximately 24,000 acres as high priority for conservation to protect water quality. Together, these high-priority acres represent fewer than 5 percent of the Upper Neuse River Basin.

Continuing their collaborative work, state and local government programs, the Ellerbe Creek Watershed Associations, Upper Neuse River Basin Association, Eno River Association, Tar River Land Conservancy, Triangle Greenways Council, Triangle Land Conservancy, Trust for Public Land, willing landowners, and other critical partners utilize a variety of conservation options including conservation easements/agreements, fee-simple purchase, donations, bargain sales, etc to protect the Upper Neuse water resources.

Due to population growth and development however, the opportunities for protecting these priority tracts may be short-lived. Most experts agree there is a threshold ratio of impervious surface to natural land which, when crossed, results in a measurable decline in water quality in the watershed. Many believe the threshold occurs when the watershed is 10 percent impervious. Based on the region's current rate of population growth, more than one-third of the sub-watershed in UNRB will exceed the 10 percent threshold by 2025.

Additionally, a report released by Triangle Green Print Project (2002), the current rate of land protection in the region must double to increase protected land from 8 percent to a region-wide goal of 15 percent within 25 years.

Current status of the Upper Neuse Clean Water Initiative:
Since the inception of the Upper Neuse Clean Water Initiative, 17,000 acres and 17 miles of streams that drain to area reservoirs have been preserved. They are currently negotiating the purchase of another 26 tracts which would preserve and additional 3,900 acres along more than 39 miles of streams.

For a copy of the plan and additional information on the Upper Neuse Clean Water Initiative please go to: http://www.ctnc.org/site/PageServer?pagename=prot_upperneuse.

1.5.4 Riparian Corridor Conservation Program

An additional source of information on the Basin's land conservation priorities are riparian corridor conservation plans. The Clean Water Management Trust Fund (CWMTF) – Conservation Trust for North Carolina (CTNC) Riparian Corridor Conservation Program facilitates the identification and establishment of integrated networks of protected areas and forested riparian corridors. More specifically, the program involves pass through funding from CWMTF, through CTNC, to the state's 24 local and regional land trusts to develop conservation plans with detailed analysis of a defined project area and prioritization of waterfront parcels for protection and restoration based on each property's impacts on water quality in a targeted stream segment. Additionally the program funds implementation of existing plans in which land trusts undertake landowner outreach, education (often in the form of workshops), easement negotiations, acquisition negotiations and other recommendations laid out in previously established riparian corridor conservation plans. This statewide coordinated effort to protect and restore riparian buffers and greenways represents one of the most cost-effective and long-term means of protecting water quality.

Riparian Corridor Conservation Plans developed thus far in the Upper Neuse River Basin include:

- Upper and Lower Eno River watershed– written by the Eno River Association (919) 620-9099
- Little River watershed (Orange & Durham Counties) - written by the UNRBA on behalf of the Eno River Association (919) 620-9099
- Upper Neuse River Basin – written by Triangle Greenways Council (www.trianglegreenways.org).

1.5.5 Falls Lake Nutrient Management Strategy Overview

Background

In 2005 the NC General Assembly passed Senate Bill 981, which tasks the Environmental Management Commission (EMC) to develop and implement a Nutrient Management Strategy (NMS) for certain drinking water supply reservoirs that are impaired or that may become impaired within five years of adoption of the bill. Based on water quality data collected between 2002 and 2006, Falls Lake will be listed on the EPA 303(d) list in 2008 for chlorophyll *a*. The portion of the lake above I-85 will also be listed for turbidity. The current deadline for adoption of the Falls Lake NMS is July 2009 as established in Session Law 2006-250. However in light of the lengthy modeling process required and to allow adequate time for a public stakeholder process, DWQ met with the sponsors of the original bill in late 2007 and early 2008 to discuss the need to extend the timeline. In November 2008 DWQ submitted a request to the North Carolina General Assembly to extend the deadline for EMC adoption of the strategy to September 2010.

Modeling Plan

A Falls Lake Technical Advisory Committee (TAC) was formed in July 2005. The role of the TAC was to assist DWQ with the development of mathematical tools for the management of nutrients in Falls Lake including review and modification of the monitoring strategy and developing levels of confidence for decision making associated with the monitoring and modeling activities conducted to develop the TMDL. The field study data collection process was completed in the fall of 2007. Development of the lake and watershed model was started in January 2007 and completed by DWQ staff in November 2008. The output of the watershed model is currently being reviewed by the TAC and is scheduled to be presented to the stakeholders in January 2009. The lake model is scheduled for completion by February 2009.

Stakeholder Process

A stakeholder process began in August 2008 and is scheduled to include eleven meetings that will run through October 2009. This process will provide a comprehensive stakeholder group the opportunity to work with the DWQ in developing the nutrient management strategy for Falls Lake and its watershed. This collaboration will provide stakeholders and DWQ staff the opportunity to exchange ideas on how to best develop and implement a successful nutrient management strategy for Falls Lake. In addition to addressing specific questions and/or concerns from individual stakeholders, this process will provide a public forum to do the following:

- Discuss the results from the modeling process
- Receive input on stakeholder interests and expectations
- Develop alternatives and preferred solutions identified by the stakeholders

- Receive input from stakeholders on the potential nutrient reduction rules, fiscal analysis data, and accounting tool development
- Incorporate stakeholder advice and recommendations into the decision making process to the maximum extent possible

Rulemaking Process

- Draft rule text (coincides with the stakeholder process)
- Draft fiscal analysis (overlaps with the stakeholder process)
- Take draft rules and fiscal analysis to WQC and EMC for approval to go to public comment
- Public Comment Period
- EMC Hearing Officers Deliberate
- Take rules to EMC for approval
- Approved rules go to Rules Review Commission (RRC)
- Rules are adopted unless the RRC receives ten or more letters contesting the rules
    - If ten or more letters are received by the RRC then the rules go to the N.C. General Assembly for further consideration

Potential Rules

Although the specific rules that will eventually be developed are dependent upon the outcomes of the modeling and stakeholder process, the nutrient management strategy will in all likelihood address point and nonpoint sources of nutrients into the Falls Lake watershed. The framework and accounting tools will be similar to those used in the current Neuse nutrient reduction strategy and may include:

- New development stormwater nutrient export goals
- Existing development stormwater controls
    - Stormwater retrofits for existing development
    - Pet waste program
    - Residential fertilizer application education outreach program
- Reductions in effluent nutrient loads from wastewater treatment plants
- Load reductions from agricultural practices

1.5.6 Mercury Contamination – Fish Tissue Assessment

The DWQ 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.

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. For more information about DHHS fish consumption advisories go to http://www.epi.state.nc.us/epi/fish/current.html.

1.5.7 ORW reclassification of Deep Creek [AU# 27-3-4] and Rocky Fork Branch [AU# 27-3-4-1]

Deep Creek [AU# 27-3-4; WS-III; NSW] from source to Flat River (16.3 miles) is currently Supporting aquatic life due to a Good benthic (JB1) and an Excellent fish community bioclassification (JF3). Stream banks were stable with some erosional areas present at site JB1. This stream has been rated either Excellent or Good since first sampled for benthos in the spring of 1990. However, since July 1995 this site has received a Good bioclassification. No major changes in water quality have been indicated since 1995. EPT taxa richness has been similar for the 1995, 2000, and 2005 samples collected at this site.

The high quality watershed characteristics associated with the fish site qualifies it as a regional fish community reference site. This is the fourth time in which this stream site (JF1) has been rated Excellent based on its fish community. Deep Creek was classified to Outstanding Resource Water (ORW), based on these four Excellent fish community ratings.

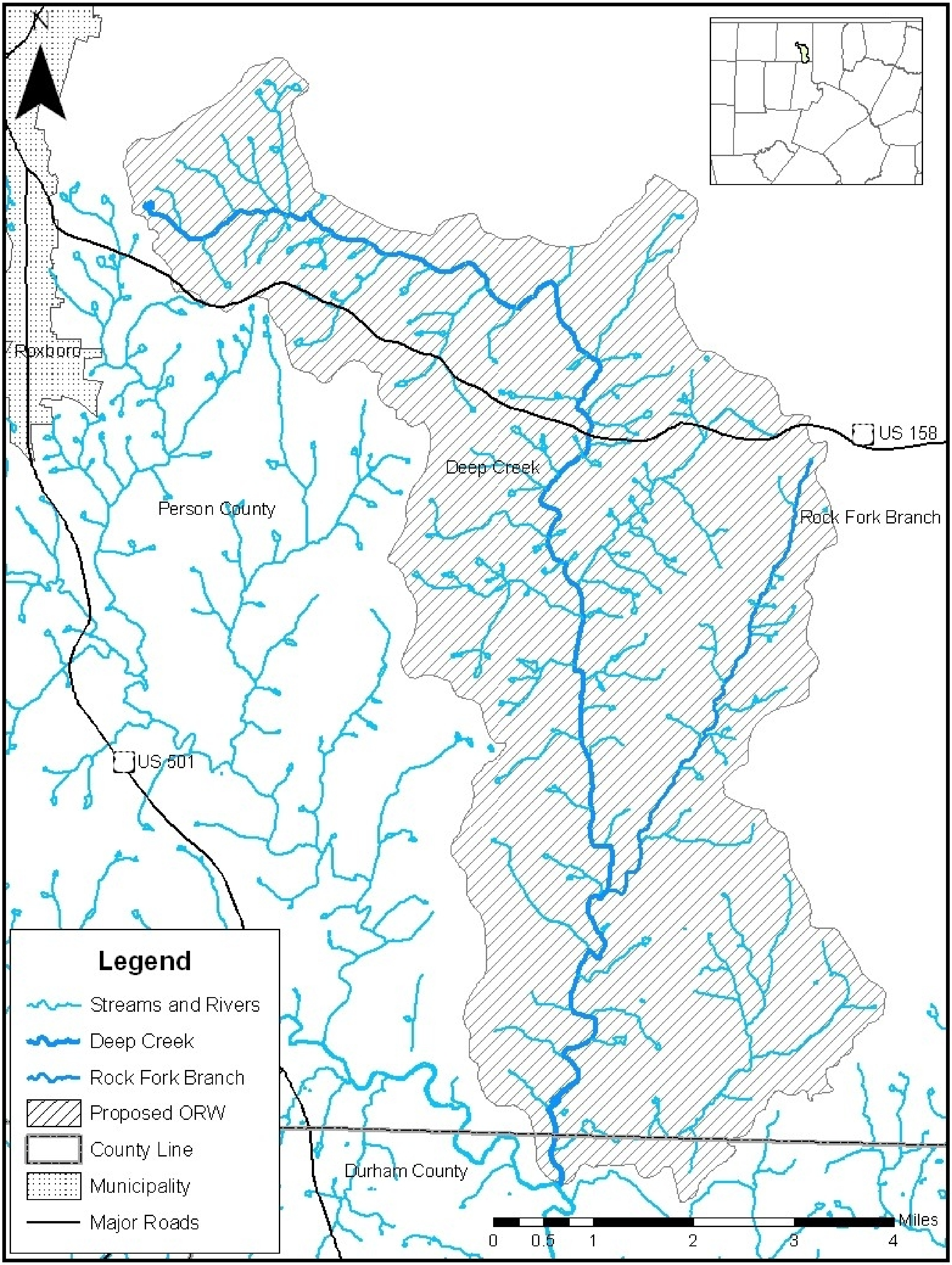
The Deep Creek watershed reclassification was from Water Supply-III (WS-III), Nutrient Sensitive Waters (NSW) to WS-III, Outstanding Resource Waters (ORW), and NSW. The reclassification consists of the entire watershed of Deep Creek, from its source to Flat River including Rocky Fork Branch (Figure 6).

The ORW reclassification area is relatively undeveloped and mostly forested with a small amount of pastureland, row crops and residences. The reclassification area measures approximately 23,660 acres and approximately 22 miles of named stream length.

The ORW supplemental classification is a designation intended to protect unique and special waters having excellent water quality and being of exceptional state or national ecological or recreational significance. The lower reaches of the Deep Creek watershed (from its mouth to SR 1734) are included in the North Carolina Natural Heritage Program's Flat River Aquatic Habitat, a state-significant site that is home to rare and endangered mussels, amphibians and fish (NCDEHNR, 1993). The fish site JF3 also serves as a DWQ fish community regional reference site because of the high quality instream and riparian habitat characteristics.

In November 2006, DWQ staff received permission from the NC EMC to proceed to public hearing on the Deep Creek watershed ORW reclassification. The reclassification was then approved by the NC EMC in September 2007 and took effect November 1, 2007.

Deep Creek Proposed ORW, Neuse River Basin



27-3-4_ProposedORWBW

Created June 23, 2006

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

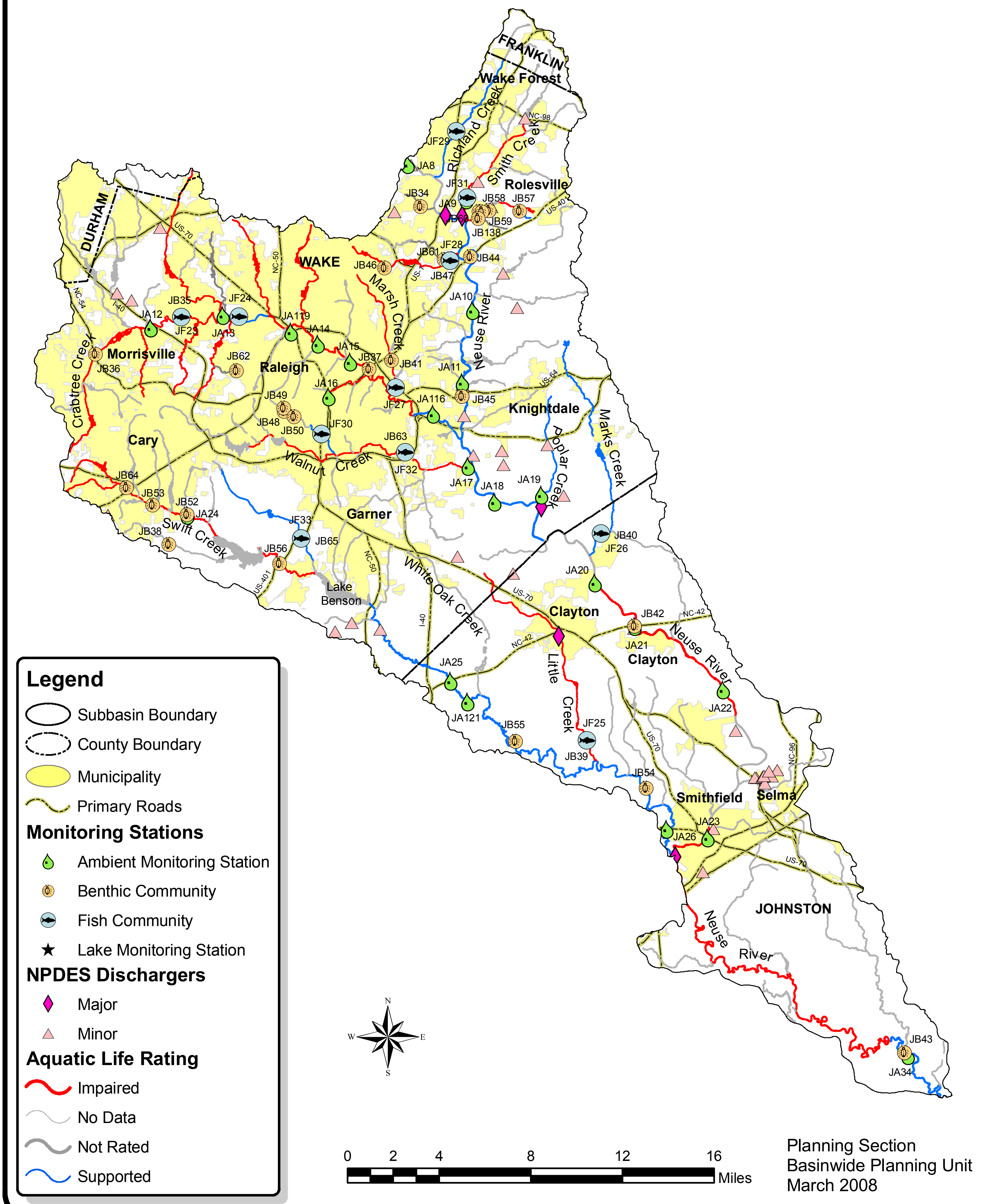
Total Streams:	511.8 mi/1860.6 ac
Total Supporting:	100.5 mi
Total Impaired:	151.1 mi
Total Not Rated:	2.0 mi/0.0 ac
Total No Data:	249.9 mi

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



Watershed (WBD-10 Number) 0302020107 Milburnie Lake-Neuse River

Subwatershed (WBD-12 Number) 030202010701 Richland Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-21-(1.5)	**Richland Creek**	From Wake-Franklin County Line to Neuse River	WS-IV;NSW	03-04-02	6.3 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1

Subwatershed (WBD-12 Number) 030202010702 Smith Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-23-(2)	**Smith Creek**	From dam at Wake Forest Reservoir to Neuse River	C;NSW	03-04-02	5.8 FW Miles	5	**Ammonia** WWTP NPDES **Habitat Degradation** Construction MS4 NPDES WWTP NPDES	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
								Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Aquatic Life	Impaired	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005	2008	5
								Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Subwatershed (WBD-12 Number) 030202010704 Perry Creek-Neuse River

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(20.7)	**NEUSE RIVER**	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	2		Aquatic Life	Not Rated	Data Inconclusive	Iron	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
27-(22)ut1	**UT1 to NEUSE RIVER**	From source to Neuse River	WS-IV;NSW,CA	03-04-02	1.6 FW Miles	3a		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2005		3a
27-(22.5)	**NEUSE RIVER**	From Town of Wake Forest proposed water supply intake to mouth of Beddingfield Creek	C;NSW	03-04-02	22.6 FW Miles	2		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
								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
27-24a1	**Toms Creek (Mill Creek)**	From source to Browns Lake	C;NSW	03-04-02	1.6 FW Miles	5	**Habitat Degradation** MS4 NPDES WWTP NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-24aut2 From source to Toms Creek C;NSW	**UT2 to Toms Creek (Mill Creek)**	03-04-02	0.7 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2001		1
27-24b From Browns Lake to Neuse River C;NSW	**Toms Creek (Mill Creek)**	03-04-02	1.5 FW Miles	**5**	**Chlorine** WWTP NPDES **Habitat Degradation** Construction MS4 NPDES WWTP NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5
27-24but4 From source to Toms Creek C;NSW	**UT4 to Toms Creek (Mill Creek)**	03-04-02	1.7 FW Miles	**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2001		3a
27-25-(1) From source to dam at Greshams Lake B;NSW	**Perry Creek (Greshams Lake)**	03-04-02	2.4 FW Miles	**5**	**Habitat Degradation** Impoundment	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	1996	1998	5
27-25-(2) From dam at Greshams Lake to Neuse River C;NSW	**Perry Creek**	03-04-02	2.5 FW Miles	**5**	**Habitat Degradation** MS4 NPDES **Low Dissolved Oxygen** MS4 NPDES **Low pH** **Nutrient Impacts** MS4 NPDES	Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
						Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5
27-25-3-(2) From dam at Camp Durant to Perry Creek C;NSW	**Unnamed Tributary near Neuse**	03-04-02	2.1 FW Miles	**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2004		3a

Watershed (WBD-10 Number) 0302020108 Crabtree Creek

Subwatershed (WBD-12 Number) 030202010801 Upper Crabtree Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-33-(1) From source to backwaters of Crabtree Lake C;NSW	**Crabtree Creek**	03-04-02	5.1 FW Miles	**5**	**Habitat Degradation** MS4 NPDES WWTP NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5

Table 6 Neuse River Basin — Subbasin (WBD-8 Number) 03020201 — DWQ Subbasin 03-04-02

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-33-(3.5)a	**Crabtree Creek (Crabtree Lake)**	From backwaters of Crabtree Lake to Cary WWTP	B;NSW	03-04-02	6.8 FW Miles	5	**Low Dissolved Oxygen**; **PCB**: Industrial Site; **Turbidity**: MS4 NPDES	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
								Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2008	5
								Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	1994	1998	4s
								Fish Consumption	Impaired	Standard Violation	PCB	2006	2008	5
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
27-33-4	**Brier Creek**	From source to Crabtree Lake, Crabtree Cr.	C;NSW	03-04-02	6.5 FW Miles	5	**PCB**: Industrial Site	Fish Consumption	Impaired	Standard Violation	PCB	2006	2008	5
27-33-4-1	**Little Brier Creek**	From source to Brier Creek	C;NSW	03-04-02	5.3 FW Miles	5	**PCB**: Industrial Site	Fish Consumption	Impaired	Standard Violation	PCB	2006	2008	5
27-33-5	**Black Creek**	From source to Crabtree Lake, Crabtree Cr.	C;NSW	03-04-02	3.6 FW Miles	5	**Habitat Degradation**: MS4 NPDES; **Toxic Impacts**: MS4 NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2000	1998	5

Subwatershed (WBD-12 Number) 030202010802 — Turkey Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-33-9	**Sycamore Creek (Big Lake)**	From source to Crabtree Creek	B;NSW	03-04-02	61.8 FW Acres	5		Aquatic Life	Impaired	Data Inconclusive	Aquatic Weeds	1998	1998	5
27-33-9-2	**Turkey Creek (Lake Ann)**	From source to Sycamore Creek	B;NSW	03-04-02	3.6 FW Miles	3a		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2000		3a

Subwatershed (WBD-12 Number) 030202010803 — Middle Crabtree Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-33-11	**Richlands Creek**	From source to Crabtree Creek	C;NSW	03-04-02	4.7 FW Miles	5	**Habitat Degradation**	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	1996	2004	5
27-33-11ut3	**UT3 to Richlands Creek**	From source to Richlands Creek	C;NSW	03-04-02	1.4 FW Miles	3a		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2004		3a

Assessment Unit Number / Description / Classification / DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-33-12-(1) From source to dam at Lake Lynn B;NSW 03-04-02	**Hare Snipe Creek (Lake Lynn)** 2.0 FW Miles	5	**Habitat Degradation**	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2000	1998	5
27-33-12-(2) From dam at Lake Lynn to Crabtree Creek C;NSW 03-04-02	**Hare Snipe Creek** 2.5 FW Miles	5	**Habitat Degradation**	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2000	1998	5
27-33-14a From source to Shelly Lake C;NSW 03-04-02	**Mine Creek** 3.3 FW Miles	5	**Habitat Degradation**	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	1995	1998	5
27-33-14b FromShelly Lake to Crabtree Creek C;NSW 03-04-02	**Mine Creek** 1.5 FW Miles	5	**Habitat Degradation**	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2000	1998	5
27-33-8 From source to Crabtree Creek B;NSW 03-04-02	**Reedys Creek (Reedy Creek Lake)** 28.8 FW Acres	5		Aquatic Life	Impaired	Data Inconclusive	Aquatic Weeds	1998	1998	5
27-33-(3.5)b From Cary WWTP to mouth of Richlands Creek B;NSW 03-04-02	**Crabtree Creek (Crabtree Lake)** 5.4 FW Miles	5	**Chlorine** WWTP NPDES **Habitat Degradation** MS4 NPDES **Nutrient Impacts** MS4 NPDES **Turbidity** MS4 NPDES	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
				Aquatic Life	Supporting	No Criteria Exceeded	Low Dissolved Oxygen	2006	1998	2t
				Aquatic Life	Impaired	Standard Violation	Turbidity	2006	1998	5
				Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2004		1
				Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
				Fish Consumption	Impaired	Standard Violation	PCB	2006	2008	5
				Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
27-33-(10)a From mouth of Richlands Creek to Hairsnipe Creek C;NSW 03-04-02	**Crabtree Creek** 2.0 FW Miles	5	**PCB** Industrial Site	Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
				Fish Consumption	Impaired	Standard Violation	PCB	2006	2008	5

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-33-(10)b Crabtree Creek From mouth of Hairsnipe Creek to 2.75 miles upstream of Neuse River C;NSW 03-04-02 10.9 FW Miles	5	**Fecal Coliform Bacteria** MS4 NPDES **Habitat Degradation** MS4 NPDES WWTP NPDES **PCB** Industrial Site **Turbidity** MS4 NPDES	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
			Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2004	5
			Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	4s
			Fish Consumption	Impaired	Standard Violation	PCB	2006	2008	5
			Recreation	Not Rated	Potential Standards Violation	Fecal Coliform (recreation)	2006		3a

Subwatershed (WBD-12 Number) 030202010804 Lower Crabtree Creek

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

Watershed (WBD-10 Number) 0302020110 Swift Creek

Subwatershed (WBD-12 Number) 030202011001 Lake Wheeler-Swift Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-43-(1)a	**Swift Creek**			5	**Habitat Degradation**	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									
27-43-(1)b	**Swift Creek**			5	**Habitat Degradation**	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)					Impoundment	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2001	1998	5
WS-III;NSW		03-04-02	5.5 FW Miles		MS4 NPDES	Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
					Low Dissolved Oxygen	Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
					Nutrient Impacts							
					MS4 NPDES							
					WWTP NPDES							
					Toxic Impacts							
					MS4 NPDES							
					Turbidity							
					MS4 NPDES							
27-43-2	**Williams Creek**			5		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									
					Subwatershed (WBD-12 Number) 030202011002				**Lake Benson-Swift Creek**			
27-43-5-(1.5)	**Unnamed Tributary to Swift Creek (Yates Mill Pond)**			2		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						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2004		1
WS-III;NSW		03-04-02	6.2 FW Miles									
27-43-(1)d	**Swift Creek**			5	**Habitat Degradation**	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					Impoundment							
WS-III;NSW		03-04-02	2.4 FW Miles		MS4 NPDES							
27-43-(5.5)a	**Swift Creek (Lake Benson)**			5	**Habitat Degradation**	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					Impoundment							
WS-III;NSW,CA		03-04-02	0.9 FW Miles		MS4 NPDES							
27-43-(5.5)b	**Swift Creek (Lake Benson)**			2		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**			

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-43-(8) From dam at Lake Benson to Neuse River; C;NSW	**Swift Creek**	03-04-02	32.7 FW Miles	2		Aquatic Life	Not Rated	Data Inconclusive	Iron	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
Subwatershed (WBD-12 Number) 030202011005 Little Creek												
27-43-12 From source to Swift Creek; C;NSW	**Little Creek**	03-04-02	11.4 FW Miles	5	**Habitat Degradation** Stormwater Runoff	Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
						Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5
Watershed (WBD-10 Number) 0302020111 Walnut Creek-Neuse River												
Subwatershed (WBD-12 Number) 030202011101 Walnut Creek												
27-34-(1.7) From dam at Lake Johnson to backwaters of Lake Raleigh; C;NSW	**Walnut Creek**	03-04-02	1.4 FW Miles	5	**Habitat Degradation**	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity FishCom	1995	1998	5
27-34-(4)a From dam at Lake Raleigh to UT 0.6 miles west of I-440; C;NSW	**Walnut Creek**	03-04-02	6.4 FW Miles	5	**Habitat Degradation** MS4 NPDES	Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
						Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5
27-34-(4)b From UT 0.6 miles west of I-440 to Neuse River; C;NSW	**Walnut Creek**	03-04-02	3.7 FW Miles	5	**Turbidity** MS4 NPDES	Aquatic Life	Not Rated	Data Inconclusive	Zinc	2006		3m
						Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
						Aquatic Life	Not Rated	Data Inconclusive	Copper	2006		3m
						Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2008	5
						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2000		1
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
27-34-6b From Hunt Drive to Walnut Creek; C;NSW	**Rocky Branch**	03-04-02	2.0 FW Miles	2	**Habitat Degradation** MS4 NPDES	Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
Subwatershed (WBD-12 Number) 030202011102 Marks Creek												
27-38 From soruce to Neuse River; C;NSW	**Marks Creek (Lake Myra)**	03-04-02	10.3 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1

Subwatershed (WBD-12 Number) 030202011103 Poplar Creek-Neuse River

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(36) NEUSE RIVER From mouth of Beddingfield Creek to a point 0.2 mile downstream of Johnston County SR 1700 WS-V;NSW 03-04-02 4.3 FW Miles	2		Aquatic Life	Not Rated	Data Inconclusive	Zinc	2006		3m
			Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
			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
27-(38.5) NEUSE RIVER From a point 0.2 mile downstream of Johnston County SR 1700 to point 1.4 mile downstream of Johnston County SR 1908 WS-IV;NSW 03-04-02 9.7 FW Miles	5	**Turbidity** Construction General Agriculture/Pasture Stormwater Runoff	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
			Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2008	5
			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
27-35 Poplar Creek From source to Neuse River C;NSW 03-04-02 5.5 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Subwatershed (WBD-12 Number) 030202011105 Buffalo Creek-Neuse River

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(41.7) NEUSE RIVER From City of Smithfield water supply intake to a point 1.7 miles upstream of Bawdy Creek WS-V;NSW 03-04-02 26.2 FW Miles	5	**Fecal Coliform Bacteria** MS4 NPDES **Mercury** WWTP NPDES **Turbidity** Construction MS4 NPDES WWTP NPDES	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
			Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2008	5
			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
			Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1

Watershed (WBD-10 Number) 0302020117 Moccasin Creek-Neuse River

Subwatershed (WBD-12 Number) 030202011702 Polecat Branch-Neuse River

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(49.5)a NEUSE RIVER From a point 1.7 miles upstream of Bawdy Creek to subbasin 030402-030412 boundary WS-IV;NSW 03-04-02 7.0 FW Miles	2		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
			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

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 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. 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.

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
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]

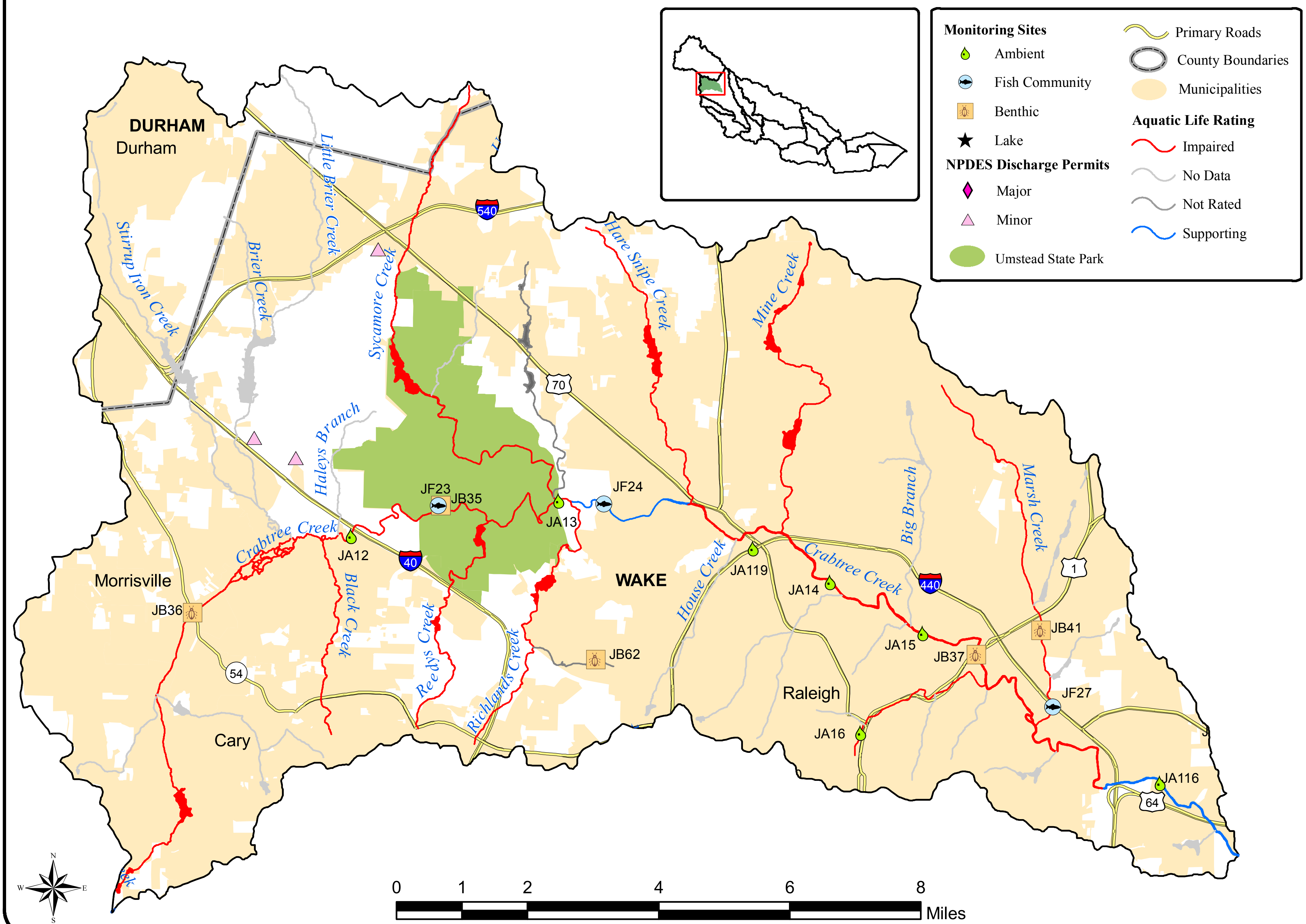
Crabtree Creek Watershed Map (Figure 8)

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.

<u>Crabtree Creek (Crabtree Lake) [AU# 27-33-(3.5)a]</u>
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 µmhos/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).

<u>Crabtree Creek (Crabtree Lake) [AU# 27-33-(3.5)b]</u>
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 µmhos/cm and the maximum NH_3, NO_3+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).

<u>Crabtree Creek [AU# 27-33-(10)a, b, & c]</u>
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_3, NO_3+NO_2, 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

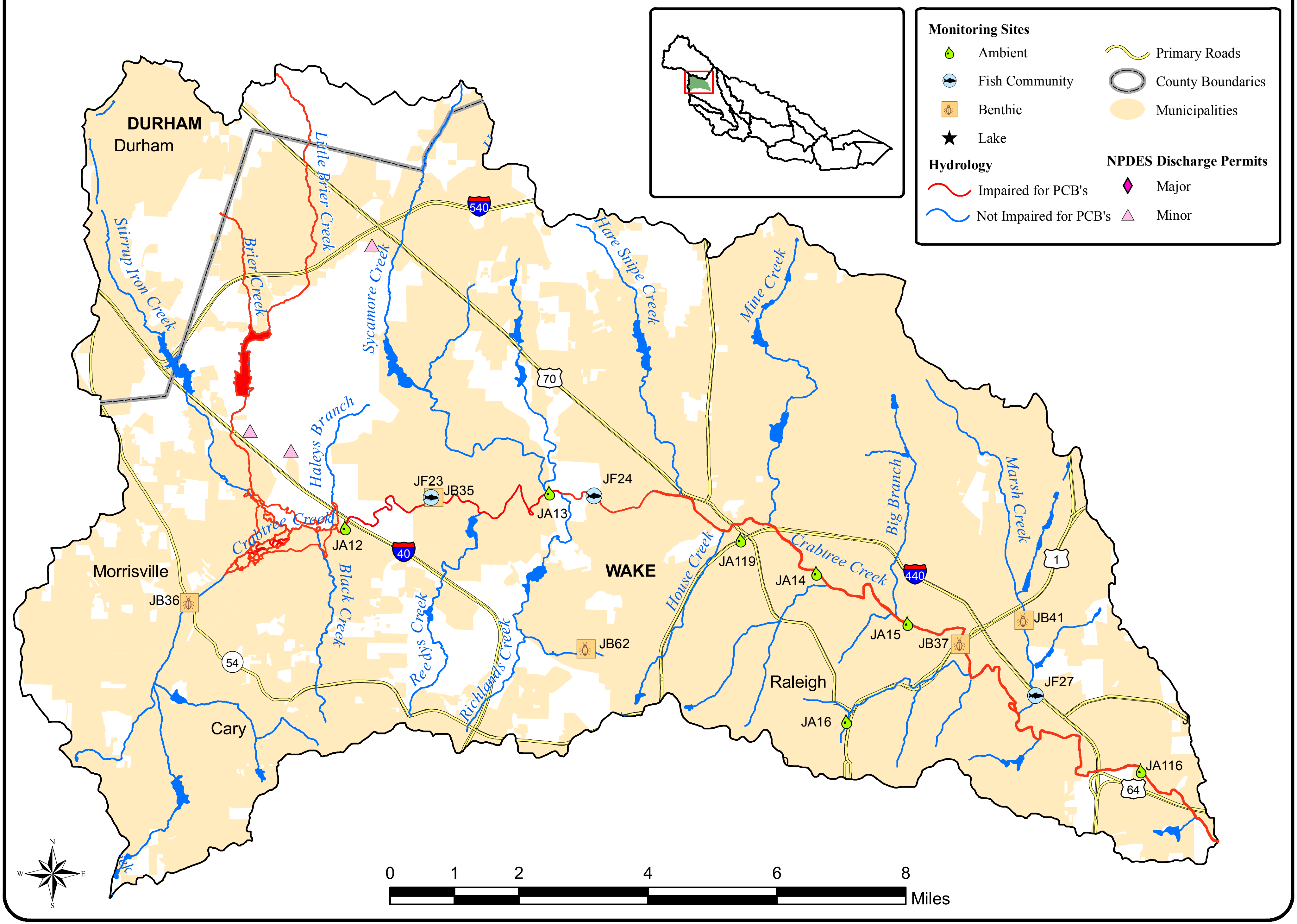


Table 8 Impaired Streams in the Crabtree Creek Watershed (not sampled during this assessment period; see Figure 8).

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/). 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 µmhos/cm. The copper concentrations were also above the state action level of 7 µg/l in 65 percent of the samples with a maximum recorded level of 28 µg/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.

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 µmhos/cm. Smith Creek is supporting for recreational uses.

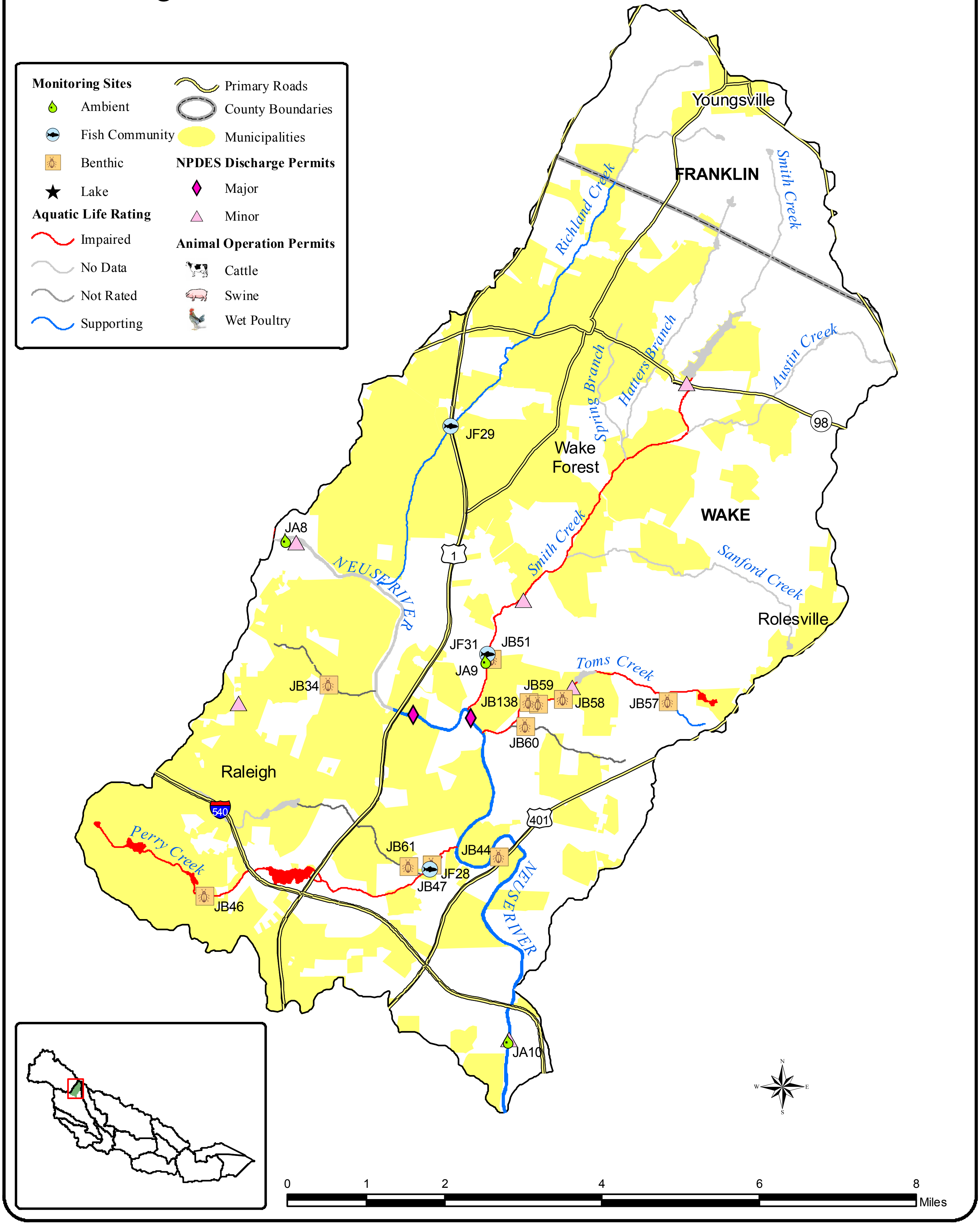
There are now two minor NPDES dischargers within five miles upstream of the biological assessment site: Whippoorwill Valley WWTP and G.G. Hill WTP. Jones Dairy Farm WWTP permit was recinded in October 2005. They had several limit violations in the last few years of operation (BOD,TSS and nitrogen). These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



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 Greshems 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 setteable 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 µmhos/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.

<u>NC WARP Assessment Report: Biological Impairment in the Upper Swift Creek Watershed</u>

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.

<u>NCEEP Upper Swift Creek Local Watershed Plan</u>

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.

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 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 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). 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.erdc.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) and the DWQ TMDL for the Headwaters of Swift Creek Watershed (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.

	9/1/2000 - 8/31/2005 Assessment		**Current Assessment** 1/1/2002 - 12/31/2006	
Station ID Map / DWQ #	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 JA21 / J4170000 – LNBA **Co-located – combined data**	12.1 3.3 **7.6**	0 2.3 **1.4**	11.9 8.3 **10.1**	0 1.2 **0.7**
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 steams 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 µmhos/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 Reachs 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.

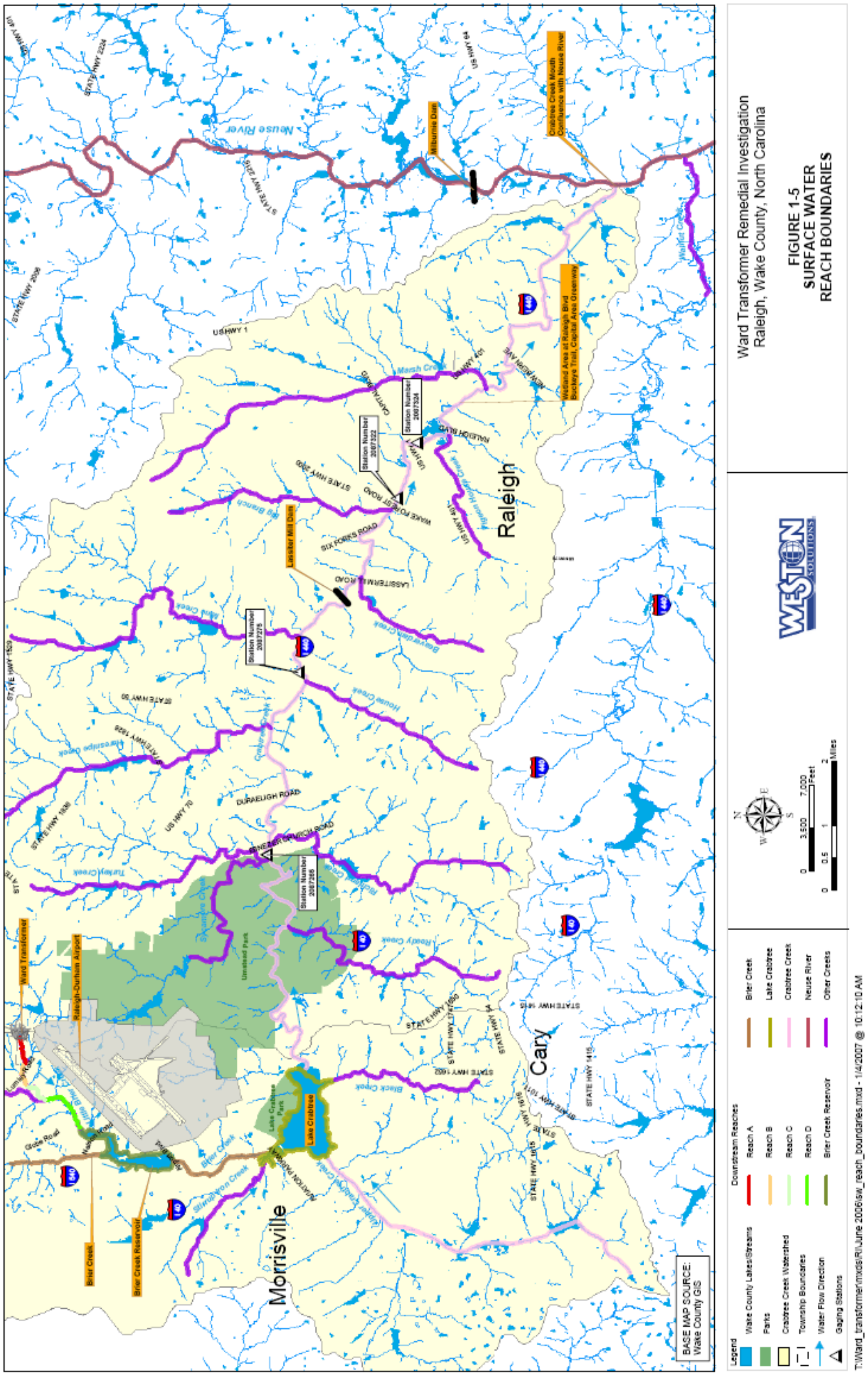
EPA determined that Alternative 5 which included sediment removal from Brier Creek Reservoir and Lake Crabtree would have a large negative impact on the habitat and aquatic organisms as well as due to the increase complexity of the project wouldn't result in a shorter recovery time for this area. The 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/wardtransfornerproposedplanfactsheet.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

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.

Chapter 3
Neuse River Subbasin 03-04-03
Including the: Middle Creek and Terrible Creek

3.1 Subbasin Overview

Subbasin 03-04-03 at a Glance

Land Cover (percent)

Forest/Wetland:	57.3
Surface Water:	1.1
Urban:	22.0
Cultivated Crop:	17.6
Pasture/Managed Herbaceous:	1.9

Counties
Johnston and Wake

Municipalities
Holly Springs, Apex and Fuquay-Varina

Stream Statistics

Total Streams:	117.7 mi/98.0 ac
Total Supporting:	45.0 mi
Total Impaired:	10.2 mi
Total Not Rated:	2.5 mi/0.0 ac
Total No Data:	50.6/98.0 ac

This subbasin is located in southern Wake and Central Johnston counties. Middle Creek is the largest stream in this subbasin, flowing from one end to the other. All other streams are tributaries to Middle Creek, and drain agricultural areas.

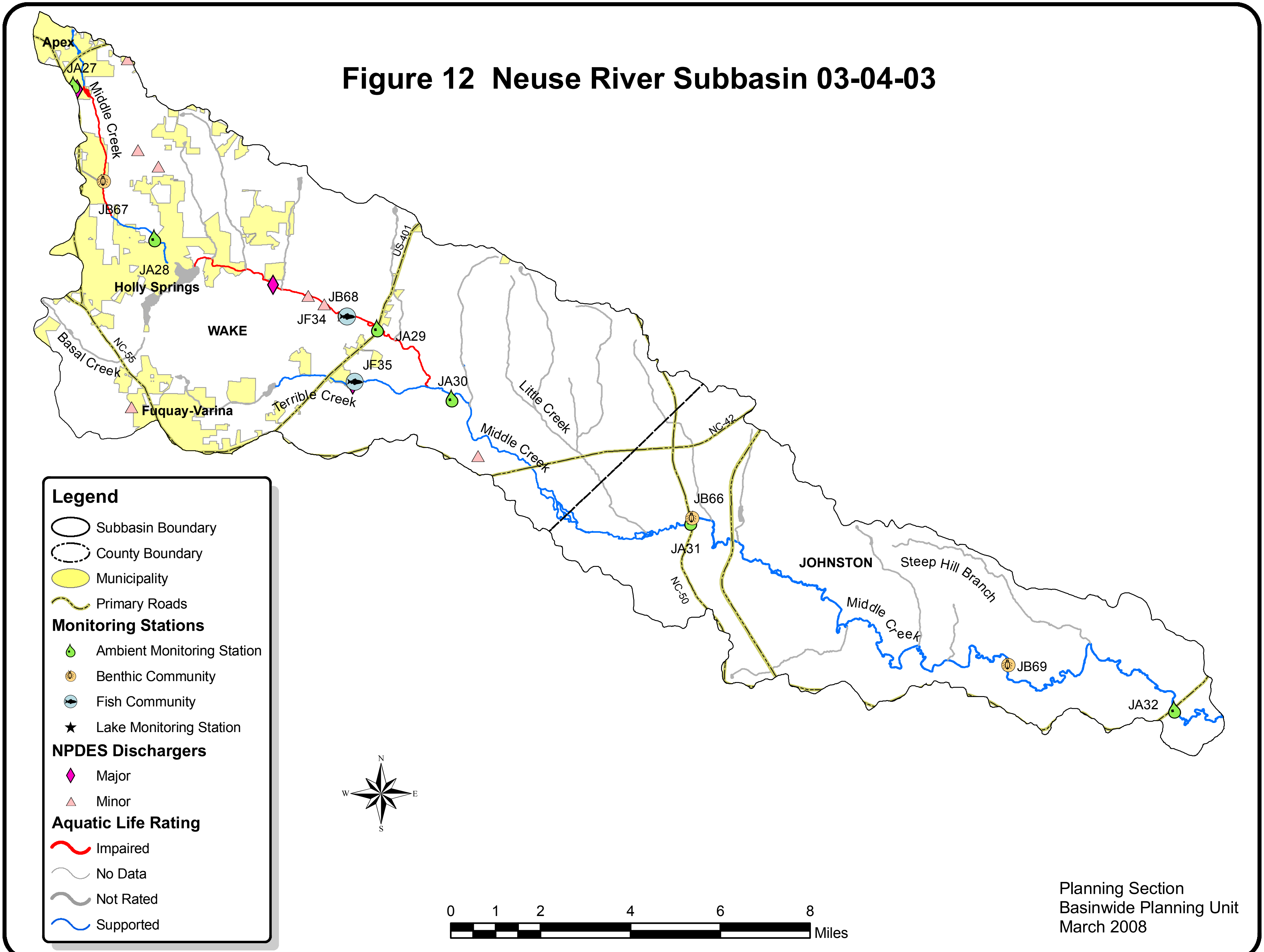
The two fastest growing municipalities in this subbasin are Apex and Holly Springs. Over the past decade, the population of Holly Springs has increased by 88.9 percent (8,168) and Apex increased by 76.3 percent (15,423). Land cover is roughly one-half forest/wetland and one-quarter urban; cropland makes up the majority of the remainder of land cover. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 16.

There are 3 major and 11 minor NPDES wastewater discharge permits in this subbasin with a total permitted flow of 26 MGD (Figure 12). The largest are South Cary WRF (16 MGD), Terrible Creek WWTP (6 MGD), and Middle Creek WWTP (3.6 MGD). There are also six individual NPDES stormwater permit in the subbasin. Refer to Appendix III for identification and more information on NPDES permit holders. Wake County has developed a stormwater programs under Phase II. Apex, Holly Springs and Johnston County have developed model stormwater ordinances and administer local stormwater programs as required by the Neuse NSW strategy stormwater rules (Chapter 18). There are 2 permitted animal operations in this subbasin.

There are two new water quality impairments in this subbasin, a biological impairment based on a fair benthic bioclassification in the upper portion of the watershed and a turbidity impairment below Sunset Lake. Turbidity and fecal coliform bacterial levels were elevated throughout the upper portion of the Middle Creek watershed most likely due to the high rate of growth in the Apex and Holly Spring area. The increased volume of stormwater runoff is contributing to instream habitat loss and sedimentation. With the projected increase in population growth for this area, this trend is likely to continue unless we take steps now to improve stormwater controls and 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.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 6. Table 11 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 for more information about use support methodology.

Figure 12 Neuse River Subbasin 03-04-03



Planning Section
Basinwide Planning Unit
March 2008

Watershed (WBD-10 Number) 0302020109 Middle Creek

Subwatershed (WBD-12 Number) 030202010901 UpperMiddle Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-43-15-(1)a	**Middle Creek**	From source to 0.8 miles south of US 1	C;NSW	03-04-03	1.4 FW Miles	**3a**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Recreation	Not Rated	Potential Standards Violation	Fecal Coliform (recreation)	2006		3a
27-43-15-(1)b1	**Middle Creek**	From 0.8 miles south of US 1 to ut on west of creek 3.0 miles downstream	C;NSW	03-04-03	3.0 FW Miles	**5**	**Habitat Degradation** MS4 NPDES WWTP NPDES **Low Dissolved Oxygen** WWTP NPDES	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	2008	5
27-43-15-8-(2)	**Terrible Creek**	From dam at Johnsons Pond to Middle Creek	C;NSW	03-04-03	7.8 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
27-43-15-(1)b2	**Middle Creek**	From ut on west isde of creek 3.0 miles downstream to backwaters of Sunset Lake	C;NSW	03-04-03	1.6 FW Miles	**3a**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Recreation	Not Rated	Potential Standards Violation	Fecal Coliform (recreation)	2006		3a
27-43-15-(4)a	**Middle Creek**	From dam at Sunset Lake to Terrible Creek	C;NSW	03-04-03	7.2 FW Miles	**5**	**Fecal Coliform Bacteria** MS4 NPDES Stormwater Runoff **Nutrient Impacts** General Agriculture/Pasture Stormwater Runoff **Turbidity** Construction Stormwater Runoff	Aquatic Life	Not Rated	Data Inconclusive	Zinc	2006		3m
								Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
								Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2004		1
								Aquatic Life	Impaired	Standard Violation	Turbidity	2006	2008	5
								Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Subwatershed (WBD-12 Number) 030202010902 Middle Middle Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-43-15-(4)b	**Middle Creek**	From Terrible Creek to Mill Branch	C;NSW	03-04-03	10.1 FW Miles	**2**		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
								Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2002		3a
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Assessment Unit Number / Description / Classification	Name / DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-43-15-(4)c	**Middle Creek**		**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
From Mill Branch to Swift Creek					Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
C;NSW	03-04-03	27.1 FW Miles			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	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.

Waters in the following sections and in Table 11 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.

3.2 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. Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 12 for a summary of use support for waters in subbasin 03-04-03 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

3.3 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 303(d) 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.

Table 12 Summary of Use Support Ratings in Subbasin 03-04-03

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
Freshwater acres (impoundments)	0	0	0.0	0	0.0	0	98	98
Freshwater miles (streams)	58	10	9	45	38	3	60	118

% - Percent of total miles/acres.

3.3.1 Middle Creek Watershed [AU# 27-43-15-(1)a, 27-43-15-(1)b1, 27-43-15-(1)b2, 27-43-15-(2), 27-43-15-(4)a & 27-43-15-(4)b]

2002 Recommendations

DWQ will also attempt to determine the source of the low dissolved oxygen levels in the upper watershed. Apex received a CWMTF grant to make WWTP upgrades. Because of the water quality impacts noted and the increasing development pressure, Middle Creek is a NCEEP (formerly NCWRP) targeted local watershed.

Current Status

Middle Creek [AU# 27-43-15-(1)a]

Middle Creek [AU# 27-43-15-(1)a; C; NSW] from source to 0.8 miles South of US-1 (1.4 miles) is Supporting for aquatic life because none of the ambient monitoring criteria that is used to assess aquatic life was exceeded at ambient monitoring station JA27. This section of Middle Creek was added to the 2004 303(d) list for DO standard violations with 16 percent of the samples less than 4 mg/l during the last assessment period. During the current assessment period there were 5 percent of the readings below 4 mg/l and 14 percent below 5 mg/l. Nutrients and turbidity levels were elevated as well as conductivity, which ranged between 53 to 577 µmhos/cm. These are all indicators that there are still issues that need to be addressed within this section of the watershed.

The state standard for dissolved oxygen is no more that 10 percent of the reading less than a daily average of 5.0 mg/l with a minimum instantaneous reading of 4 mg/l. All the ambient monitoring stations throughout the Neuse use instantaneous reading (except for a few stations within the Neuse River Estuary). As indicated by the data collected at this station, this segment is no longer below 4 mg/l more than 10 percent of the time. However, there are still 14 percent of the samples below 5 mg/l which will have a negative effect on the aquatic organisms in this watershed as will be seen in the segment below.

This segment of Middle Creek will be removed from the 2008 303(d) list for low DO standard violation. Depending on the watershed development and stream protection efforts made, this segment of Middle Creek could easily end up back on the 303(d) list.

This section of Middle Creek is also Not Rated for recreational use due to elevated fecal coliform bacteria levels in 34 percent of the samples. There was no 5-in-30 day fecal sampling done at this location because this segment of Middle Creek is classified as class C waters. Due to personnel and budgetary constraint, DWQ is unable to intensively sample all areas with elevated fecal coliform bacteria levels. DWQ makes class B waters a priority for 5-in-30 day sampling.

The Division of Water Quality assessed this segment of Middle Creek following a large industrial fire at the EQ Storage facility. No impacts to the stream were noted.

Middle Creek [AU# 27-43-15-(1)b1]

Middle Creek [AU# 27-43-15-(1)b1; C; NSW] from 0.8 miles South of US 1 to ut (unnamed tributary) on west of creek 3.0 miles downstream (3.0 miles) is Impaired for aquatic life due to a Fair benthic bioclassification at site JB67. This was the first time this site was sampled and was added during this assessment period to help assess impacts from activities in the upper part of the Middle Creek watershed (runs through part of Apex and Holly Springs). Stream banks were subject to erosion due to a lack of woody vegetation. The riparian zone was wide and intact in the area sampled upstream of the road crossing (SR1301). The high conductivity (319µmhos/cm) potentially reflects the discharger and urbanization present upstream of this site. Apex Water Reclamation Facility (NC0064050) is the only major NPDES discharger upstream. The tolerance assessment of the taxa found ranged from very slightly intolerant to highly tolerant species with some abundant taxa indicators of low dissolved oxygen and organic enrichment.

This segment of Middle Creek will be added to the 2008 303(d) list due to impaired biological integrity.

Middle Creek [AU# 27-43-15-(1)b2

Middle Creek [AU# 27-43-15-(1)b2; C; NSW] from the ut on west side of creek 3.0 miles downstream to backwaters of Sunset Lake (1.6 miles) is Supporting aquatic life due to No Criteria Exceeded at ambient monitoring station JA28. Station JA28 is about 2 miles down stream of the benthic site (JB67) and exhibited elevated turbidity in exactly 10 percent of the samples during this assessment period. The maximum turbidity recorded was 150 NTUs. The conductivity and nutrients were also high with conductivity ranging between 86 and 588 µmhos/cm and the maximum recorded NO_2+NO_3 and TP were 3.04 mg/l and 4.7 mg/l respectively. These were much higher than the ambient monitoring station upstream (JA27).

This segment is Not Rated for recreational uses due to elevated fecal coliform bacteria levels at JA28. The levels were elevated in 28 percent of the samples collected.

Middle Creek (Sunset Lake) [AU# 27-43-15-(2)]

Middle Creek (Sunset Lake) [AU# 27-43-15-(2); B; NSW] from backwaters of Sunset Lake to dam at Sunset Lake is currently listed as No Date due to the fact that it was not monitored during this assessment period.

Middle Creek [AU# 27-43-15-(4)a]

Middle Creek [AU# 27-43-15-(4)a; C; NSW] from the dam at Sunset Lake to Terrible Creek (7.2 miles) is Impaired for aquatic life due to a turbidity standards violation in 11 percent of the samples collected at JA128. Site JA128 replaced site JA29 in July 2005. Both sites had elevated fecal coliform levels with 21 and 17 percent of the samples above 400 cfu/100ml at JA29 and JA128, respectively. Due to the elevated fecal coliform counts, this segment is Not Rate for recreational uses.

The biologist found the macroinvertebrates to be rated Good-Fair and the fish community to be Excellent at sites JB68 and JF34.

Although this stream has been historically noted as having eroded banks, breaks in the riparian zone were rare, and plant coverage was good in this section of the stream. Bluegreen algal mats in the stream indicate the high nutrient load from the many NPDES dischargers and nonpoint runoff in the upstream watershed. The Specific conductance measurements were 221 and 283 µmhos/cm during the benthos and fish community samples, respectively. The conductivity ranged from 82 to 519 µmhos/cm at the ambient stations. The Good-Fair rating was consistent with the last assessment in 2000, however it had been rated Fair in both 1986 and 1995. The biologist found that there has been a shift in the substrate composition since the 1986, with a replacement of larger substrate by smaller resulting in a shift in benthic taxa seen at this location (see ESS Basinwide Assessment Report Neuse River Basin April 2006 for more information on substrate shift (http://h2o.enr.state.nc.us/esb/Basinwide/Neuse06BasinReportFinal.pdf)).

This was the first time that a fish community assessment was made at this location. Fish community assessments have been made at 4 other Middle Creek watershed locations in the past, however this was the only site monitored during this assessment period. The Middle Creek watershed has always shown a high diversity of fish and this remained true during this assessment period, which resulted in an Excellent fish rating. The fish fauna in this stream were clearly not showing any negative affects from the elevated conductivity. The DWQ biologist recommend continued sampling in this portion of the watershed, as the fish community may eventually show signs of stress from the changing substrate.

<u>Middle Creek [AU# 27-43-15-(4)b]</u>

Middle Creek [AU# 27-43-15-(4)b; C; NSW] from Terrible Creek to Mill Creek (10.1 miles) is Not Rated for aquatic life due to the rating given at the benthic site JB66. This basinwide site could not be sampled in 2005 because this segment of the stream was too deep to wade. This site was sampled in 2002 during a special drought study to assess the effects of low rainfall between 1999 and 2002. It was found that this site was highly impacted by the lack of rain in the area and was given a Not Rated bioclassification. None of the ambient monitoring parameters used to assess aquatic life exceeded the state standards at site JA30 or JA31, however there was a single turbidity violation of 665 NTUs at ambient monitoring station JA31. This large amount of sediment could possibly have had a severe effect on the benthic habitat at this location. The conductivity was also high at both ambient monitoring stations with reading ranging between 58 and 495 µmhos/cm. The benthic site should be reassessed during the next assessment period.

This segment of the Middle Creek watershed is Supporting for recreation because the fecal coliform bacteria levels were within allowable limits at the ambient monitoring stations JA30 and JA31.

<u>Middle Creek [AU# 27-43-15-(4)c]</u>

Middle Creek [AU# 27-43-15-(4)c; C; NSW] from Mill Creek to Swift Creek (27.1 miles) is Supporting aquatic life due to a Good-Fair bioclassification at site JB69. Benthic site JB69 is ~13 miles down stream from JB66 and was sampled to assess the impacts from the rapidly developing area around the Town of Smithfield. The banks were moderately stable and the riparian zone was wide and intact. The conductivity was still high (221 µmhos/cm) at this site even though there are no dischargers within 10 miles. With increasing stress on the community predicted due to rapid development in the watershed, it is recommended that this site be added as a benthic basinwide site for continual monitoring of water quality.

None of the ambient monitoring parameters used to assess aquatic life exceeded the state standards at site JA32. The conductivity ranged between 70 and 388 µmhos/cm.

This segment of the Middle Creek watershed is also Supporting for recreation because the fecal coliform bacteria levels were within allowable limits at the ambient monitoring station JA32.

Wake County used funds from the County's Capital Improvement Fund as well as funds from a 2005 CWMTF grant ($714,000) to purchase 233 acres as well as an adjoining property, which contains wetlands and riparian buffers along Middle Creek for the future Wake County Southeast Regional Park. This conservation area will include the Middle Creek Aquatic Habitat, a Natural Heritage site of local significance. It supports several rare animal species. Among the rare mussel species found here are the Atlantic Pigtoe, Yellow Lance, Triangle Floater, Eastern Lampmussel, Roanoke Slabshell, as well as a rare fish the Carolina Madtom and the North

Caroline Spiny Crayfish. The CWMTF grant requires that the county convey to the state a conservation easement on any property for which CWMTF funds were used. This will provide water quality protection as well as allow for the development and use of the property for public greenway trails, walking, biking, educational tours, scientific study and other uses in accord with the County's Open Space Program.

Recommendations.
With the projected increase in population growth for this area, steps are needed now to improve stormwater controls and 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.

Effective enforcement of sediment and erosion control regulations will be essential to the prevention of additional sediment inputs from construction activities. Development of improved erosion and sediment control practices would be beneficial.

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 purchased approximately 225 acres of open space along Middle Creek in segment AU# 27-43-15-(4)a.

The Triangle Greenway Council accepted the donation of 78 acres on Middle Creek, conserving a proposed greenway corridor approximately one mile long that includes Natural Heritage Program Element Occurrences. Negotiations are continuing with the owners of approximately 80 acres of adjoining floodplains and wetlands that may be conserved.

The Triangle Greenway Council also accepted donation of 24 acres on Middle Creek in Holly Springs that is part of an existing greenway corridor with a paved trail.

3.4 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.

3.4.1 Terrible Creek [AU# 27-43-15-8-(2)]

2002 Recommendations

The Fuquay-Varina Terrible Creek WWTP has had past aquatic toxicity failures. DWQ will work with the town to remedy the toxicity problems.

Current Status

Terrible Creek [AU# 27-43-15-8-(2); C; NSW] from the dam at Johnsons Pond to Middle Creek is Supporting for aquatic life based on a Good fish community bioclassification at site JF35. This is not a normal basinwide sampling site. This sample was requested by the Raleigh Regional Office to assess the biological impacts below the Fuquay Varina WWTP outfall in response to repeated weekly and monthly permit violations of total ammonia nitrogen, 5-day biochemical oxygen demand, and fecal coliform bacteria. The facility began operations in the mid 1990s and treats approximately 95 percent domestic waste and 5 percent industrial waste. The facility is permitted to discharge up to 1 MGD and has a staged permit to discharge upon expansion up to 6 MGD. The instream concentration is 100 percent with a summer 7Q10 equaling 0 cfs. The instream substrate was moderately embedded and riffles were infrequent. At places along the left shoreline, the channel was entrenched and the bank was severely eroded and collapsing due to storm and flood events. The left bank had a very narrow riparian zone. Livestock in the area were excluded from the stream by a fence. The right bank was wooded with a wide forested riparian zone.

The Terrible Creek WWTP (NC0066516) did not experience any aquatic toxicity failures during this assessment period, however they did have many limit violations. In 2006 alone, the facility had experienced 7 months with BOD limit violations, 9 months with fecal coliform, 8 months with Ammonia and 2 months with total suspended solids violations. Of these violations, the facility was assessed a penalty by DWQ for 14 limit violations resulting in fines totaling $10,427. They have requested remission from these fines. As of June 2007, no violations have been reported in BIMS (Basinwide Information Management System) for this facility. This facility has a new operator and it appears that they are making great strides in complying with their discharge limits.

Recommendations

Given the repeated violation by this discharger as well as the increase in development in this area, DWQ would recommend that a benthic macroinvertebrate sample be taken at this location during the next assessment period. The benthic community is more likely to be affected by the repeated exposure to high ammonia and low DO levels. Fish have the ability to swim down stream if conditions are unpleasant where as the benthic community is relegated to a single location with not much ability to quickly relocate if needed. These would be a more sensitive indicator of repeated violation by a discharger or impacts due to a developing 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).

3.5 Additional Water Quality Issues within Subbasin 03-04-03

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.

3.5.1 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.

Chapter 4
Neuse River Subbasin 03-04-04
Including the: Hannah Creek, Black Creek and Mill Creek

4.1 Subbasin Overview

Subbasin 03-04-04 at a Glance

Land Cover (percent)

Forest/Wetland:	50.1
Surface Water:	1.1
Urban:	1.9
Cultivated Cropland:	45.9
Pasture/ Managed Herbaceous:	0.2

Counties
Johnston, Sampson, Wake and Wayne

Municipalities
Benson, Four Oaks and Smithfield

Stream Statistics

Total Streams:	227.1 mi
Total Supporting:	2.0 mi
Total Impaired:	32.9 mi
Total Not Rated:	48.2 mi
Total No Data:	144.1 mi

This subbasin is primarily located in southern Johnston County. The uppermost portion of the subbasin lies in Wake County. Very small segments of the subbasin also reside in Sampson and Wayne Counties. Streams are characteristically of low to moderate gradient with sandy substrates. This subbasin includes the entire watershed of Black Creek, to its confluence with the Neuse River. Mill Creek and all of its tributaries (including Hannah Creek and Stone Creek) are also included in this subbasin to the Neuse River confluence.

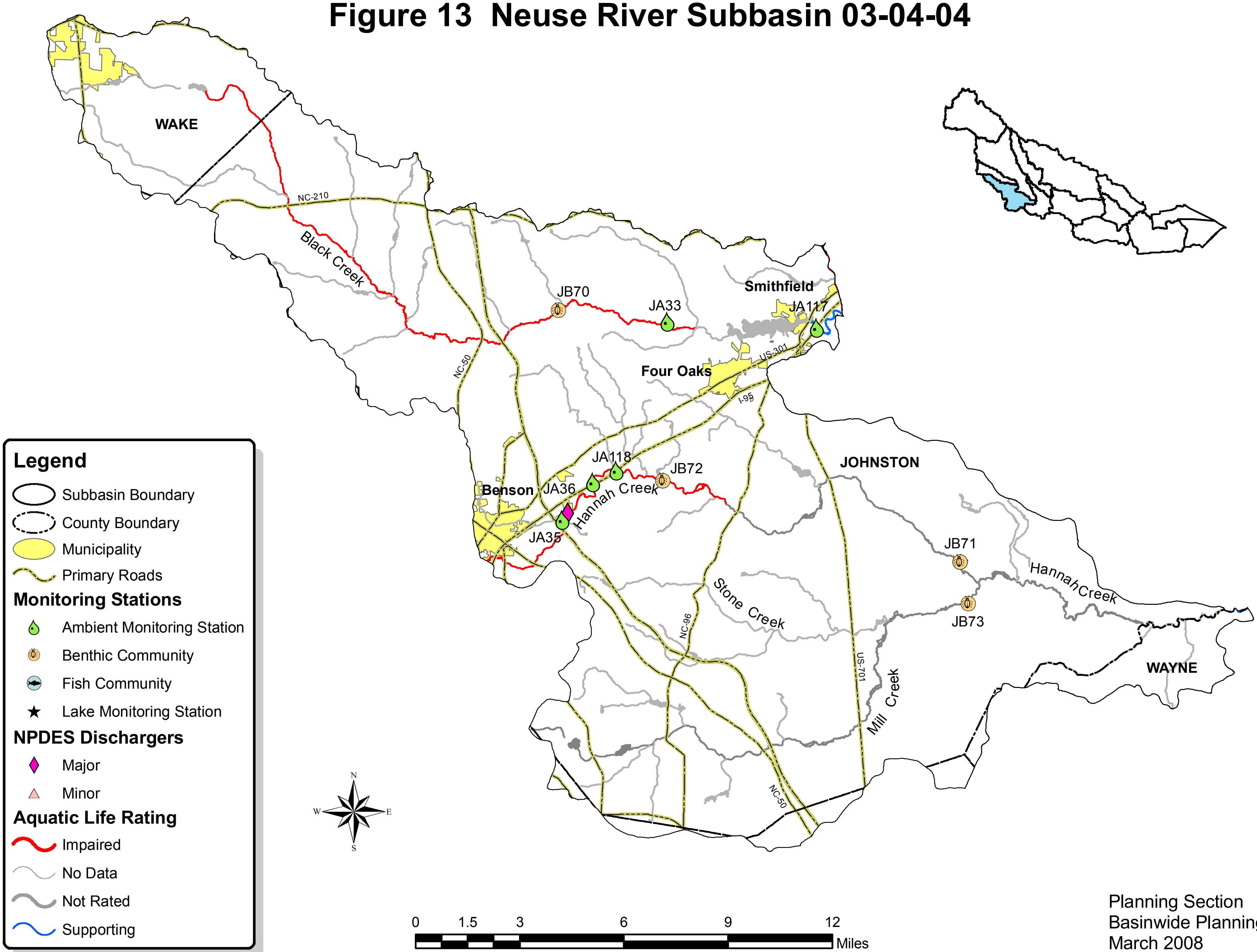
Population growth in this subbasin is concentrated on the I-95 corridor between Benson and Smithfield. In the decade between 1990 and 2000, the town of Smithfield increased in population by 46 percent (3,327), making it the largest municipality in the watershed. Land cover in the subbasin consists of mixed forest, forested wetlands, pasture, and cropland. Roughly half is forest/wetland, and the majority of the remainder is cropland. Primary crops are cotton, soybeans, corn, wheat, sweet potatoes, peanuts, and tobacco. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 16.

There is 1 major (Benson WWTP, 1.9 MGD) and no minor active permitted NPDES discharger in this subbasin. There are also nine individual NPDES stormwater permits. Refer to Appendix III for identification and more information on NPDES permit holders. Johnston and Wake Counties have model stormwater ordinances as required by the Neuse NSW strategy stormwater rules (Chapter 18). There are also 26 permitted animal operations in this subbasin.

An ambient monitoring station was added above the Benson WWTP to help determine if the low dissolved oxygen (DO) issues in Hannah Creek were the result of the WWTP discharge. It was apparent from the DO and fecal coliform bacteria data that there is a problem upstream of the WWTP; however the number of the DO standard violations increased significantly downstream from the WWTP. Local officials have mentioned that at times there are cattle in the creek above the WWTP. An attempt to work with local landowners to incorporate appropriate BMPs should be made to help improve the water quality in the segment of Hannah Creek.

A biological sample was collected below the WWTP to see if the conditions in the stream could be impacting the benthic community. The low DO levels measured during sampling suggests that it is limiting the benthic community at the site. This site is impaired for biological integrity due to a fair bioclassification.

Figure 13 Neuse River Subbasin 03-04-04



Planning Section
Basinwide Planning Unit
March 2008

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category

Watershed (WBD-10 Number) 0302020112 Black Creek

Subwatershed (WBD-12 Number) 030202011201 Little Black Creek-Black Creek

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-45-(2)		**Black Creek**	**5**	**Low Dissolved Oxygen**	Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	2008	5
From dam at Panther Lake to mouth of Sassarixa Creek				Natural Conditions	Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2005		3a
C;NSW	03-04-04	22.6 FW Miles			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Subwatershed (WBD-12 Number) 030202011203 Holts Lake-Black Creek

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-45-(14)		**Black Creek**	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
From dam at Holts Lake to Neuse River											
C;NSW	03-04-04	2.0 FW Miles			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Watershed (WBD-10 Number) 0302020113 Mill Creek

Subwatershed (WBD-12 Number) 030202011301 Upper Hannah Creek

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-52-6a		**Hannah Creek**	**5**	**Fecal Coliform Bacteria**	Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	2004	5
From source to NC 96				General Agriculture/Pasture	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	2008	4s
C;NSW	03-04-04	10.3 FW Miles		**Low Dissolved Oxygen**	Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
				General Agriculture/Pasture							
				WWTP NPDES							

Subwatershed (WBD-12 Number) 030202011302 Lower Hannah Creek

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-52-6b		**Hannah Creek**	**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2005		3a
From NC 96 to Mill Creek											
C;NSW	03-04-04	13.4 FW Miles									

Subwatershed (WBD-12 Number) 030202011303 Upper Mill Creek

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-52-(1)		**Mill Creek (Moorewood Pond)**	**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2005		3a
From source to Mill Branch											
C;NSW	03-04-04	34.7 FW Miles									

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.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 7. Table 13 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 for more information about use support methodology.

Waters in the following sections and in Table 13 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.

4.2 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. Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 14 for a summary of use support for waters in subbasin 03-04-04 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

4.3 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 303(d) 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.

Table 14 Summary of Use Support Ratings in Subbasin 03-04-04

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
Freshwater miles (streams)	83	33	15	2	1	48	144	227

% - Percent of total miles/acres.

4.3.1 Black Creek Watershed [AU# 27-45-(2) & 27-45-(14)]

Current Status

Black Creek [AU# 27-45-(2)]

Black Creek [AU# 27-45-(2); C; NSW] from the dam at Panther Lake to the mouth of Sassarixa Creek (22.6 miles) is Impaired for aquatic life due to a low DO standard violation in 12 percent of the samples (< 4 mg/l) at ambient monitoring station JA33. DO levels were also below 5 mg/l in 29 percent of the samples. This was a new LNBA station, which was added in December 2004 (moved station JA117 to this location in order to get a better assessment of the overall watershed). This is likely due to swamp drainage. A further assessment will have to be made in order to determine if this is natural or not.

DWQ biologist could Not Rate the benthic community at site JB70. This stream is in a transitional zone between a Swamp and Coastal A stream category and therefore should not be rated until criteria are developed for such streams. Until new criteria are developed, this site will be dropped as a basinwide site. The riparian zone was found to be wide and intact on both sides and there was no evidence of channelization or stream bank erosion occurring at the sampling site.

This segment will be added to the 2008 303(d) list of impaired waters for low DO violations.

Black Creek [27-45-(14)]

Black Creek [27-45-(14); C; NSW] from the dam at Holts Lake to the Neuse River (2.0 miles) is currently on the 303(d) list for low DO standards violation. This segment will be removed from the 303(d) list as of 2008 because the DO standards violation was only exceeded in 2 percent of the samples, which is less than the 10 percent state limit. This segment of the Black Creek is Supporting for both aquatic life and for recreation at site JA117. This site was moved further up in the watershed above Holts Lake in order to get a better assessment of this area.

Recommendations

A DO TMDL will have to be produced for this watershed within 13 years, unless natural conditions are determined to be the cause of the low DO. The entire Black Creek watershed will be incorporated into a DO TMDL at that time.

4.3.2 Hannah Creek Watershed [27-52-6a & 27-52-6b]

2002 Recommendations

DWQ and LNBA will continue to monitor the site to detect any water quality changes. DWQ will work with Benson to remedy toxicity problems and to determine the source of low dissolved oxygen in Hannah Creek.

Currently (2007) Hannah Creek 27-52-6a (from source to NC96 (10.3 miles)) is on the 303(d) for Low DO standards violation.

Current Status

Hannah Creek [AU# 27-52-6a]

Hannah Creek [27-52-6a; C; NSW] from the source to NC96 (10.3 miles) is Impaired for aquatic life due to a fair benthic bioclassification at site JB72 and due to low DO standards violation at ambient monitoring stations JA35, JA36 and JA118. The DO was below 4 mg/l in 16, 58 and 23 percent of the samples and fecal coliform bacteria levels were elevated above 400 CFU /100 ml in 17, 14 and 16 percent of the samples at JA35, JA36 and JA118 respectively. The fecal numbers are not above the state standard of 20 percent. Therefore, this area is Supporting for recreational uses. Station JA35 is located ~ 0.2 mile above the Benson WWTP and sampling was initiated at this station in February 2004 to help determine if the low DO issues in Hannah Creek were the result of the WWTP discharge. It is apparent from the DO and fecal coliform bacteria data that there is a problem upstream of the WWTP, however the number of the DO standard violations increased significantly downstream from the WWTP. There has been mention of cattle in the creek above the WWTP. An attempt to work with local landowners to incorporate appropriate BMPs should be made to help improve the water quality in the segment of Hannah Creek.

Ambient monitoring station JA36 replaced JA118 in February 2004 due to sampling safety issues and is about 1 mile upstream of JA118. Elevated conductivity was also recorded at these sites with values ranging between 60 and 377 µmhos/cm. These sites are 1.7 and 2.7 miles below the Benson WWTP. The data indicates that the WWTP as well as other current land uses in the area are contributing to the degraded water quality in this stream.

Benthic site JB72 was requested in order to determine if the water quality in this area is having a detrimental effect on the aquatic organisms and to see if the low DO levels could be associated with natural conditions. This site was sampled in February 2005 using swamp methods and again in July 2005 using standard qualitative methods. It was determined at the time of the July sample, that the good stream flow during the summer period indicated that this site does not have the characteristics of a swamp site so, sampling using standard qualitative methods is the appropriate method to assess this section of Hannah Creek. The banks were well stabilized by the vegetation present. The riparian zone was wide and intact at the sampling site. The conductivity was moderately elevated (97 µmhos/cm) and the DO at the time of sampling was 3.0 mg/l. This site was rated as Fair. Unfortunately, benthic sampling without a historical data set cannot address the original question of whether low DO levels are associated with natural conditions. The low DO level measured during sampling suggests that it is limiting the benthic community at the site.

Benson WWTP (NC0020389) is the single active major NPDES permitted discharger upstream of these sites. Discharge is limited to 1.5 MGD. They have not had any major discharge issues over the past several years. There has been discussion of the WWTP moving out of Hannah Creek and discharging into the Neuse River or possibly the Cape Fear River.

The 10.3 mile stretch of Hannah Creek will remain on the 303(d) list for low DO standard violation and will be added to the 2008 303(d) list for impaired biological integrity due to the Fair benthic bioclassification during this assessment period.

<u>Hannah Creek [AU# 27-52-6b]</u>
Hannah Creek [27-52-6b; C; NSW] from NC96 to Mill Creek (13.4 miles) is Not Rated for aquatic life due to sampling at site JB71. This site was rated twice as Good-Fair (1995, 2001) and twice as Fair (1991, 2000) and in September 2005 it received a Not Rated bioclassification. The conditions found at this location in 2005 where impacted possibly by extreme low flow conditions. This area, as seen by a USGS flow gauge at Little River near Princeton (within 15 miles of the benthic site) was experiencing a 25 year low flow event for the month of September

2005 (see ESS Neuse River Basinwide Assessment Report for a graph of the data). The drought in this area continued through November of 2005. This area did not see much relief from the drought for most of 2006 as well. The 2005 sample found the lowest number of taxa ever sampled at this site. Erosional areas were present on both sides of the streambanks. Grasses were dominate on one bank, giving a high potential for bank failure during high flow events. Breaks in the moderately narrow riparian zone were common on one side and rare in the wide zone on the other side. Because of the extreme low flow conditions resulting from a very dry September for the area, the site was Not Rated.

Recommendation
DWQ encourages the local SWCD and NRCS office to work with landowners to voluntarily adopt and install conservation practices in this watershed. Work with landowners above the WWTP is needed to eliminate the direct access cattle have to the stream. This will likely improve the water quality conditions above the WWTP.

Water Quality Initiative
From 2000-2006 in this 14 digit watershed, the NCACSP installed 99 acres of cropland conversion to grass, 4 acres of critical area planting, 0.3 acre of grassed waterway, 9.9 acres of riparian buffers, and 1 incinerator at a cost of $20,595. These BMPs affect 137 acres in the watershed, saving 996 Tons of soil per year, saving 2,611 pounds of nitrogen per year, and reducing 232 pounds of phosphorus each year.

4.4 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.

4.4.1 Mill Creek [AU# 27-52-(1)]

Mill Creek [AU# 27-52-(1); C; NSW] from source to Mill Branch (34.7 miles) is Not Rated for aquatic life due to the benthic bioclassification at site JB73. As described above for Hannah Creek AU# 27-52-6b, this area experienced an extreme low flow conditions during the sampling period for Mill Creek. This site had been sampled three times before 2005. On each previous occasion it was rated Good-Fair with either 12 or 13 EPT taxa present. During the 2005 assessment only 4 EPT taxa were present. The conditions found at this location in 2005 were highly impacted by extreme low flow conditions. This site will have to be resampled at a later date to see if these impacts are reversed upon normal flow conditions or whether there are other stressors in this watershed that has also lead to the decline in the benthic macroinvertebrate community.

Recommendation
DWQ will continue to monitor the benthic community in Mill Creek to see if it was able to recover after the devastating drought period in late 2005.

DWQ encourages the local SWCD and NRCS office to work with landowners to voluntarily adopt and install conservation practices in this watershed.

4.5 Additional Water Quality Issues within Subbasin 03-04-04

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.

4.5.1 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.

Chapter 5
Neuse River Subbasin 03-04-05

Including the: Neuse River, Stoney Creek, Bear Creek, Falling Creek and Walnut Creek

5.1 Subbasin Overview

Subbasin 03-04-05 at a Glance

Land Cover (percent)

Forest/Wetland:	51.6
Surface Water:	0.8
Urban:	8.2
Cultivated Crop:	36.5
Pasture/ Managed Herbaceous:	2.9

Counties
Craven, Greene, Jones, Lenoir and Wayne

Municipalities
Dover, Walnut Creek, Goldsboro, La Grange and Kinston

Stream Statistics

Total Streams:	364.1 mi/8.0 ac
Total Supporting:	51.8 mi
Total Impaired:	58.0 mi
Total Not Rated:	19.0 mi/0.0 ac
Total No Data:	235.3 mi

This subbasin includes the southeast corner of Wayne County, most of Lenoir County, and small portions of Greene, Craven, and Jones Counties. The Neuse River, from the mouth of Stoney Creek to the mouth of (though not including) Contentnea Creek, is within the subbasin. The major tributaries are Walnut Creek, Bear Creek, Falling Creek, Southwest Creek, Stoney Creek, Moseley Creek, Briery Run and Stonyton Creek.

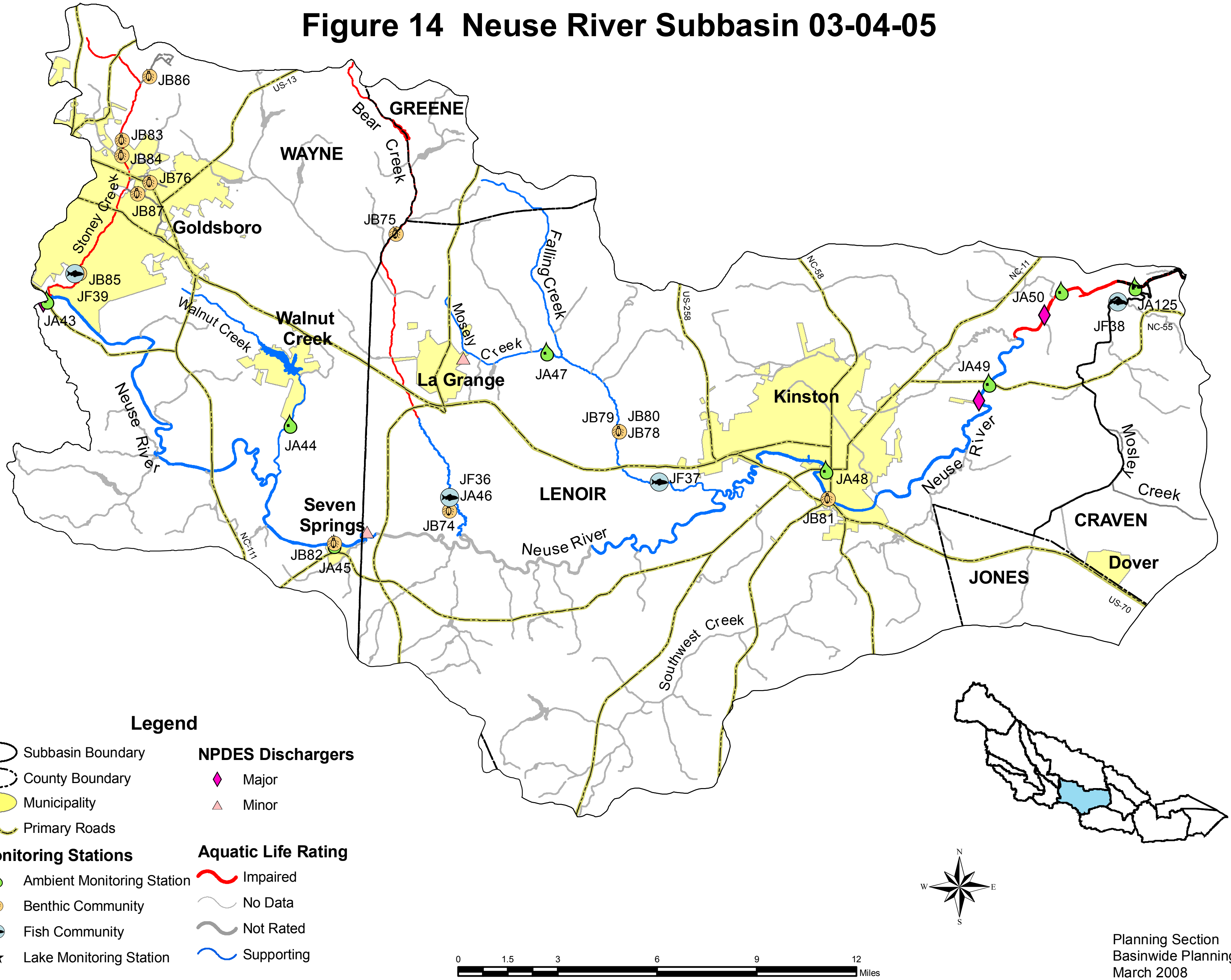
Population growth in this subbasin is near Goldsboro and Kinston. The population for the 2 main counties (Wayne and Lenoir) over the past ten years has had little change. Wayne County has seen a 9.8 percent (8,663) increase, and Lenoir County increased by 3.8 percent (2,324). The land cover is split between forest/wetland and cropland with a small portion covered by urbanization. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 16.

There are 4 major and 3 minor NPDES discharge permits in this subbasin with a total permitted flow of 40.5 MGD. The largest are Goldsboro WWTP (17.6 MGD) and Kinston Regional Water Reclamation (11.8 MGD). There are also 35 individual NPDES stormwater permit in the subbasin. Refer to Appendix III for identification and more information on NPDES permit holders. Goldsboro and Wayne County have developed a stormwater program under Phase II and model stormwater ordinances as required by the Neuse NSW strategy stormwater rules (Chapter 18). There are also 84 permitted animal operations in this subbasin.

There are two new water quality impairments in this subbasin, a biological impairment based on a fair benthic bioclassification in the Bear Creek watershed and a low dissolved oxygen (DO) impairment in the lower segment of the Neuse River mainstem. Bear Creek like many other creeks in the coastal plain have been channelized and is affected by the lack of riparian buffers and agricultural runoff.

Many small tributary in this subbasin are in agricultural land use areas. There are many municipal/industrial and swine waste land application fields in this area as well. These land use practices along with the growing urban areas in this subbasin may be impacting the river near Goldsboro and Kinston. Low dissolved oxygen detected at ambient monitoring stations may be the result of the large volume of discharges in this segment of the river as well as from possible swamp drainage.

Figure 14 Neuse River Subbasin 03-04-05



Planning Section
Basinwide Planning Unit
March 2008

Watershed (WBD-10 Number) 0302020117 Moccasin Creek-Neuse River

Subwatershed (WBD-12 Number) 030202011705 Quaker Neck Lake-Neuse River

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(56)b	**NEUSE RIVER**			**5**	**Mercury**	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
From subbasin 030405-030412 boundary to a point 0.7 mile downstream of the mouth of Coxes Creek.						Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
C;NSW		03-04-05	21.5 FW Miles		**Nutrient Impacts** MS4 NPDES Row Crop Agriculture	Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2000		1
					Turbidity MS4 NPDES Row Crop Agriculture	Fish Consumption	Impaired	Standard Violation	Mercury	2004	2004	5
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Watershed (WBD-10 Number) 0302020201 Walnut Creek-Neuse River

Subwatershed (WBD-12 Number) 030202020101 Headwaters Stoney Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-62	**Stoney Creek**			**5**	**Habitat Degradation** General Agriculture/Pasture MS4 NPDES	Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
From source to Neuse River						Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5
C;NSW		03-04-05	10.7 FW Miles									

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-62-0.5	**Stoney Run**			**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2004		3a
From source to Stoney Creek												
C;NSW		03-04-05	2.5 FW Miles									

Subwatershed (WBD-12 Number) 030202020102 Outlet Stoney Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-62-3	**Billy Branch**			**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2004		3a
From source to Stoney Creek												
C;NSW		03-04-05	1.3 FW Miles									

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-62ut23	**UT 23 to Stoney Creek**			**3a**	**Habitat Degradation** General Agriculture/Pasture MS4 NPDES	Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2004		3a
From source to Stoney Creek												
C;NSW		03-04-05	2.5 FW Miles									

Subwatershed (WBD-12 Number) 030202020106 Lake Wakena-Walnut Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-68	**Walnut Creek (Lake Wackena, Spring Lake)**			**4a**	**Low Dissolved Oxygen**	Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
From source to Neuse River					**Low pH**	Aquatic Life	Not Rated	Data Inconclusive	Aquatic Weeds	1998	1998	4a
C;NSW		03-04-05	6.9 FW Miles			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Watershed (WBD-10 Number) 0302020202 Bear Creek-Neuse River

Subwatershed (WBD-12 Number) 030202020202 Headwaters Bear Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-72-(0.1)	**Bear Creek**	From source to a point 0.3 mile downstream of Lenoir County SR 1002	C;Sw,NSW	03-04-05	12.4 FW Miles	5	**Habitat Degradation** General Agriculture/Pasture	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	2008	5

Subwatershed (WBD-12 Number) 030202020203 Outlet Bear Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-72-(5)	**Bear Creek**	From a point 0.3 mile downstream of Lenoir County SR 1002 to Neuse River	WS-IV;Sw,NSW	03-04-05	5.5 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
								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

Subwatershed (WBD-12 Number) 030202020205 Falling Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-77	**Falling Creek**	From source to Neuse River	C;Sw,NSW	03-04-05	15.5 FW Miles	2		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
								Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
27-77-2	**Mosely Creek**	From source to Falling Creek	C;Sw,NSW	03-04-05	5.2 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Subwatershed (WBD-12 Number) 030202020206 City of Kinston-Neuse River

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(75.7)a	**NEUSE RIVER**	From Lenoir County proposed water supply intake to Stoneyton Creek.	C;NSW	03-04-05	25.6 FW Miles	2		Aquatic Life	Not Rated	Data Inconclusive	Iron	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

Watershed (WBD-10 Number) 0302020203 Mosley Creek-Neuse River

Subwatershed (WBD-12 Number) 030202020306 Mosley Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-84	**Mosley Creek**	From source to Neuse River	C;Sw,NSW	03-04-05	12.7 FW Miles	3a		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a

Subwatershed (WBD-12 Number) 030202020307 Mosley Creek-Neuse River

Assessment Unit Number / Description / Classification	Name / DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(75.7)b	**NEUSE RIVER**		**5**	**Low Dissolved Oxygen**	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
From Stoneyton Creek to mouth of Contentnea Creek.				ANOPS land app site	Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
C;NSW	03-04-05	6.5 FW Miles		ND land app site	Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	2008	5
				Nutrient Impacts	Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
				Natural Conditions							
				Row Crop Agriculture							
				Stormwater Runoff							

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.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 14. Table 15 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 for more information about use support methodology.

Waters in the following sections and in Table 15 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.

5.2 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. Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 16 for a summary of use support for waters in subbasin 03-04-05(see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

5.3 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 303(d) 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.

Table 16 Summary of Use Support Ratings in Subbasin 03-04-05

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
Freshwater acres (impoundments)	0	0	0.0	0	0.0	0	8	8
Freshwater miles (streams)	129	58	16	52	14	19	235	364

% - Percent of total miles/acres.

5.3.1 Bear Creek Watershed [AU# 27-72-(0.1) & 27-72-(5)]

Bear Creek [AU# 27-72-(0.1)]
Current Status
Bear Creek [AU# 27-72-(0.1); C; Sw; NSW] from source to a point 0.3 miles downstream of Lenoir County SR1002 (12.4 miles) is Impaired for aquatic life due to a Fair benthic bioclassification at site JB75. This site was added during this assessment period to assess the conditions further up in the watershed in an area that may be undergoing changes in land use, from agriculture to urban. This site is 9.5 stream miles upstream from the normal basinwide site (JB74). The stream channel at this site was linear, indicating that the stream segment had been channelized sometime in the past. The substrate was a mix of silt and sand, and thus not conducive to colonization for most macroinvertebrates. The riparian zone on both banks contained breaks, and was narrow on the right side. There was a large erosional area on the right bank, which had little vegetation available for stabilization. Further upstream, the stream is a channelized ditch with no functional riparian zone for a distance of at least 100 m. The lack of adequate instream habitat is one probable contributor to the degraded benthic community at this site. Agricultural non-point source pollution not buffered by a healthy riparian zone upstream of the reach samples may be contributing to degradation. Channelization may also be affecting the benthic community by decreasing habitat diversity.

The upper reaches of Bear Creek may have experienced low flow conditions in June and July of 2005. This may have influenced the benthic conditions found at this site at the end of July. This site should be reassessed during the next basinwide cycle.

This section of Bear Creek will be added to the 303(d) impaired waters list in 2008 for impaired biological integrity.

Bear Creek [AU# 27-72-(5)]
2002 Recommendations
DWQ will continue to monitor Bear Creek to assess future impacts related to land use changes in the watershed.

Current Status
Bear Creek [27-72-(5); WS-IV; SW; NSW] from a point 0.3 miles downstream of Lenoir County SR 1002 to Neuse River (5.5 miles) is Supporting aquatic life due to a Good-Fair benthic bioclassification at site JB74 and No Criteria Exceeded at ambient monitoring station JA46.

The nutrients and the conductivity levels were elevated at this site. The nitrate reading range between 0.92 and 3.29 mg/l, with 50 percent of the readings above 2.19 mg/l.

The macroinvertebrate site (JB74) had been sampled three times prior to 2005. It was rated as Good-Fair for each sampling event up through 2005 except for 1995, when it was rated as Fair. For 2005, the site showed the greatest number of EPT taxa over all previous sampling events. The stream channel at this site had some sinuosity and did not have the appearance of a channel that had been dredged. Stream bank foliage comprised mostly of grasses with sparse woody vegetation, giving a high potential for bank failure during high flows. The riparian zone was wide and entirely intact at the sampling point. The water chemistry at the time of sampling was similar at the two sites which were sampled on the same day and therefore probably do not account for the differences in the EPT taxa observed at the two sites.

This segment is also Supporting for recreation due to acceptable fecal coliform bacteria levels at site JA46 (above the state standard 13 percent of the time).

Watershed Recommendations
DWQ recommends that the local resource agency pursue buffer restoration in this watershed as well as other agricultural BMPs to help reduce sedimentation and nutrient loading.

Recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

Water Quality Initiative
From September 2000 – December 2006, in the two 14 digit watersheds that contain this portion of Bear Creek, the NC ACSP installed the following BMPs to reduce the impact of agricultural production on waters quality at cost to the program of $100,118: 87 acres of 3 year conservation tillage, 224 acres of long term no till, 18 acres of cropland conversion to grass, 250 acres of nutrient scavenger crop, 233 acres of conservation tillage, 17 acres of riparian buffers, 280 acres of nutrient management, 1 dry stack and 4 incinerators. These BMPs affected 3,424 acres of land, saving 7,657 Tons of soil, saving 52,252 pounds of nitrogen, saving 17,631 pounds of phosphorus, managing 47,479 pounds of waste-nitrogen, and managing 60,378 pounds of waste-phosphorus.

5.3.2 Stoney Creek Watershed [AU# 27-62, 27-62-0.5 & 27-62ut23]
Stoney Creek, Walnut Creek and Sleepy Creek Watershed Map (Figure 15)

The entire 10.7 mile stretch of Stoney Creek is currently on the NC State 303(d) impaired waters list for impaired biological integrity. Potential sources of the impairment were listed as urban runoff/storm sewers and agricultural. DWQ studied the stressors and sources of the biological impairment and outlined a general watershed strategy that recommends restoration activities and best management practices (BMPs) to address the identified problem (NC-DWQ, Stoney Creek WARP, June 2003; http://h2o.enr.state.nc.us/swpu/stoneycreek/scfinal.pdf). Stoney Creek is located in Wayne County and its headwaters start flowing north of Goldsboro and flows southward joining the Neuse River near Seymour Johnson Air Force Base (SJAFB). The upper portion of the watershed is primarily agriculture, although development activity is increasing. The majority of the lower watershed lies within the City of Goldsboro, where a mixture of residential, military, commercial and light industrial land uses predominate. As of 1998, impervious areas cover approximately 20 percent of the study area, with higher levels (29 percent) evident in the lower study area below New Hope Rd. It is likely that this impervious percentage has increased substantially since 1998.

It is important to note that this area experienced several weather related extreme events that potentially impacted the study area. In September 1999 (before this assessment period), tropical storm Dennis and hurricane Floyd brought some of the largest amounts of rain and the most severe flooding on record. Precipitation at SJAFB during the month of September 1999 was 26.9 inches compared with a historic average of 4.8 inches. Then drought conditions prevailed with precipitation well below normal during 2000 (-15 percent), 2001 (-10.4 percent) and between January and September 2002 (-18.4 percent). The WARP study took place during this drought period. The normal basinwide samples were collected in 2004 and 2005. Samples taken later in the basinwide assessment should have allowed enough time for the aquatic organism to recover from the weather extremes seen in this watershed prior to and early on in this assessment period. However, Stoney Creek was added to the 303(d) impaired waters list in 1998 so the conditions in this area were already impacted before the extreme weather event, therefore, the natural populations may not have been suitable for re-colonization. See the 2003 WARP report for more details on the specific finding for the Stoney Creek watershed (NC-DWQ, June 2003 (Stoney Creek WARP)).

2002 Recommendations
DWQ will continue to monitor Stoney Creek to evaluate impacts of development in the Goldsboro area. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Stoney Creek. The Watershed Assessment and Restoration Project is currently doing a detailed assessment of Stoney Creek to define the extent of water quality problems and narrow the possible causes.

Goldsboro and Seymour Johnson should consider water quality impacts to Stoney Creek and prevent potential water quality problems by installing and maintaining BMPs during and after development

Current Status
Stoney Creek [AU# 27-62]
Stoney Creek [AU# 27-62; C; NSW] from source to Neuse River (10.7 miles) is Impaired for aquatic life due to a fair benthic bioclassification at JB85. This site was sampled in 2001, twice in 2000 and in 1995. As in 2005, the site was rated Fair on each prior occasion, except in 1995 when it was rated poor. At the sampling location, the bank vegetation was sparse, allowing for bank failure during high flow events. The riparian zone was wide and intact on both sides of the stream. Most of the abundant organisms found at this site were classified as moderately to highly tolerant of pollutants.

Fish community was also assessed at this site (JF39). Fish sites in this basin are all Not Rated because no assessment criteria have been established for the Coastal Plain streams. However, the number of fish and number of species has gradually increased over time.

Site JB83 was the most upstream sampling location on Stoney Creek. This section of the stream was Not Rated due to the stream size at the time of sampling in 2001. The data indicated a degraded community that was limited by low dissolved oxygen. The habitat was extremely poor at this site, where the negative impacts from channelization were evident. Habitat improved substantially downstream, where it was clearly adequate to support a more diverse benthic community than what currently exists. Since the benthos is impaired below this site it implies that other factors in addition to habitat conditions are likely impacting the benthic community.

The WARP report concluded that toxicity was considered one of the primary causes of impairment below JB83. Habitat degradation, low DO and scour were additional stressors that also contributed to biological degradation through the watershed.

Impairment in the lower Stoney Creek is also likely impacted by the lack of benthic colonization sources due to the low DO stress and poor habitat in the headwaters.

See the 2003 WARP study for more specifics on this watershed (http://h2o.enr.state.nc.us/swpu/stoneycreek/scfinal.pdf).

Stoney Creek will remain on the 303(d) list of impaired waters for impaired biological integrity.

Recommendations

These are some of the recommendations from the 2003 WARP study. Please see the original document for complete details.

The following actions are necessary to address current sources of impairment in Stoney Creek.

1. Develop and implement a strategy to address toxic inputs from the urban portions of the watershed, including a variety of source reductions and stormwater treatment methods.
2. Evaluate the potential risk of agricultural pesticides on water quality, given the extensive crop acreage in the upper watershed.
3. Plant native woody riparian vegetation along Stoney Creek and its tributaries to provide an adequate supply of woody material to the stream and improve bank stability.
4. Implement feasible and cost-effective stormwater retrofit projects in the urban portions of the watershed to mitigate the hydrologic effects of development.
5. Encourage nutrient reduction efforts throughout the watershed. Low DO levels in the watershed are likely due primarily to natural swamp drainage, human inputs may significantly contribute to the problem.
6. Prevent further channel erosion and habitat degradation.
7. Develop and enforcement improved sediment and erosion control regulations.
8. Protect existing wetlands and riparian buffers along all waterbodies, including ephemeral streams.

Stoney Run Creek [AU# 27-62-0.5]

Stoney Run Creek [AU# 27-62-0.5] from source to Stoney Creek (2.5 miles) is Not Rated for aquatic life due to a benthic bioclassification at site JB86. This site could not be rated because the drainage size is less than 3 square miles. This small tributary to Stoney Creek is in the upper part of the watershed and is located about 150 meters below a small yard pond. It was very difficult to find an adequate sampling location in the upper part of the Stoney Creek watershed. These small tributaries often have no visible flow either in winter or summer. The lack of visible flow in this system is due to the low relief of the geographical area and the abundance of beaver dams in the area. The habitat was good at this location however, the high specific conductance (105 µmhos/cm) and the low pH (5.8) suggests some input from the upstream pond and lawns.

This site was not rated, however the overall data was indicative of a stressed stream. This stress could be either from upstream land use or unstable hydrology (stops flowing or dries up in the summer). The presence of a pond or other impoundments generally restrict any macroinvertebrate recolonization from upstream and inhibits normal flow in the stream below the impoundment, thereby adversely affecting the macroinvertebrate community directly down stream.

UT 23 to Stoney Creek [AU# 27-62ut23]
UT 23 to Stoney Creek [AU# 27-62ut23] from source to Stoney Creek (2.5 miles) is Not Rated due to the unstable hydrology of this watershed. The data suggest a stressed system with little instream habitat available for macroinvertebrate colonization. However, the stream banks were stable with little potential for erosion or failure, good shading and an extensive and intact riparian zone on one bank. The benthic community was dominated by the toxics or organics indicating species. This stream probably stops flowing during dry summer months. This site should be assessed using swamp methodology during the next assessment period.

5.3.3 Neuse River [AU# 27-(56)b, 27-(75.7)a & 27-(75.7)b]

2002 Recommendations
In order to maintain the historically Good bioclassification in this segment of the Neuse River, DWQ recommends continued improvements to the WWTPs and consideration of water quality impacts during development and other intensive land uses. Continued implementation of the Neuse NSW strategy should help to minimize water quality impacts to this segment of the Neuse River.

The Neuse River and tributaries (Falling Creek and Briery Run) near Kinston have indications of nonpoint source pollution impacts. NCEEP has a stream restoration project in Falling Creek, and the six local watersheds in this area are targeted for restoration.

Current Status
Neuse River [AU# 27-(56)b]
Neuse River [AU# 27-(56)b; C; NSW] from the subbasin 030405-030412 boundary to a point 0.7 miles downstream of the mouth of Coxes Creek (21.5 miles) is supporting aquatic life due to no criteria exceeded at ambient monitoring stations JA43 and JA45 (Figure 15). The data indicate that this area is impacted by non-point source runoff. The nutrients were elevated as can be seen in table 18 below, the turbidity was elevated with exceedances above the standard of 50 NTU in 7 and 3 percent of the samples at JA43 and JA45 respective and the conductive ranged between 60 and 264 µmhos/cm.

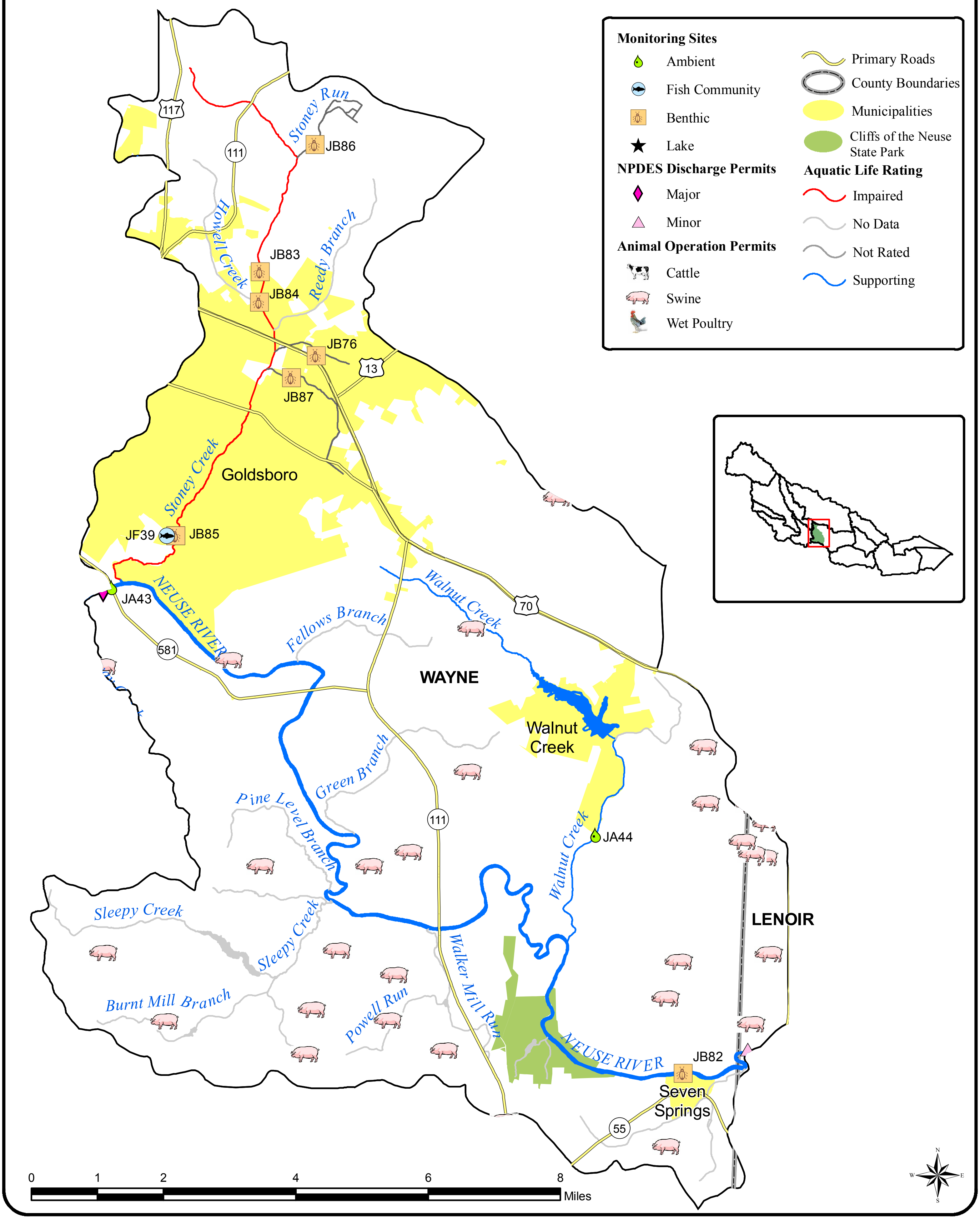
This segment was added to the 2004 303(d) list for fish consumption due to elevated mercury levels in fish tissue samples. See the text below for specifics on fish tissue sampling that occurred during this assessment period. All waters within the Neuse Basin and throughout the State of NC are impaired on an evaluated basis for fish consumption due to elevated mercury in fish tissue. This specific 2004 impairment was based on actual monitoring within this segment.

Neuse River [AU# 27-(75.7)a]
Neuse River [AU# 27-(75.7)a; C; NSW] from Lenoir County proposed water supply intake to Stoneyton Creek (25.6 miles) is Supporting for aquatic life and recreation due to a Good benthic rating at site JB81 and No Criteria Exceeded at ambient monitoring stations JA48 and JA49.

The data at benthic site JB81 was quite consistent between the 2000 and 2005 sampling period. Bank vegetation was sparse allowing for erosion during high flows. The riparian zone was relatively wide on both banks, intact on the right bank but with infrequent breaks on the left.

Low dissolved oxygen levels were seen at both of the ambient monitoring stations, however they did not exceed the state standard by greater than 10 percent (see Table 17). Dissolved oxygen levels less than 4 mg/l were seen in 6 percent of the samples taken at station JA49. They were also less than 5 mg/l in 12 percent of the samples at this same site. The minimum recorded DO readings were 2.8 mg/l and 3.1 mg/l at stations JA48 and JA49 respectively. The conductivity was also high in this segment with readings ranging between 55 and 1336 µmhos/cm. The range of nutrient concentrations can be seen in Table 18.

Figure 15 Stoney, Walnut, and Sleepy Creek Watersheds



The City of Kinston expanded and upgrade the 4.5 MGD Northside WWTP to an 11.85 MGD regional treatment facility (Kinston Regional Wastewater Reclamation Facility). This facility replaced the failing Peachtree WWTP. The Peachtree WWTP had many BOD, DO and NH3 violations over the last several year. Operations began at the new plant in August 2006 and ceased at the Peachtree plant September 1, 2006.

The DWQ biologist assessed a sludge spill in 2007 from the Peachtree WWTP to an unnamed tributary to the Neuse River. Benthic samples were collected above and below the affected area. Both areas were highly impacted by organic pollutants. The species found at these sites reflected the organically enriched, low dissolved oxygen conditions in this stream. The bottom substrate changed dramatically between the two sites with the upstream benthic substrate mostly sand to mostly biosolids and silt downstream of the sludge spill. The conductivity also went up from 234 µmhos/cm upstream to 337 µmhos/cm downstream. It appears that this stream as a whole is possibly impacted by urban runoff.

<u>Neuse River [AU# 27-(75.7)b]</u>

Neuse River [AU# 27-(75.7)b; C; NSW] from Stoneyton Creek to the mouth of Contentnea Creek (6.5 miles) is Impaired for aquatic life due to low DO levels at ambient station JA50. Twelve percent of the samples were below 4 mg/l and 21 percent were below 5 mg/l. The minimum recorded DO level was 2.5 mg/l. High levels of nutrients were also observed at this location (see Table 18). Station JA50, a Lower Neuse Basin Association site, replaced station JA125 in January 2003.

This section of the Neuse River will be added to the 2008 303(d) impaired waters list for DO standard violation.

Many small tributary in this subbasin are in agricultural land use areas. There are many municipal/industrial and swine waste land application fields in this area as well. These land use practices along with the growing urban areas in this subbasin may be impacting the river near Goldsboro and Kinston. Low dissolved oxygen detected at ambient monitoring stations may be the result of the large volume of discharges in this segment of the river as well as from possible swamp drainage.

Table 17 Dissolved Oxygen data over the last several assessment periods (instantaneous DO data).

	9/1/1995-08/31/2000	9/1/2000 - 8/31/2005 Assessment		**Current Assessment** 1/1/2002 - 12/31/2006	
Station ID MAP / DWQ #	DO < 4 mg/l (%)	DO < 4 mg/l (%)	DO < 5 mg/l (%)	DO < 4 mg/l (%)	DO < 5 mg/l (%)
JA43 / J5970000		0	1.7	0	1.7
JA45 / J6024000	3.8	1.2	8.2	1.2	8.2
JA48 / J6150000 – DWQ JA48 / J6150000 - LNBA **Co-located – combined data**	2.5	0.6 1.2 **0.8**	3.1 8.2 **4.9**	1.0 1.2 **1.0**	3.9 7.1 **4.8**
JA49 / J6250000	2.5	7.1	14.1	5.9	11.8
JA50 / J6340000		17.4*	30.4*	12.1**	21.2**
JA125 / J637000	2.5	0^	3.1^	0^^	0^^

* Data for 46 sampling dates between January 2003 and August 2005.
** Data for 66 sampling dates between January 2003 and December 2006.
^ Data for 32 sampling dates between September 2000 and December 2002.
^^ Data for 11 sampling dates between January 2002 and December 2002.

Table 18 Nutrient concentrations during this assessment periods.

	Current Assessment 1/1/2002 - 12/31/2006			
Station ID MAP / DWQ #	NH3 mg/l	NO3 mg/l	TKN mg/l	TP mg/l
JA43 / J5970000	0.02-0.08	0.07-0.82	0.35-0.74	0.06-0.3
JA45 / J6024000	0.01-0.38	0.07-1.38	0.2-1.88	0.02-0.67
JA48 / J6150000 – DWQ JA48 / J6150000 – LNBA Co-located station	0.02-0.11 0.01-0.31	0.11-1.1 0.08-1.02	0.29-0.8 0.2-1.84	0.05-0.21 0.02-0.32
JA49 / J6250000	0.01-0.5	0.03-3.77	0.22-1.89	0.03-0.45
JA50 / J6340000*	0.01-0.34	0.11-3.43	0.2-1.84	0.03-9.96
JA125 / J637000^	0.02-0.39	0.41-1.24	0.4-0.6	0.09-0.14

* Data for 66 sampling dates between January 2003 and December 2006.
^ Data for 11 sampling dates between January 2002 and December 2002.

Neuse River - Fish Tissue Monitoring

All waters in the Neuse River basin are Impaired on an evaluated basis in the Fish Consumption category for mercury contamination. This is based on a fish consumption advice from the NC Department of Health and Human Services (NC DHHS). For more information on fish consumption advisories and advice, contact NC DHHS (http://www.schs.state.nc.us/epi/fish/current.html).

Largemouth bass, striped bass, sunfish, and catfish samples were collected from the Neuse River near Goldsboro and Kinston during 2000 and analyzed for mercury and heavy metal contaminants. The samples were collected as part of an eastern North Carolina mercury assessment.

Near Goldsboro, three largemouth bass, and one striped bass (4 of 21 total samples) contained mercury concentrations exceeding the state criteria of 0.4 ppm. Mercury levels in all samples ranged from 0.10 to 0.52 ppm. Results for other metals were non-detectable or below EPA and North Carolina screening values. Two additional largemouth bass samples were collected from the Goldsboro station during 2003 and analyzed for organics and PCB contaminants. The samples contained trace amounts of DDE, a DDT metabolite, and dieldrin but concentrations were well below US EPA, US FDA, and State of North Carolina criteria. PCB contaminants were not detected.

Near Kinston, all largemouth bass samples (7 of 20 total samples) contained mercury concentrations exceeding the state criteria of 0.4 ppm. Mercury levels in all samples ranged from 0.11 to 1.40 ppm. Results for other metals were non-detectable or below EPA and North Carolina screening values. For more information on fish tissue monitoring see the Environmental Sciences Section, Basinwide Assessment Report Neuse River Basin, 2006 (http://h2o.enr.state.nc.us/esb/Basinwide/Neuse06BasinReportFinal.pdf).

Water Quality Initiative

From September 2000 – December 2006, the following BMPs were installed through the NC ACSP at a cost of $36,132: 250 acres of 3 year conservation tillage, 25 acres of cropland conversion to grass, 5 acres of cropland conversion to trees, 1 acre of grassed waterway, 31 acres of filter strips and 186 acres of riparian buffers. These BMPs affect 590 acres and save 1,961 Tons of soil, 6,261 pounds of nitrogen, and 1,147 pounds of phosphorus.

5.3.4 Walnut Creek (Lake Wackena, Spring Lake) [AU# 27-68]

Stoney Creek, Walnut Creek and Sleepy Creek Watershed Map (Figure 15)

2002 Recommendations

DWQ and LNBA will continue to monitor the site to detect any water quality changes. DWQ will work with the Village WWTP to determine the source of low dissolved oxygen in Walnut Creek.

Current Status

Walnut Creek (Lake Wackena, Spring Lake) [AU# 27-68; C; NSW] from the source to the Neuse River (6.9 miles) is currently supporting aquatic life due to no criteria exceeded at ambient monitoring station JA44. The water quality appears to have improved significantly within this tributary of the Neuse River (see Table 19 below). This site was previously impaired for low dissolved oxygen with DO levels below 4 mg/l in 32.5 percent of the samples during the last assessment period (9/95-8/00). During this assessment period, DO levels were below 4 and 5 mg/l in 4.7 and 12.9 percent of the sample respectively. The number of pH readings below the state minimum pH standard of 6 has also dropped over this same time period (see Table 19). Nutrients however still appear to be elevated.

This segment is Supporting for recreation due to acceptable fecal coliform bacteria levels at site JA44.

This segment of Walnut Creek will be removed from the 2008 303(d) list for low DO standard violations.

Table 19 Percentage of dissolved oxygen and pH readings below the state standard over the last several assessment periods.

Assessment Period	DO < 4 mg/l (%)	DO < 5 mg/l (%)	pH < 6 (%)	n
1/2002 – 12/2006	4.7	12.9	2.4	85
9/2000 – 8/2005	7.1	22.4	14.1	85
9/1995 – 8/2000	32.5	51.3	33.8	80

5.4 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.

5.4.1 Falling Creek [AU# 27-77]

Current Status
Falling Creek [AU# 27-77; C; Sw; NSW] from source to the Neuse River is Supporting for aquatic life due to a Good-Fair benthic bioclassification at Site JB78. This site was tested in 2001 and 2005 and received a Good-Fair rating on both occasions. Stream bank vegetation was diverse and included trees, shrubs, and grasses, however erosional areas were present. The riparian zone was wide and intact on both banks. Fish community was assessed at site JF37. A rating was not assigned because an assessment criterion for a Coastal Plain stream is still being developed. It is likely that a rating could be assigned at a later date once the criteria have been finalized. This will be the case for all fish community sites sampled in this subbasin. The fish community was severely impacted at this site post-Hurricane Fran in 1996. The fish community now appears to be similar to the pre-Hurricane Fran in terms of species diversity and abundance.

5.5 Additional Water Quality Issues within Subbasin 03-04-05

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.

5.5.1 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.

See section 5.3.3 (Neuse River) within this chapter for site-specific fish tissue information collected near Goldsboro and Kinston.

Chapter 6
Neuse River Subbasin 03-04-06
Including the: Little River and Buffalo Creek

6.1 Subbasin Overview

Subbasin 03-04-06 at a Glance

Land Cover (percent)

Forest/Wetland:	59.4
Surface Water:	0.8
Urban:	3.2
Cultivated Crop:	33.0
Pasture/ Managed Herbaceous:	3.7

Counties
Franklin, Johnston, Wake, Wayne and Wilson

Municipalities
Rolesville, Zebulon, Wendell, Kenly and Goldsboro

Stream Statistics

Total Streams:	220.2 mi/50.7ac
Total Supporting:	103.5 mi
Total Impaired:	8.7 mi
Total Not Rated:	7.7 mi/0.0 ac
Total No Data:	100.3 mi

This subbasin includes eastern Wake County, northeast Johnston County, and central Wayne County; a small portion of Franklin County at the headwaters of Little River is included as well. The main waterbodies in this subbasin is the Little River, from the headwaters of the stream to the Neuse River and Buffalo Creek.

The collective population of the municipalities in this subbasin has increased by a little over 600 in the past ten years. The town of Goldsboro's population has decreased by 4 percent (1,562) during the same time period. Land cover for this subbasin is over half forest/wetland, with the remainder crop and pastureland and about three percent urban. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 16.

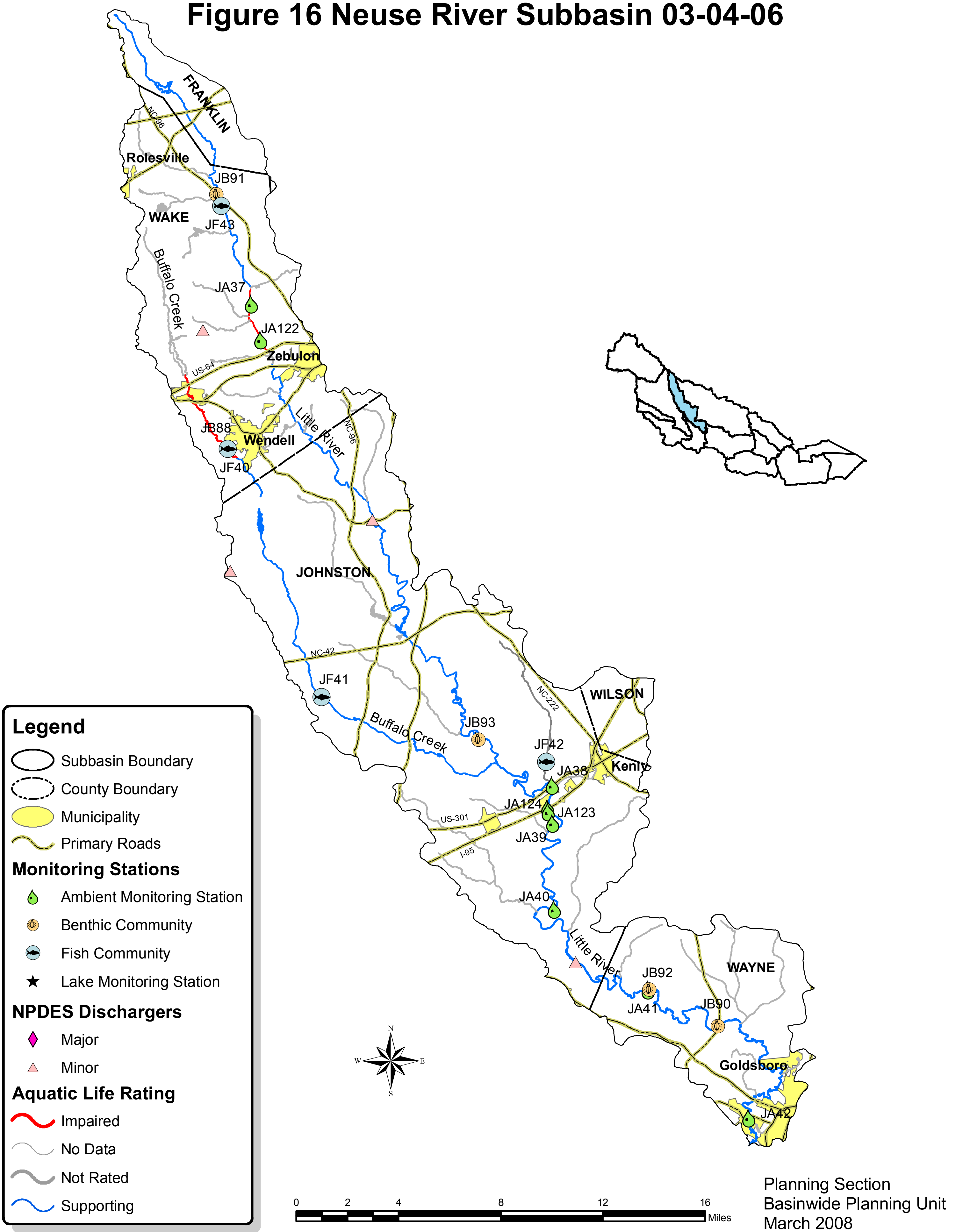
There are 6 minor NPDES wastewater discharge permits in this subbasin with a total permitted flow of 1.18 MGD. The largest of these is Kenly Regional WWTP (0.60 MGD). There are also 9 individual NPDES stormwater permits in the subbasin. Refer to Appendix III for identification and more information on NPDES permit holders. Wayne and Wake counties have developed a stormwater program under Phase II. Wake, Johnston, and Wayne County have also developed model stormwater ordinances as required by the Neuse NSW strategy stormwater rules (Chapter 18). There are also 16 permitted animal operations in this subbasin.

The City of Raleigh's Little Creek WWTP in subbasin 03-04-07 is looking to expand to about 8 MGD. This WWTP currently discharges 2.2 MGD to Little Creek which has a 7Q10 low flow of zero at the discharge point, which limits its waste assimilation capacity during dry weather. The City of Raleigh is looking at a possible discharge site in the Little River in Wake County just north of the Johnston County line.

The City of Raleigh is also in the process of purchasing land in the upper Little River watershed for the development of a 1,100 acre Little River Reservoir which will likely yield about 17 MGD. This is in the City of Raleigh's long term plans for providing adequate drinking water supply to the growing Raleigh area and the six municipalities it supplies.

There is a single new water quality impairment on the Little River for low dissolved oxygen. This is in the area of the proposed reservoir. This impairment is possibly due to the extensive network of beaver dams in the area. One of the main stressors in this watershed is habitat

Figure 16 Neuse River Subbasin 03-04-06



Planning Section
Basinwide Planning Unit
March 2008

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Watershed (WBD-10 Number) 0302020115 Upper Little River														
Subwatershed (WBD-12 Number) 030202011501 Headwaters Little River														
27-57-(1)a	**Little River (Moores Pond, Mitchell Mill Pond)**	From source to Big Branch	WS-II;HQW,NSW	03-04-06	13.2 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2004		1
								Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
27-57-(1)b	**Little River (Moores Pond, Mitchell Mill Pond)**	From Big Branch to 0.2 miles upstream of Wake County SR 2368	WS-II;HQW,NSW	03-04-06	2.9 FW Miles	**5**	**Low Dissolved Oxygen**	Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	2008	5
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
								Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
Subwatershed (WBD-12 Number) 030202011502 Upper Buffalo Creek														
27-57-16-(2)	**Buffalo Creek**	From dam at Robertsons Pond to a point 200 feet upstream from West Haywood Street near Wendell	B;NSW	03-04-06	5.8 FW Miles	**5**	**Habitat Degradation** Construction Stormwater Runoff **Low Dissolved Oxygen**	Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
								Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5
27-57-16-(3)a	**Buffalo Creek (Wendell Lake)**	From a point 200 feet upstream from West Haywood Street near Wendell to UT on west side of creek 0.8 miles south of Wendell Lake	C;NSW	03-04-06	4.0 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
Subwatershed (WBD-12 Number) 030202011503 Cattail Creek-Little River														
27-57-(8.5)a	**Little River (Tarpleys Pond)**	From bridge at N.C. Hwy. 97 to Little Buffalo Creek	WS-V;NSW	03-04-06	33.5 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
Subwatershed (WBD-12 Number) 030202011504 Lower Buffalo Creek														
27-57-16-(3)b	**Buffalo Creek (Wendell Lake)**	From UT on west side of creek 0.8 miles south of Wendell Lake to Little River	C;NSW	03-04-06	15.0 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
Watershed (WBD-10 Number) 0302020116 Lower Little River														
Subwatershed (WBD-12 Number) 030202011601 Little Buffalo Creek														

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-57-17 From source to Little River; C;NSW	03-04-06	**Little Buffalo Creek**	7.7 FW Miles	**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
Subwatershed (WBD-12 Number) 030202011602 Little Creek-Little River												
27-57-(20.2)a From Spring Branch to 4.2 miles upstream of NC 581; WS-IV;NSW	03-04-06	**Little River**	8.5 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards 1n3	2006		1
						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
						Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
27-57-(8.5)b From Little Buffalo Creek to Spring Branch; WS-V;NSW	03-04-06	**Little River (Tarpleys Pond)**	11.5 FW Miles	**2**		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
						Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
						Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1
Subwatershed (WBD-12 Number) 030202011603 Dennis Branch-Little River												
27-57-(20.2)b From 4.2 miles upstream of NC 581 to a point 0.6 mile downstream of Smith Mill Run; WS-IV;NSW	03-04-06	**Little River**	11.9 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
Subwatershed (WBD-12 Number) 030202011604 Buck Swamp-Little River												
27-57-(21.1) From a point 0.6 mile downstream of Smith Mill Run to City of Goldsboro water supply intake; WS-IV;NSW,CA	03-04-06	**Little River**	1.1 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
27-57-(21.2) From City of Goldsboro water supply intake to U.S. Hwy. 70; C;NSW	03-04-06	**Little River**	1.2 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
27-57-(21.4) From U. S. Highway 70 to a point 1.0 mile downstream from U. S. Highway 70; B;NSW	03-04-06	**Little River**	1.0 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-57-(22)		**Little River**	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
From a point 1.0 mile downstream from U.S. 70 to Neuse River					Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
C;NSW	03-04-06	2.6 FW Miles									

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.

degradation. This is likely due to stormwater runoff from the developing towns of Zebulon and Wendell as well as from agricultural practices in the watershed.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 9. Table 20 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 for more information about use support methodology.

Waters in the following sections and in Table 20 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.

6.2 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. Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 21 for a summary of use support for waters in subbasin 03-04-06 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

6.3 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 303(d) 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.

Table 21 Summary of Use Support Ratings in Subbasin 03-04-06

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
Freshwater acres (impoundments)	0	0	0.0	0	0.0	0	51	51
Freshwater miles (streams)	120	9	4	104	47	8	100	220

% - Percent of total miles/acres.

6.3.1 Little River Watershed [27-57-(1)a, 27-57-(1)b, 27-57-(8.5)a, 27-57-(8.5)b, 27-57-(20.2)a, 27-57-(20.2)b, 27-57-(21.1), 27-57-(21.2), 27-57-(21.4) & 27-57-(22)]

2002 Recommendations

DWQ and LNBA will continue to monitor the Little River to assess impacts related to land use changes and to determine the source of the low dissolved oxygen. Because of the rare species in the Little River, this watershed should be targeted for land acquisition to protect the riparian area beyond the 50-foot required buffer. Wake County Parks and Recreation has received a CWMTF grant to establish greenways on portions of the Little River.

Current Status

Little River (Moors Pond, Mitchell Mill Pond) [AU# 27-57-(1)a]

Little River [AU# 27-57-(1)a; WS-II; HQW; NSW] from source to Big Branch (13.2 miles) is Supporting for aquatic life due to a Good-Fair benthic and Good fish community bioclassification at JB91 and JF43 respectively. These stream banks were stable with no evidence of erosion and the riparian zone was wide and intact on both sites.

The macroinvertebrates have consistently received a Good-Fair rating at site JB91 since 1995. The DO levels have been low each time ranging from 2.6 to 4.0 mg/l. This site was observed to be highly productive during this assessment period. The taxa tolerance ranged from intolerant to tolerant to pollutants.

Little River (Moors Pond, Mitchell Mill Pond) [AU# 27-57-(1)b]

Little River [AU# 27-57-(1)b; WS-II; HQW; NSW] from Big Branch to 0.2 miles upstream of Wake County SR 2368 (2.9 miles) is Impaired for aquatic life due to low dissolved oxygen levels of less than 4 mg/l in 34 percent of the samples at ambient monitoring station JA37. DO was below 5 mg/l in 42 percent of the samples. There are no other ambient monitoring stations further up in this watershed. The biologists have noted that there have been consistently low DO levels seen at the benthic site upstream. The bugs however have consistently been rated Good-Fair at that site. It is currently unclear if the low DO levels are due to natural conditions or due to some human influence. Dissolved oxygen levels were also low at ambient monitoring station JA122. Data was collected at this site between May and September 2003. Eighty percent were below 4mg/l and 90 percent were below 5 mg/l. The minimum DO reading at JA37 was 0.5 mg/l and at JA122 was 1.6 mg/l.

These segments are also Supporting for recreation due to acceptable fecal coliform bacteria levels at sites JA37 and JA122.

These segments of the Little River will be added to the 2008 303(d) impaired waters list for low DO standard violation. It is important to note that this impairment is within an area that has a supplemental classification of High Quality Water (HQW). It is possible that the many beaver dams in the area are contributing to the low dissolved oxygen. There are no NPDES point source dischargers in upper reaches of the Little River however; there are a few cattle and horse farm operations above the impaired area.

Wake County is purchasing land in this area for a possible future drinking water reservoir (see details below).

<u>Little River (Tarpleys Pond) [AU# 27-57-(8.5)a]</u>
Little River [AU# 27-57-(8.5)a; WS-V; NSW] from bridge at NC Hwy 97 to Little Buffalo Creek (33.5 miles) is Supporting aquatic life due to a Good benthic bioclassification at site JB93. This was the second consecutive time that this site was rated Good (2000 and 2005). The water was slightly turbid at the time of sampling and the instream substrate embeddedness was about 50 percent. The bank vegetation was sparse, allowing for erosion during high flow events. The riparian zone was wide and intact on both sides of the stream. The tolerance estimate for the most abundant taxa collected ranged from intolerant to tolerant.

<u>Little River (Tarpleys Pond) [AU# 27-57-(8.5)b]</u>
Little River [AU# 27-57-(8.5)b; WS-V; NSW] from Little Buffalo Creek to Spring Branch (11.5 miles) is Supporting for aquatic life and recreation due to No Criteria Exceeded at ambient monitoring stations JA38, JA39, JA40, JA123 and JA124. The DO levels at these stations ranged from 0 to 6 percent of the readings below 4 mg/l and 6 to 28 percent below 5 mg/l. These are all within the state criteria for supporting waters as can be seen by the Good (JB93) and Good-Fair (JB92) benthic bioclassification above and below these stations.

This section of Little River will be removed from the 303(d) impaired waters list for low dissolved oxygen standard violation.

The Kenly Regional WWTP (NC0064891) is a minor discharger (<1MGD) that discharges into this segment of the Little River. It has had fecal coliform bacteria violations off and on for the last several years. During 2006, the facility had 12 weekly or monthly geometric mean exceedances. This facility uses an ultraviolet (UV) disinfection system to kill bacteria. The regional office noted that the UV bulbs are not changed often enough resulting in violations of the state standard and an issuance of a notice of violation from the state.

<u>Little River [AU# 27-57-(20.2)a]</u>
Little River [AU# 27-57-(20.2)a; WS-IV; NSW] from Spring Branch to 4.2 miles upstream of NC581 (8.5 miles) is Supporting for aquatic life and recreation due to a Good-Fair benthic bioclassification at site JB92 and No Criteria Exceeded at ambient monitoring station JA41. Only 5 percent of the samples monitored were below 5 mg/l DO, with a minimum recorded reading of 4.3 mg/l during this assessment period.

This segment was previously added to the 2004 impaired waters list due to low DO reading during the last assessment period (Sept 1995 – Aug 2000). The benthic macroinvertebrate site

(JB92) was a special study site requested within the low DO 303(d) listed segment. The hope was to determine if the low DO levels were due to natural causes. Since this was the first time this site was sampled the biologist were unable to make that determination. However, the DO levels in this segment of the Little River are currently classified as Supporting or adequate for aquatic life. There were two abundant taxa that were indicators of possible organic enrichment and one taxa an indicator of low DO. The tolerance range for the taxa found at this site ranged from slightly intolerant to highly tolerant.

The stream banks had little or no woody vegetation present for stabilization, which makes them susceptible to erosion as well as provided minimal shading. The riparian zone was wide and intact on the left, very narrow but intact on the right. There was limited instream habitat available for macroinvertebrate colonization.

This segment of the Little River will be removed from the 2008 impaired waters list for low DO standard violations.

Princeton WWTP (NC0026662) had numerous limit violations over the prior five years, leading to several Notices of Violations (NOVs) and an active Special Order of Consent (SOC) between August 2003 and December 2005. This facility had 7 fecal coliform bacteria limit violations in 2006 and 3 in 2007. According to the Raleigh Regional Office staff, this facility was having fecal coliform issue due to the length and low flow of effluent in their discharge pipe. They have rectified the problem and have not had any violations since August 2007.

Little River [AU# 27-57-(20.2)b]

Little River [AU# 27-57-(20.2)b; WS-IV; NSW] from 4.2 miles upstream of NC581 to a point 0.6 mile downstream of Smith Mill Run (11.9 miles) is Supporting for aquatic life due to a Good benthic bioclassification at site JB90. This site was rated Good in 1991, as Good-Fair in 1995 and 2000 and has returned to Good in 2005 (current assessment period). There has been a shift in the substrate composition, from large substrate particles to smaller (mostly sand and silt). This may account for the sudden appearance and abundance of certain species at this site. This data can be found in the 2006 ESS Neuse River Basinwide Assessment Report (http://h2o.enr.state.nc.us/esb/Basinwide/Neuse06BasinReportFinal.pdf). The tolerance value of the abundant taxa ranged from intolerant to highly tolerant.

The banks were sparsely vegetated or otherwise composed of grasses, allowing for erosion during high flow events. The riparian zone was wide on both sides, but with frequent breaks on one side of the stream.

Little River [AU# 27-57-(21.1), 27-57-(21.2), 27-57-(21.4), 27-57-(22)]

Little River [AU# 27-57-(21.1); WS-IV; NSW; CA, AU# 27-57-(21.2); C; NSW, AU# 27-57-(21.4); B; NSW, AU# 27-57-(22); C; NSW] from a point 0.6 miles downstream of Smith Mill Run to Neuse River (5.9 miles) is Supporting for aquatic life and recreation due to No Criteria Exceeded at ambient monitoring station JA42. Four percent of the samples were below 5 mg/l DO with a minimum recorded reading of 4.4 mg/l.

Little River Trend Analysis

DWQ conducted a trends and annual load analysis at several stations throughout the basin. The stations chosen for assessment were those in close proximity to a USGS gauging station. All trends were assessed using flow and seasonal adjustments.

Station JA40 was chosen due to the close proximity of the USGS gauging station (#02088500) at SR 2320 near Princeton. Trends were done on data collected between 1990 and 2000. The analysis included trends on total nitrogen (TN), defined as the sum of total Kjeldahl nitrogen and nitrate-nitrogen, total phosphorus (TP) and temperature. A trend analysis was not possible for TN and TP for the current use support assessment window due to a decrease in nutrient sampling frequency at site JA40 starting in 2001. Care should be taken when interpreting these results since it is not known if this trend has continued, reversed or leveled off after 2000.

The results indicated that there was a significant decrease TN concentration in the Little River at station JA40. This trend suggests that the average decrease in TN concentration per year was 0.012 mg/l, which corresponds to an average median TN concentration decrease of 1.5 percent per year during the time period of 1990 through 2000.

In contrast, there was also a significant increase in TP concentration in the Little River. The average increase in TP concentration per year was 0.003 mg/l corresponding to the median TP concentration increasing by an average of 2.3 percent per year during the same time period (1990-2000). TP exhibited a strong seasonal pattern, with higher concentrations generally occurring from May-October.

Temperature did not show a significant trend for this time period.

Recommendations

DWQ should increase the sampling frequency at site JA40 in order to assess future trends at this location. A minimum of 9 samples/year are required in order to perform a statistical trends analysis. It is recommended that this site be sampled monthly.

DWQ and LNBA will continue to monitor the Little River to assess impacts related to land use changes and to determine the source of the low dissolved oxygen. Because of the rare species in the Little River, this watershed should be targeted for land acquisition to protect the riparian area beyond the 50-foot required buffer. Wake County Parks and Recreation has received a CWMTF grant to establish greenways on portions of the Little River.

DWQ recommends that the local resource agency pursue buffer restoration in this watershed as well as other agricultural BMPs to help reduce sedimentation and nutrient loading.

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

Wake County with the assistance of several municipalities are looking at building a new drinking water reservoir on the Little River in the eastern part of the Wake County. More than 2000 acres will be acquired for the reservoir and park facilities, which will include 200-ft buffers surrounding the reservoir. According to Wake County website, as of June 2006, 1,880 acres have been acquired at a cost of $14,419,992. The expected completion date for the reservoir is 2025. This reservoir will help Wake County and several municipalities to meet their expected water needs through 2040. It is estimated that the reservoir will provide 17 million gallons of water per day.

Wake County entered into a partnership with the federal government to preserve 94 acres of farmland and greenway approximately one mile upstream from the proposed Little River Reservoir site and Mitchell Mill State Natural Area. Wake County used funds from the Open Space Preservation Program and a grant from the USDA NRCS Farm and Ranch Lands Protection Program which provides grant funds to assist local governments to purchase agricultural conservation easements designed to restrict the property from any future development or use other than agriculture-related activities. The property consists of approximately 83 acres of farm and timberland, 11 acres of floodplain and 3,500 feet of river frontage on Little River. Increased development is likely to occur in this area; therefore it is important to preserve more open space in the watershed in order to decrease the impact from future development on this important water supply watershed.

The Open Space Program is targeting 184 acres in the Little River Watershed.

6.3.2 Buffalo Creek [AU# 27-57-16-(2)]

2002 Recommendations

DWQ will continue to monitor Buffalo Creek to assess future impacts related to development in the upper watershed. Communities in eastern Wake County should consider water quality impacts to Buffalo Creek during development and utilize BMPs to minimize these impacts during and after development activities. Because of the water quality impacts and the rapid development, Buffalo Creek is a NCWRP targeted local watershed.

Current Status

Buffalo Creek [AU# 27-57-16-(2); B; NSW] from the dam at Robertsons Pond to a point 200 feet upstream from West Haywood St. near Wendell (5.8 miles) is Impaired for aquatic life due to a Fair benthic bioclassification at JB88. This site was sampled one other time in 1991 and received a Poor bioclassification. This site was requested to assess this rapidly developing area upstream of Lake Wendell.

The instream habitat available for colonization was lacking and could contribute to the degraded benthic community. Low DO levels (3.2 mg/l at the time of sampling) are also likely limiting the benthic community. Urbanization around the site is the likely source for stressors to this stream. Grasses were the dominate vegetation on the stream bank, allowing for a high erosion potential to occur in this area. The riparian zone was wide and intact. The tolerance estimate for the taxa found ranged from slightly intolerant to highly tolerant, with 2 abundant taxa as indicators of low dissolved oxygen and another an indicator of organic enrichment. This site has improved slightly since it was last sampled in 1991.

Fish community was also assessed at this site (JF40) and received a Good bioclassification rating. The sample showed a fairly good trophic structure despite the low number of fish collected.

This site will remain on the 303(d) list of impaired waters for impaired biological integrity due to the Fair benthic bioclassification rating during this assessment period.

All of Buffalo Creek will be included in a TMDL management strategy.

Recommendations
DWQ recommends that the local resource agency pursue buffer restoration in this watershed as well as other agricultural BMPs to help reduce sedimentation and nutrient loading.

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).

6.4 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.

6.4.1 Buffalo Creek [AU# 27-57-16-(3)a & 27-57-16-(3)b]

Current Status
Buffalo Creek [AU# 27-57-16-(3)a; C; NSW] from a point 200 feet upstream from West Haywood Street near Wendell to UT on west side of creek 0.8 miles south of Wendell Lake (4 miles) and [AU# 27-57-16-(3)b; C; NSW] from UT on west side of creek 0.8 miles south of Wendell Lake to Little River (15.0 miles) is currently Supporting aquatic life due to a Good-Fair fish community bioclassification at site (JF41). The rating at this site remained the same as the 2000 rating, however the total number of fish collected was roughly half of that caught during the last assessment period. The instream habitat and the vegetative cover were good and the riparian corridor was wide and intact.

The Pace Mobile Home Park treatment facility (NC0064246), a small 15,000 GPD discharger has had several discharge violations over the last 1.5 years. Between January 2006 and April 2007 they had 4 BOD daily or monthly maximum violations, 3 major fecal coliform daily maximum violations and 5 monthly average exceedances in total ammonia nitrogen concentrations. Many of these resulted in civil penalties.

Section 27-57-16-(3)a should have been removed from the 303(d) list during the last assessment due the Good-Fair rating at JF41 in 2002. This segment will be removed from the 2008 303(d) list.

Recommendation
DWQ should take a benthic sample in the lower Buffalo Creek watershed during the next assessment period. Benthic organisms tend to be a little more sensitive and would be a good

indicator as to the effects from development on this segment of the creek. A benthic assessment was done in 2000 and was found to support a good-fair benthic population.

DWQ recommends that the local resource agency pursue buffer restoration in this watershed as well as other agricultural BMPs to help reduce sedimentation and nutrient loading.

6.5 Additional Water Quality Issues within Subbasin 03-04-06

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.

6.5.1 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.

Chapter 7
Neuse River Subbasin 03-04-07

Including the: Contentnea Creek, Little Contentnea Creek, Little Creek, Moccasin Creek, Turkey Creek, Hominy Swamp, Toisnot Swamp and Nahunta Swamp

7.1 Subbasin Overview

Subbasin 03-04-07 at a Glance

Land Cover (percent)

Forest/Wetland:	52.9
Surface Water:	0.6
Urban:	4.1
Cultivated Crop:	39.8
Pasture/ Managed Herbaceous:	2.6

Counties
Franklin, Greene, Johnston, Lenoir, Nash, Pitt, Wake, Wayne and Wilson

Municipalities
Bailey, Middlesex, Lucama, Black Creek, Fremont, Pikeville, Saratoga, Snow Hill, Grifton, Zebulon, Wilson and Farmville

Stream Statistics

Total Streams:	655.5 mi/1,307.9 ac
Total Supporting:	165.3 mi
Total Impaired:	84.6 mi
Total Not Rated:	46.7 mi/510.5 ac
Total No Data:	358.9 mi

This is the largest subbasin in the Neuse River basin, encompassing over 1,000 square miles in 9 different counties, including portions of Franklin, Wake, Johnston, Nash, Wilson, Wayne, Pitt, Lenoir, and almost all of Greene County. It contains the entire Contentnea Creek watershed, including Buckhorn Reservoir and its 2 primary tributaries, Moccasin Creek and Turkey Creek.

Over the past decade, the cumulative growth in population for the 3 major municipalities is over 8,000. Zebulon and Wilson increased by 21.6 percent and 16.8 percent respectively. Farmville's population has decreased by 0.6 percent. Over half of the land cover is forest/wetland and cultivated cropland covers the other portion. There are many hog farms located throughout this subbasin. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 16.

There are 4 major and 12 minor NPDES wastewater discharge permits in this subbasin with a total permitted flow of 23.4 MGD. The largest is Wilson WWTP (14 MGD). There are also 40 individual NPDES stormwater permit in the subbasin. Refer to Appendix III for identification and more information on individual NPDES permit holders. Franklin, Nash, Wake and Wayne Counties have developed a stormwater program under Phase II. Johnston County has a model stormwater ordinances as required by the Neuse NSW strategy stormwater rules (Chapter 18). There are also 150 permitted animal operations in this subbasin. Both agricultural practices and point source dischargers impact the water quality in this subbasin.

There are three new water quality impairments in this subbasin, a biological impairment based on a fair benthic bioclassification in Contentnea Creek and two low dissolved oxygen (DO) impairments in Moccasin and Turkey Creeks. The entire length of Little Contentnea and Hominy Swamp remained impaired for biological integrity.

Water quality improvement was documented in Nahunta Swamp with the benthic bioclassification improving from fair to good-fair during this assessment period. Nahunta Swamp contained the highest diversity of macroinvertebrate fauna in this subbasin. Over $108,000 of the Agriculture Cost Share Program funds were spent between September 2000 and December 2006 on BMP implementation in this watershed. The best management practices used ranged from conservation tillage, cropland conversion, to field border and riparian buffer

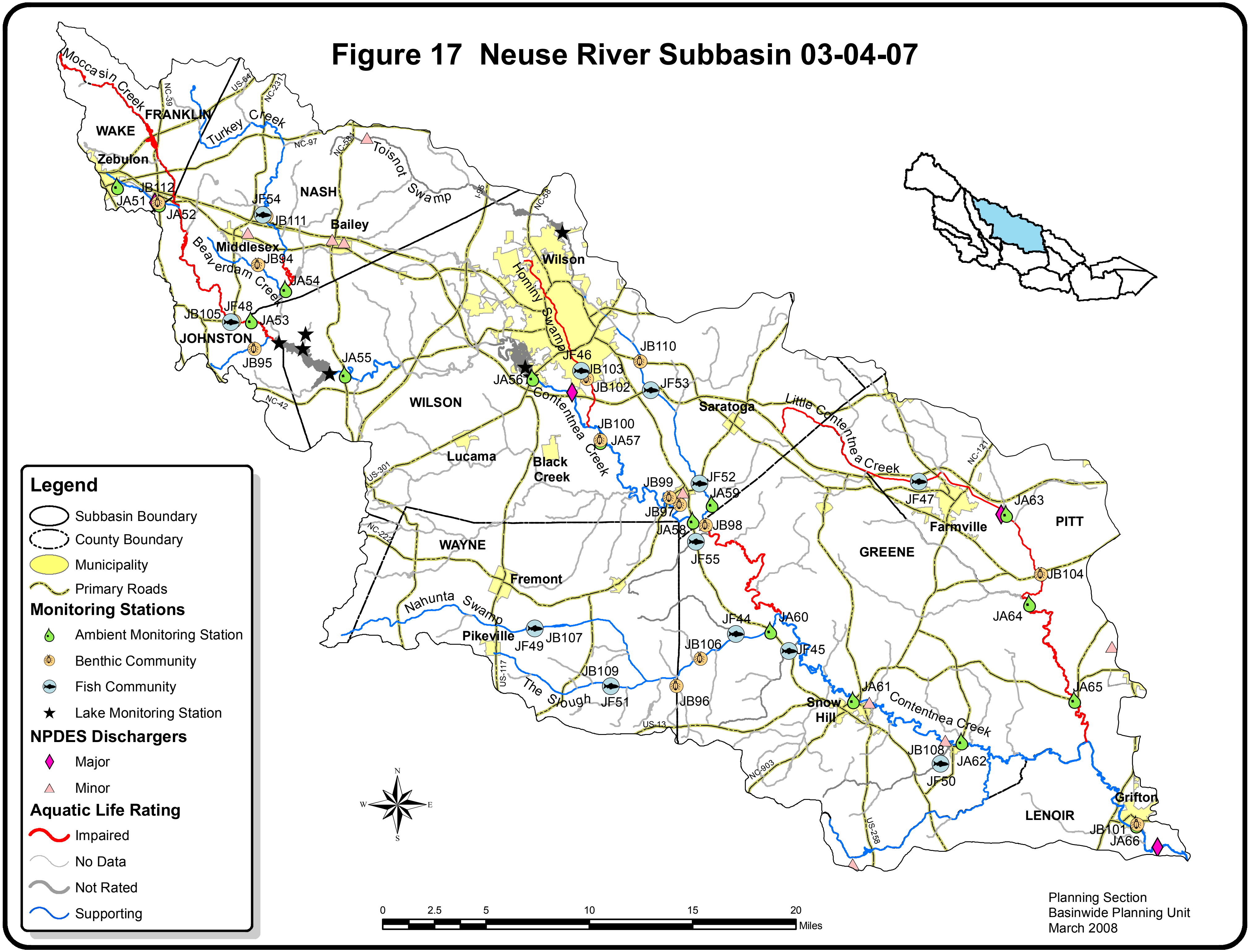


Figure 17 Neuse River Subbasin 03-04-07
Legend
Subbasin Boundary
County Boundary
Municipality
Primary Roads
Monitoring Stations
Ambient Monitoring Station
Benthic Community
Fish Community
Lake Monitoring Station
NPDES Dischargers
Major
Minor
Aquatic Life Rating
Impaired
No Data
Not Rated
Supporting
WAKE
FRANKLIN
NASH
JOHNSTON
WILSON
WAYNE
GREENE
PITT
LENOIR
Zebulon
Middlesex
Bailey
Wilson
Saratoga
Lucama
Black Creek
Fremont
Pikeville
Farmville
Snow Hill
Grifton
Moccasin Creek
Turkey Creek
Toisnot Swamp
Beaverdam Creek
Hominy Swamp
Contentnea Creek
Little Contentnea Creek
Nahunta Swamp
The Slough
JA51
JB112
JA52
JF54
JB111
JB94
JA54
JB105
JF48
JA53
JB95
JA55
JA56
JF46
JB103
JB102
JB110
JF53
JB100
JA57
JB99
JF52
JA59
JB97
JA58
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JA60
JF45
JB106
JB109
JF49
JB107
JF51
JB96
JA61
JB108
JA62
JF50
JB101
JA66
NC-39
US-64
NC-231
NC-97
NC-581
I-95
NC-58
NC-42
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NC-222
US-117
US-13
NC-903
US-258
NC-121
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20
Miles
Planning Section
Basinwide Planning Unit
March 2008

Watershed (WBD-10 Number) 0302020301 Buckhorn Reservoir

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Subwatershed (WBD-12 Number) 030202030101 Upper Moccasin Creek												
27-86-2 From source to Contentnea Creek; C;NSW	**Moccasin Creek (Bunn Lake)**	03-04-07	22.8 FW Miles	5	**Habitat Degradation**: General Agriculture/Pasture; **Low Dissolved Oxygen**	Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	2008	5
						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity FishCom	2005		1
						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
27-86-2-4 From source to Moccasin Creek; C;NSW	**Little Creek (West Side)**	03-04-07	4.1 FW Miles	2	**Fecal Coliform Bacteria**: Stormwater Runoff; **Low Dissolved Oxygen**: WWTP NPDES; **Nutrient Impacts**: Stormwater Runoff, WWTP NPDES	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
Subwatershed (WBD-12 Number) 030202030102 Lower Moccasin Creek												
27-86-2-6.5 From source to Moccasin Creek; C;NSW	**Bull Branch**	03-04-07	4.0 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2000		1
Subwatershed (WBD-12 Number) 030202030103 Upper Turkey Creek												
27-86-3-(1)a1 From source to Old Middlesex Road; C;NSW	**Turkey Creek**	03-04-07	19.4 FW Miles	2	**Low Dissolved Oxygen**	Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2001		1
						Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
Subwatershed (WBD-12 Number) 030202030104 Lower Turkey Creek												
27-86-3-(1)a2 From Old Middlesex Road to SR 1101; C;NSW	**Turkey Creek**	03-04-07	2.0 FW Miles	5	**Low Dissolved Oxygen**	Aquatic Life	Impaired	Standard Violation	Low Dissolved Oxygen	2006	2008	5
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
27-86-3-8 From source to Turkey Creek; C;NSW	**Beaverdam Creek**	03-04-07	5.6 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2001		1

Subwatershed (WBD-12 Number) 030202030105 Little Creek-Buckhorn Reservoir

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-(1)a **Contentnea Cr (Buckhorn Reservoir)** Buckhorn Reservoir WS-V;NSW 03-04-07 758.2 FW Acres	**4a**	**Chlorophyll a** General Agriculture/Pasture **Nutrient Impacts** General Agriculture/Pasture	Aquatic Life	Not Rated	Data Inconclusive	Water Quality Standards Aquatic Life	2005		3a
			Aquatic Life	Not Rated	Data Inconclusive	Low Dissolved Oxygen	1998	1998	4a
			Water Supply	Not Rated	Data Inconclusive	Water Quality Standards Water Supply	2005		3a

Watershed (WBD-10 Number) 0302020303 Toisnot Swamp

Subwatershed (WBD-12 Number) 030202030301 Upper Toisnot Swamp

Assessment Unit	Overall Category	Potential Stressors / Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-11-(1) **Toisnot Swamp (Silver Lake, Lake Wilson)** From source to a point 0.6 mile upstream of Wilson County SR 1326 WS-III;NSW 03-04-07 18.4 FW Miles	**3a**		Aquatic Life	Not Rated	Data Inconclusive	High Water Temperature	2005		3a
			Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2005		1

Subwatershed (WBD-12 Number) 030202030303 Middle Toisnot Swamp

Assessment Unit	Overall Category	Potential Stressors / Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-11-(5)b **Toisnot Swamp** From UT 0.9 miles south of US 301 to Contentnea Creek C;Sw,NSW 03-04-07 12.0 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
			Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
			Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Watershed (WBD-10 Number) 0302020304 Wiggins Mill Reservoir-Contentnea Creek

Subwatershed (WBD-12 Number) 030202030401 Little Swamp-Contentnea Creek

Assessment Unit	Overall Category	Potential Stressors / Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-(1)b **Contentnea Cr (Buckhorn Reservoir)** From Buckhorn Reservoir to a point 0.6 mile upstream of Marsh Swamp WS-V;NSW 03-04-07 5.8 FW Miles	**2**		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
			Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
			Water Supply	Supporting	No Criteria Exceeded	Water Quality Standards Water Supply	2006		1

Subwatershed (WBD-12 Number) 030202030403 Hominy Swamp

Assessment Unit	Overall Category	Potential Stressors / Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-8 **Hominy Swamp** From source to Contentnea Creek C;Sw,NSW 03-04-07 9.9 FW Miles	**5**	**Habitat Degradation** MS4 NPDES ND land app site **Low Dissolved Oxygen**	Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
			Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2001	2004	5

Subwatershed (WBD-12 Number) 030202030404 City of Wilson-Contentnea Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-(5.8) From a point 0.6 mile downstream of Shepard Branch to dam at Wilson Water Supply Intake (Wiggins Mill Reservoir); WS-IV;NSW,CA	**Contentnea Creek (Wiggins Mill Reservoir)**	03-04-07	510.5 FW Acres	3a		Aquatic Life	Not Rated	Data Inconclusive	High Water Temperature	2005		3a
27-86-(7)a From dam at Wilson Water Supply (Wiggins Mill Pond) to 0.7 miles upstream of Toisnot Swamp; C;Sw,NSW	**Contentnea Creek**	03-04-07	19.6 FW Miles	2		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

Subwatershed (WBD-12 Number) 030202030405 Turner Swamp-Contentnea Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-(7)b1 0.7 miles upstream of Toisnot Swamp to Nahunta Swamp; C;Sw,NSW	**Contentnea Creek**	03-04-07	15.1 FW Miles	5	**Fecal Coliform Bacteria**: General Agriculture/Pasture, WWTP NPDES; **Habitat Degradation**: General Agriculture/Pasture, Stormwater Runoff	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2002	2008	5

Watershed (WBD-10 Number) 0302020305 Nahunta Swamp

Subwatershed (WBD-12 Number) 030202030501 Headwaters Nahunta Swamp

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-14 From source to Contentnea Creek; C;Sw,NSW	**Nahunta Swamp**	03-04-07	27.1 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
						Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Subwatershed (WBD-12 Number) 030202030502 The Slough

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-14-1 From source to Nahunta Swamp; C;Sw,NSW	**The Slough**	03-04-07	8.6 FW Miles	2		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2001		1

Subwatershed (WBD-12 Number) 030202030505 Lower Nahunta Swamp

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-14-7 From source to Nahunta Swamp; C;Sw,NSW	**Appletree Swamp**	03-04-07	6.6 FW Miles	3a		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a

Watershed (WBD-10 Number) 0302020306 Little Contentnea Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category

Subwatershed (WBD-12 Number) 030202030602 Upper Little Contentnea Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-26 From source to Contentnea Creek C;Sw,NSW	**Little Contentnea Creek**	03-04-07	34.9 FW Miles	**5**	**Habitat Degradation** ANOPS land app site **Low Dissolved Oxygen** **Nutrient Impacts** ANOPS land app site	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
						Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
						Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
						Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Watershed (WBD-10 Number) 0302020307 Contentnea Creek

Subwatershed (WBD-12 Number) 030202030701 Beaman Run-Contentnea Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-12 From source to Contentnea Creek C;Sw,NSW	**Watery Branch**	03-04-07	5.9 FW Miles	**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a

Subwatershed (WBD-12 Number) 030202030702 Tyson Marsh-Contentnea Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-(7)b2 From Nahunta Swamp to Neuse River C;Sw,NSW	**Contentnea Creek**	03-04-07	45.1 FW Miles	**2**		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
						Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
						Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity Benthos	2000		3a
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
27-86-15 From source to Contentnea Creek C;Sw,NSW	**Fort Run**	03-04-07	7.1 FW Miles	**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a

Subwatershed (WBD-12 Number) 030202030703 Rainbow Creek-Contentnea Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-21 From source to Contentnea Creek C;Sw,NSW	**Rainbow Creek**	03-04-07	8.6 FW Miles	**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a

Subwatershed (WBD-12 Number) 030202030704 Wheat Swamp Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-86-24 From source to Contentnea Creek C;Sw,NSW	**Wheat Swamp Creek**	03-04-07	14.0 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2000		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.

installation or preservation to name a few. These helped to reduce the contribution of nitrogen, phosphorus and soil to the waterway. These likely contributed to the improved bioclassification in Nahunta Swamp. Nahunta Swamp like all of the other streams in this subbasin suffers from low DO, high nutrient and elevated conductivity. Many of these are indicative of nonpoint source pollution contribution.

The major source of the added nutrients in this watershed is from agricultural sources including concentrated animal operations and the land application of their waste. Point source dischargers and urban stormwater runoff from the growing towns in this watershed are also contributing to the impairments. There is a great need for additional agricultural and urban BMP installation throughout the Contentnea Creek watershed.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 17. Table 22 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 for more information about use support methodology.

Waters in the following sections and in Table 22 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.

7.2 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. Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 23 for a summary of use support for waters in subbasin 03-04-07 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

7.3 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 303(d) 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 is presented at http://h2o.enr.state.nc.us/tmdl/General_303d.htm.

Table 23 Summary of Use Support Ratings in Subbasin 03-04-07

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
Freshwater acres (impoundments)	1,269	758	58	0	0.0	511	39	1,308
Freshwater miles (streams)	297	85	13	165	25	47	359	656

% - Percent of total miles/acres.

7.3.1 Moccasin Creek (Bunn Lake) [AU# 27-86-2]
Northwestern Portion of Subbasin Watershed Map (Figure 18).

<u>Current Status</u>
Moccasin Creek [AU# 27-86-2; C; NSW] from source to Contentnea Creek (22.8 miles) is Impaired for aquatic life due to low dissolved oxygen standard violations at ambient monitoring station JA53. Dissolved oxygen levels were below 4 mg/l in 11 percent and below 5 mg/l in 22 percent of the samples. The minimum recorded DO level was 2.1 mg/l. The conductivity was also elevated at times with reading ranging from 50 to 193 µmhos/cm.

This segment is supporting for recreational uses because the fecal coliform bacteria levels were only above of state standard of 400 CFU/100 ml in 12 percent of the samples collected.

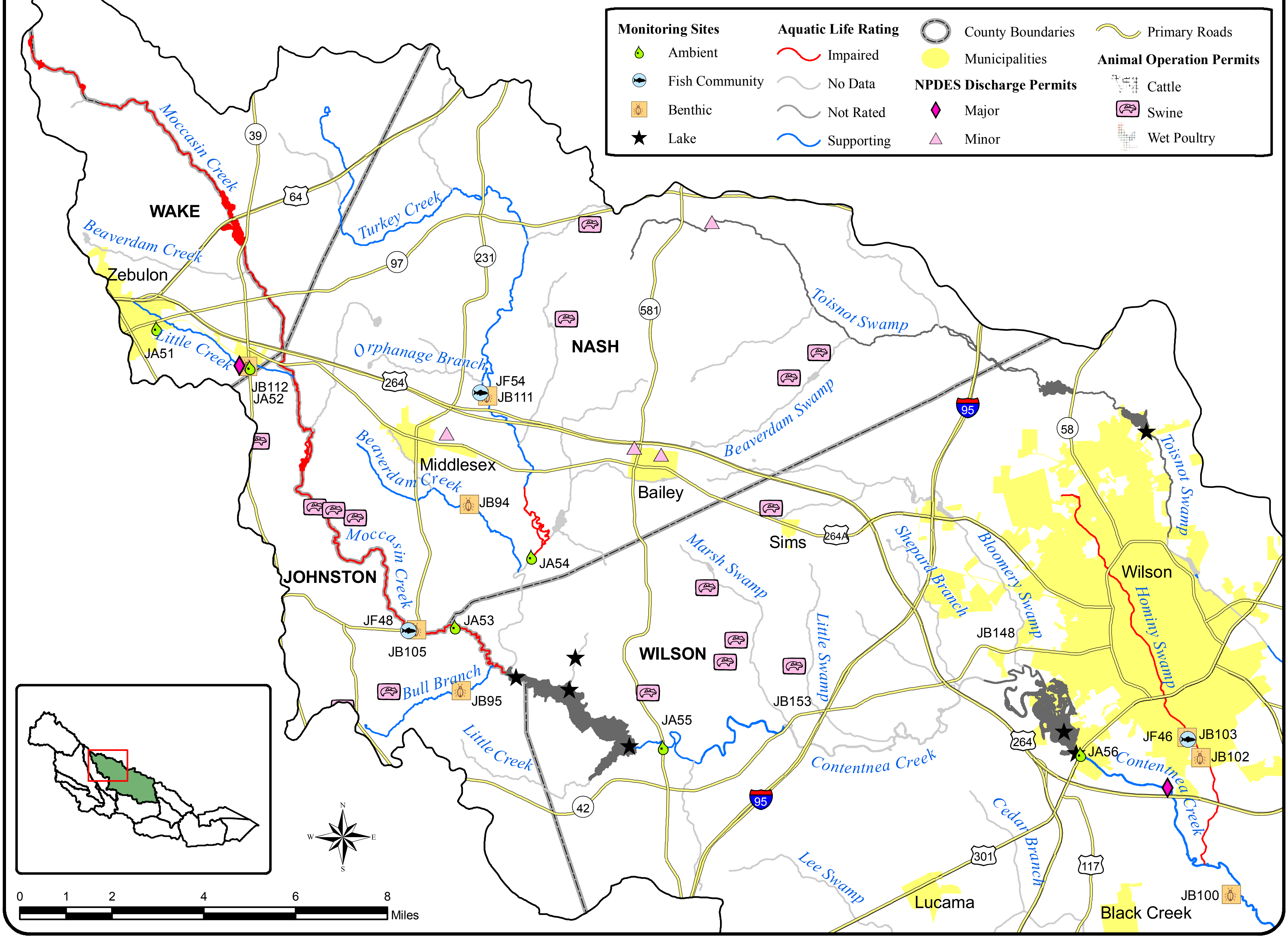
The biological sampling that occurred approximately 1 mile upstream and was found to support a Good-Fair benthic community at site JB105 and a Good fish community at site JF48. The overall rating is Impaired for biological integrity based on the ambient monitoring data. The station locations for the biological and ambient were collected close enough that a split in this segment was not justified. If the dissolved oxygen levels continue to decline, it will have a direct impact on the biological communities in this creek.

The overall instream habitat was good, however trash was present in the stream channel at the time of sampling and a moderate amount of erosion was observed. While the benthic bioclassification remained the same as the 2000 rating, the fish rating decreased from Excellent in 2000 to Good in 2005. The change in bioclassification is possibly a result of natural variation, but may also be related to the post-hurricane de-snagging efforts that occurred in this reach of Moccasin Creek since the 2000 fish community sample. The trophic structure in this transitional (Piedmont to Coastal Plain) section of the stream was skewed towards a high percentage of insectivores (90 percent) and the percentage of omnivores plus herbivores was low (5 percent).

Moccasin Creek will be added to the 2008 303(d) list for low DO standard violations.

<u>Recommendations</u>
DWQ will continue to monitor this watershed. Local resource agencies are encouraged to install appropriate BMPs in this watershed to aid in water quality improvements.

Figure 18 Northwestern Portion of Subbasin 03-04-07



7.3.2 Little Creek (West Side) [AU# 27-86-2-4]

2002 Recommendations

Previously Little Creek was impaired because dissolved oxygen levels were below 4 mg/l in 20.8 and 12.1 percent of samples. These sites are upstream and downstream of the Zebulon/Little Creek WWTP. DWQ and LNBA will continue to monitor the site to detect any water quality changes. DWQ will work with the Zebulon WWTP and the Town of Zebulon to determine the sources of low dissolved oxygen in Little Creek.

Current Status

Little Creek [AU# 27-86-2-4; C; NSW] from the source to Moccasin Creek (4.1 miles) is Supporting aquatic life due to Good-Fair benthic bioclassification at site JB112 and because No Criteria Exceeded the state standards at ambient monitoring stations JA51 and JA52. The DO levels have improved since the last assessment period in which this segment was impaired due to low DO levels. During this assessment period the DO levels were only below 4 mg/l in 7 percent of the samples at JA52 with a minimum recorded level of 3.2 mg/l. At this same site the DO levels were below 5 mg/l in 23 percent of the samples. At the ambient station upstream of the Little Creek WWTP, 3 percent of the DO readings were below 4 mg/l and 10 percent were below 5mg/l. The DO levels are greatly improved since the last assessment period but it appears that the WWTP and the town of Zebulon remain a stressor to this segment of the watershed. This can also be seen by the difference in the conductivity range upstream and downstream of the WWTP. The recorded conductivity range upstream of the WWTP was 50 to 145 µmhos/cm and downstream was 71 to 688µmhos/cm. Nutrient levels were also high at both ambient monitoring stations. There was an instream nitrate-nitrite reading of 10.8 mg/l at station JA52 (below the WWTP) while the highest recorded reading above the WWTP was 0.79 mg/l.

Despite the low DO (4.2 mg/l) and high conductivity (429 µmhos/cm) readings at the time of the benthic sampling, this site (JB112) received a Good-Fair benthic rating. The most abundant taxa found were indicative of an organic enriched and low DO environment, most likely from the WWTP upstream of the benthic site (JB112). There were also a few indicator taxa that would suggest that low flow may also be an issue during portions of the year.

Little Creek will be removed from the 2008 303(d) list of impaired waters for DO standard violations. This stream still remains very fragile and could easily be pushed back on the impaired waters list if care is not taken to improve and protect water quality in this area.

Little Creek is currently Supporting for recreation. The fecal coliform levels were above 400 CFU/100 ml in 14 percent of the samples upstream of the WWTP (JA51) and in 7 percent of the samples downstream of the WWTP (JA52).

Little Creek WWTP (NC0079316) was formerly owned by the Town of Zebulon, which merged its water and sewer operations in 2006 with the City of Raleigh Public Utilities Department (CORPUD). The Little Creek WWTP is currently permitted to discharge 2.2 MGD. The CORPUD is looking to increase the discharge up to 6 MGD in order to accommodate growth in towns of Zebulon, Wendell and Middlesex. Little Creek has a 7Q10 low flow of zero at the discharge point, which limits its waste assimilation capacity during dry weather. This would require a new discharge location and/or other discharge options to be assessed in order to increase the discharge from this plant. The City of Raleigh is looking at a possible discharge site in the Little River in subbasin 03-04-06 in addition to the 2.2 MGD into Little Creek.

Recommendations
Continued monitoring of this creek is necessary. DWQ recommends the use of stormwater BMPs as well as continued WWTP improvements to reduce the impacts to this stream.

7.3.3 Turkey Creek [AU# 27-86-3-(1)a1 & 27-86-3-(1)a2]

Current Status
Turkey Creek [AU# 27-86-3-(1)a1; C; NSW] from source to Old Middlesex Road (19.4 miles) is Supporting for aquatic life due to a Good-Fair benthic bioclassification at site JB111. This site was reassessed in 2001 to determine if the original 2000 Fair rating was accurately representing the conditions at this site. The biologist felt that the 2000 sample was possibly affected by high flow at the time of sampling. This site was not reassessed during the basinwide assessment in 2005. Turkey Creek is listed as critical habitat for the mussel *Alasmidonta heterodon*, although none were observed during the 2001 assessment. However, this part of Turkey Creek was supporting a good mussel community of *Elliptio complanata* and *Elliptio icterina*. Low dissolved oxygen levels are of concern in this area. DO at the time of sampling was 4.8-5.8 mg/l. Further downstream is impaired due to low DO standard violations.

The fish community was also assessed at this site (JF54) and currently are Not Rated due to the fact that the Coastal Plain ecoregion assessment criteria is not complete. The fauna found at this site was typical of that found in many Coastal Plain streams. This fish site should be ratable during the next assessment period.

Turkey Creek [AU# 27-86-3-(1)a2; C; NSW] from Old Middlesex Road to SR 1101 (2.0 miles) is Impaired for aquatic life due to low DO levels at ambient monitoring station JA54. DO levels were below 4 mg/l in 29 percent of the samples and below 5 mg/l in 47 percent of the samples. The minimum recorded DO value was 1.9 mg/l at this station. The conductivity was also elevated (maximum recorded value was 287 µmhos/cm) and 5 percent of the samples had a pH less than 6 (minimum pH was 5.1) at this site. It is uncertain if DO levels are naturally low or if there are other factors contributing to the low DO levels in Turkey Creek.

This segment will be added to the 2008 303(d) list of impaired waters for low DO standard violations. The TMDL management strategy will assess DO levels throughout this watershed.

Recommendation
Turkey Creek should be assessed for macroinvertebrates during the next assessment period.

Local resource agencies are encouraged to install appropriate BMPs in this watershed to aid in water quality improvements.

7.3.4 Contentnea Watershed [AU# 27-86-(1)a, 27-86-(1)b, 27-86-(5.8), 27-86-(7)a, 27-86-(7)b1 & 27-86-(7)b2]

Northwestern (Figure 18), Central (Figure 19) and Southeastern (Figure 20) Portion of the Subbasin Watershed Maps.

2002 Recommendations
DWQ will continue to monitor Contentnea Creek to assess water quality changes and determine the cause of low dissolved oxygen at the ambient monitoring site JA55. DWQ will work with

the Wilson WWTP to ensure the discharge minimizes water quality impacts to Contentnea Creek. Because of the water quality impacts and the development in the watershed, Contentnea Creek near Wilson is a NCWRP targeted local watershed.

Current Status

Contentnea Creek (Buckhorn Reservoir) [AU# 27-86-(1)a & 27-86-(1)b]

This segment of Contentnea Creek has been split in order to have the data better represent the actual hydrograph. The actual reservoir (segment (1)a) is sampled using DWQ Lakes assessment methodology and the lower portion (segment (1)b) is sampled using DWQ riverine criteria for both aquatic life and ambient monitoring. This entire segment was added to the 1998 303(d) list for impaired biological integrity and low DO standard violations. It appears that this was improperly impaired for biology in 1998. The last biological sample was taken in 1996 at NC42 and was rated as Good-Fair. It appears that this segment was improperly impairment and will be removed from the 2008 303(d) list.

Contentnea Creek (Buckhorn Reservoir) [AU# 27-86-(1)a; WS-V; NSW] (758.2 Acres) is currently Not Rated for aquatic life due to insufficient data to determine if the lake supports its designated uses (Figure 18). Only 7 samples were collected between May and August 2005. This does not meet the 10 sample minimum required to give a rating of supporting or impaired therefore it is classified as not rated for the most current use support rating.

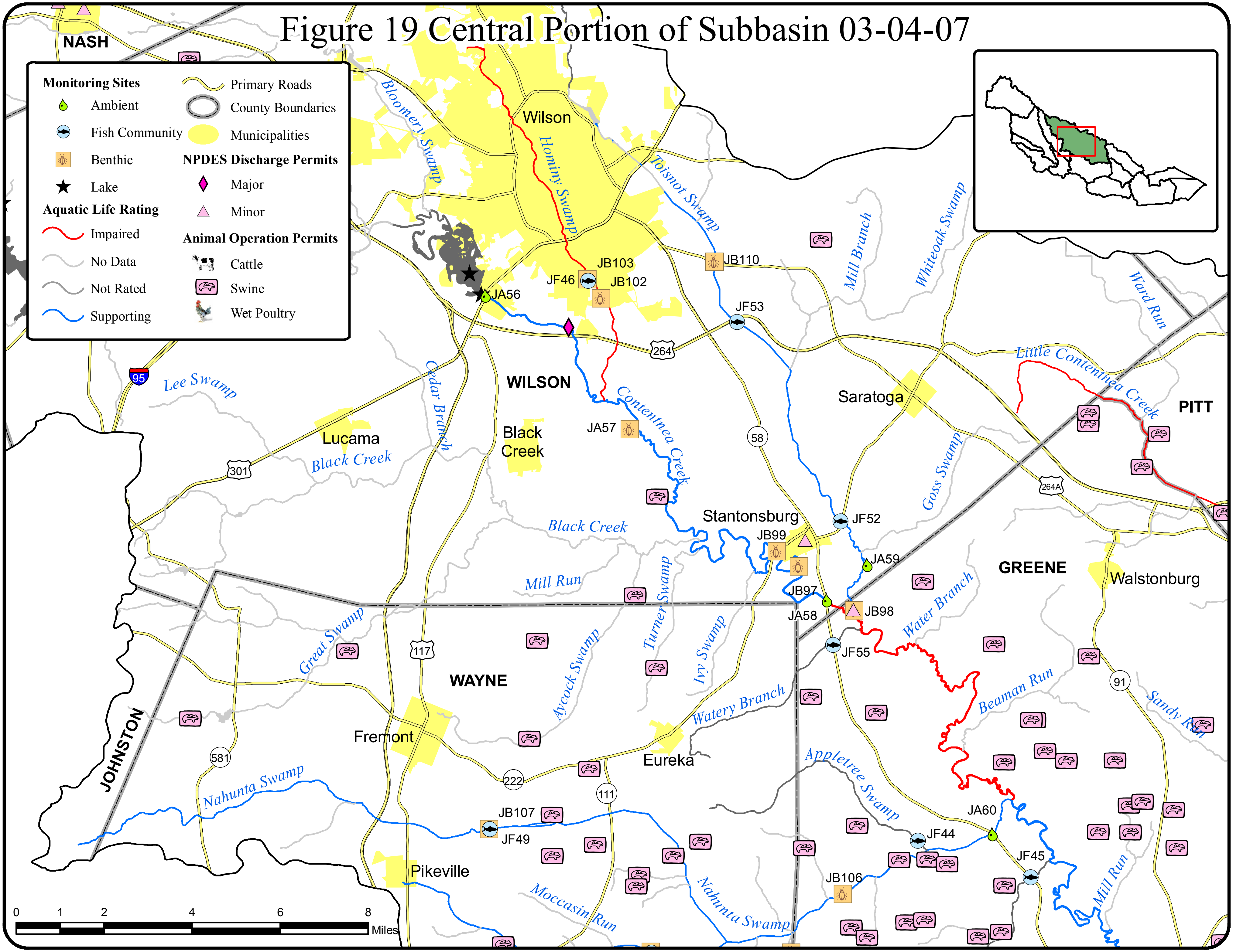
No observed surface DO values were below the state standard of 4 mg/l (instantaneous value). The surface readings ranged between 5.3 and 10.2 mg/l DO during this assessment period. Nutrient concentrations of total Kjeldahl nitrogen and total organic nitrogen in 2005 were generally moderate to high indicating a potential for high biological productivity. Total Kjeldahl nitrogen values ranged from 0.41 mg/l to 0.76 mg/l and total organic nitrogen values ranged from 0.40 mg/l to 0.74 mg/l. Phytoplankton analyses of samples collected in the upstream section of the reservoir indicated mild to severe blue-green blooms during June, July, and August of 2005 with the most severe blooms found in early August.

This segment will remain on the 303(d) impaired waters list for low DO standard violation since there were not enough samples collected during this assessment period to officially make a rating on Buckhorn Reservoir.

Contentnea Creek (Buckhorn Reservoir) [AU# 27-86-(1)b; WS-V; NSW] from the Buckhorn Reservoir dam to a point 0.6 miles upstream of Marsh Swamp (5.8 miles) is Supporting aquatic life and recreational uses due to No Criteria Exceeded at ambient monitoring station (JA55) (Figure 18). The pH was below 6 in 8.5 percent of the samples and the conductivity levels ranged between 42 and 520 µmhos/cm. This segment of Contentnea Creek is currently on the 303(d) list for low DO standard violations. During this assessment period, the DO readings were below 4 mg/l in 5 percent of the samples and below 5 mg/l in 15 percent of the samples, therefore this segment will be removed from the 2008 303(d) list for low DO. The DO levels are still low but did not fall below the states instantaneous standard of 4 mg/l DO more than 10 percent of the time.

This segment of Contentnea Creek is Supporting recreational uses because fecal coliform bacteria levels were well below the state standard.

Figure 19 Central Portion of Subbasin 03-04-07



Through the use of 2004 orthoimagery, it is estimated that 75 percent of the streams in the above watersheds are buffered with a 100 foot or greater average buffer width. This watershed is mostly cropland agriculture, although development has and will most likely continue to grow around the reservoir. There are several developments and individual housing units in this watershed. In this watershed, September 2000 – December 2006, EQIP has funded: 476 ac long term no till, 2 watering facilities, 1 water well, 172 ac of nutrient management, and 18 ac of pest management. A total of 36.3 ac of CRP CP 33 Upland Bird Habitat Buffer have also been established. This watershed contains 2 active hog lagoons. Land on the western side of Wilson County can be characterized with greater slopes therefore resulting in greater runoff reaching tributaries.

Contentnea Creek [27-86-(4.5)]

Contentnea Creek [27-86-(4.5); WS-IV; NSW] from a point 0.6 mile upstream of Marsh Swamp to a point 0.6 mile downstream of Shepard Branch (7.7 miles) is currently listed as No Data (Figure 18). Due to limited resources this segment of Contentnea Creek was not assessed in this assessment window. This may be a good place to suggest a benthic station during the next assessment period.

This watershed contains 2 active and 3 inactive hog lagoons. A great percentage of this watershed is agricultural. There are several areas of wetland buffers. There are also a few areas where agricultural fields lie directly next to the stream, therefore resulting in the potential need for buffers in this area.

Contentnea Creek (Wiggins Mill Reservoir) [27-86-(5.8)]

Contentnea Creek (Wiggins Mill Reservoir) [27-86-(5.8); WS-IV; NSW; CA] from a point 0.6 miles downstream of Shepard Branch to dam at Wilson Water Supply Intake (Wiggins Mill Reservoir) (510.5 acres) is Not Rated for aquatic life due to insufficient data to determine if the lake supports its designated uses (Figure 18). Seven samples were collected between May and September 2005. This does not meet the 10 sample minimum required to give a rating of supporting or impaired therefore, it is classified as Not Rated. All other parameters have remained relatively consistent since the last assessment of this lake.

Through the use of 2004 orthoimagery, it is estimated that the streams in this watershed are at least 70 percent buffered. The area is characterized fairly well with development. The east side of the reservoir borders the city of Wilson, with housing units surrounding the east, south, and west sides. There is little to no buffer of the southern portion of this segment. There is one active hog lagoon and 1 closed hog lagoon in the watershed leading to this segment.

Contentnea Creek [27-86-(7)a, 27-86-(7)b1 & 27-86-(7)b2]

Contentnea Creek [27-86-(7)a C; Sw; NSW] from dam at Wilson Water Supply Intake (Wiggins Mill Reservoir) to 0.7 miles upstream of Toisnot Swamp (19.6 miles) is Supporting aquatic life and recreation due to a Good benthic rating at JB99, a Good-Fair benthic rating at JB97 and JB100 as well as No Criteria Exceeded at ambient monitoring stations JA56, JA57 and JA58 (Figure 19). This segment of the Contentnea Creek has a supplemental classification of swamp water so this area is not assessed for DO because swamp waters are know to have naturally occurring low DO levels. The minimum recorded DO levels at these sites ranged from 3.4 to 4.3 mg/l. The fecal coliform bacteria levels were below the state standard; however they were elevated at the two ambient monitoring stations below the Wilson WWTP (11 and 12 percent exceeded). The nutrient and conductivity levels were also elevated in this segment of the watershed (conductivity ranged between 50 and 474 µmhos/cm).

The Town of Wilson was awarded the 2006 Clean Water State Revolving Fund (CWSRF) Pisces Award for success in environmental performance, innovation and creation. The City of Wilson improved the biosolids processing and constructed a new 6.0 MGD water reclamation facility as part of an overall strategy to improve water quality in the Neuse River Basin. The city utilized several funding sources to complete the project, which included $32.3 million in CWSRF loans. The city also created an incentives program to use reclaimed water thus conserving water resources and increasing nutrient removal.

The benthic sites in this reach of the Contentnea Creek ranged from Good-Fair (JB97 & JB100) to Good (JB99). The furthest upstream site was rated Good-Fair (JB100) in 2001. A site just upstream had received a fair rating in 1996. This site could not be resampled in 2001 so a site was chosen downstream at the next road crossing. This portion of the creek was noted as being affected by both point and nonpoint source pollution from the Town of Wilson and may be stressed by low DO in the summer months.

The next site further downstream was rated Good (JB99) even though the instream habitat for colonization was sparse. This site improved from a Good-Fair rating in 2000 to a Good rating in 2005. The total taxa and EPT taxa richness was slightly better in 2000, but there were more intolerant EPT taxa in 2005, which accounted for the increased rating at this site.

A special study was conducted in which benthic samples were collected upstream (JB97) and downstream (JB98) of the Stantonsburg WWTP. Sample JB98 (downstream site) is in the next stream segment assessed below (AU# 27-86-(7)b1). The instream habitat was relatively good at both sites, however, macrophyte areas and large woody debris were not as extensive at the upstream site. Both sites also had a wide and intact forested riparian zone but were experiencing moderated stream bank erosion. Cows were also encountered in the stream at one spot between the two sampling locations.

The upstream site while it had a lower overall species diversity and lower EPT abundance than the downstream site, it also had a more intolerant species composition, which gave the upstream site a higher borderline Good-Fair rating than the downstream site, which had a more pollution tolerant taxa and resulted in a Fair benthic bioclassification.

The Stantonsburg WWTP (NC0057606) had total residual chlorine violations throughout most of 2006. At times this plant was discharging over 1 g/l of total residual chlorine in early 2006. It is likely that these concentrations had a direct impact on the biological community downstream of this facility. This facility has been in compliance with the 28 µg/l permit limit for total residual chlorine since October 2006. This facility has also experienced sporadic fecal coliform bacteria violations throughout the same period. They are currently under a SOC for exceeding 80 percent of their designed permitted capacity.

The Stantonsburg WTP (NC0007536) has also had total residual chlorine issues over the last several years. They installed a dechlorination system in April 2007. This plant has a 17 µg/l total residual chlorine permit limit.

A Wilson County SWDC technician notes an area located in this section of Contentnea Creek that is a good area for stream restoration. Approximately 1500 feet of stream restoration is needed around the location where Woodbridge Road intersects Contentnea Creek. This area is marked with degrading road structures. Stream banks running up to the road are washing away rapidly, causing roads to collapse into the stream. Sections such as these will only get worse over time.

Contentnea Creek [AU# 27-86-(7)b1]

Contentnea Creek [AU# 27-86-(7)b1; C; Sw; NSW] from a point 0.7 miles upstream of Toisnot Swamp to Nahunta Swamp (15.1 miles) is Impaired for aquatic life due to a Fair benthic bioclassification at site JB98 (Figure 19). This was discussed above in Contentnea Creek AU# 27-86-(7)a.

This segment of Contentnea Creek will be added to the 303(d) list of impaired waters for impaired biological integrity.

Contentnea Creek [AU# 27-86-(7)b2]

Contentnea Creek [AU# 27-86-(7)b2; C; Sw; NSW] from Nahunta Swamp to Neuse River (45.1 miles) is Supporting recreational uses due to No Criteria Exceeded at ambient monitoring stations JA61, JA62 and JA66 (Figure 20). This same section is Not Rated for aquatic life due to the inability to find suitable habitat to take a macroinvertebrate sample during the routine 2005 benthic monitoring schedule. This site had received a Good-Fair benthic bioclassification at JB101 in 2000. However, the hydrology of the stream appears to have changed substantially between the two sampling dates, which didn't allow for an adequate sample to be collected in 2005. This site should be reassessed during the next Neuse Basin assessment window.

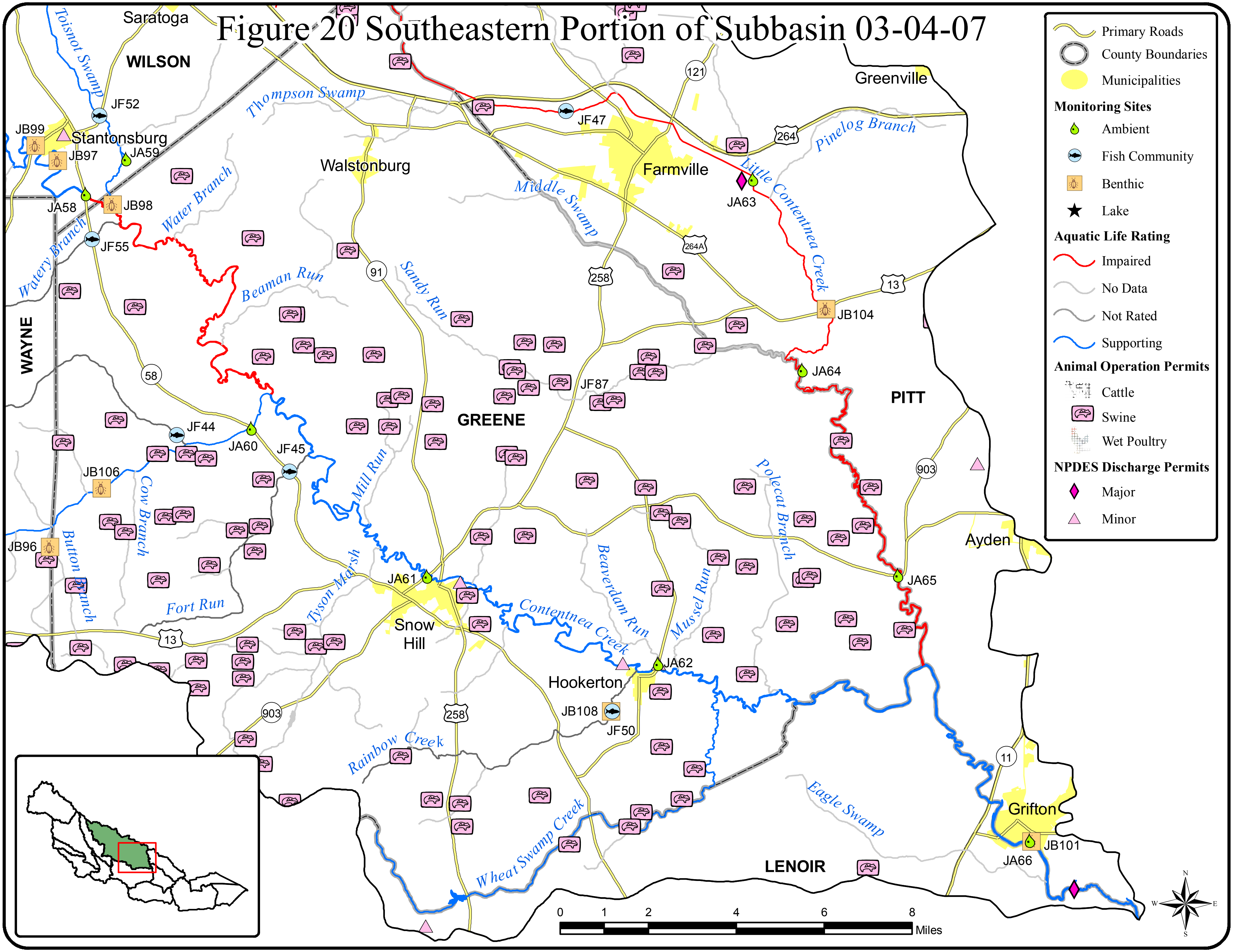
As with the segments listed above, this segment of the Contentnea Creek also has a supplemental classification of swamp water so this area is not assessed for DO because swamp waters are know to have naturally occurring low DO levels. The minimum recorded DO levels at these sites ranged form 2.2 to 2.4 mg/l. The fecal coliform bacteria levels were below the state standard, however they were elevated at JA61 (13 percent exceeded). All these stations had elevated nutrients with a maximum TKN reading of 2.25 mg/l and a nitrate-nitrite of 1.25 mg/l at station JA61.

The Contentnea Metropolitan Sewerage District WWTP (NC0032077) had several total cyanide limit violations in the later half of 2006 and early 2007. The source of the cyanide is believed to be a metal finishing facility which discharges wastewater to this plant. The metal finishing facility is in the process of changing their process so they will no longer be using cyanide. If this is truly the source of the cyanide, then this problem will be eliminated. The biologist should sample below this discharge site to see if there has been a direct impact to the aquatic organisms from the repeated cyanide exposure. DWQ should also consider doing some sediment toxicity testing in this area as well.

Contentnea Creek - Fish Tissue Monitoring

All waters in the Neuse River basin are Impaired on an evaluated basis in the Fish Consumption category for mercury contamination. This is based on a fish consumption advice from the NC Department of Health and Human Services (NC DHHS). For more information on fish consumption advisories and advice, contact NC DHHS (http://www.schs.state.nc.us/epi/fish/current.html).

Figure 20 Southeastern Portion of Subbasin 03-04-07



Largemouth bass, sunfish, redhorse sucker, and catfish samples were collected from Contentnea Creek at Snow Hill during 2003 and analyzed for mercury. The samples were collected as part of an eastern North Carolina mercury assessment. Individuals from all species (15 of 24 total samples) contained mercury concentrations exceeding the state criteria of 0.4 ppm. Mercury levels in all samples ranged from 0.13 to 0.82 ppm.

For more information on fish tissue monitoring see the Environmental Sciences Section, Basinwide Assessment Report Neuse River Basin, 2006 (http://h2o.enr.state.nc.us/esb/Basinwide/Neuse06BasinReportFinal.pdf).

Recommendations
DWQ recommends that the local resource agency pursue buffer restoration in this watershed as well as other agricultural BMPs to help reduce sedimentation and nutrient loading.

Water Quality Initiatives
The Division of Soil and Water Conservation was awarded a Section 319 Clean Water Act Grant to implement the Agricultural Sediment Initiative in this watershed as well as another watershed in the Tar-Pamlico River basin. This $300,000 grant will fund best management practice installation in Pitt, Lenoir, and Greene counties through their local Soil and Water Conservation Districts to improve water quality in these watersheds.

From September 2000 – December 2006, over $370,000 of the Agriculture Cost Share Program funds were spent on BMP implementation in this watershed. Practices included 392 acres of 3 year conservation tillage, 317 acres of long term no-till, 110 acres of cropland conversion to grass, 3 acres of critical area planting, 7,400 feet of diversions, 5,215 acres of conservation tillage, 616 acres of grassed waterways, 28 acres of field borders, 13 acres of filter strip, 321 acres of riparian buffer, 714 acres of nutrient management, 1 grade stabilization structure, 8 incinerators, 1 hydrant, 2 waste application equipment, and 1 solid set. Cumulatively, these practices affect 10,675 acres, saved 38,495 Tons of soil, 130,880 pounds of nitrogen, 35,511 pounds of phosphorus, 207,942 pounds of Waste-N managed, and 201,616 pounds of Waste-P managed.

7.3.5 Hominy Swamp [AU# 27-86-8]

2002 Recommendations
DWQ will continue to monitor Hominy Swamp to assess water quality impacts from urban and developing areas in Wilson. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Hominy Swamp. NCWRP has a restoration project on Hominy Swamp Creek, as well as a grant focusing on the assessment of water quality problems and the development of a restoration plan for this local watershed. Because of the water quality impairment and the restoration assessment, Hominy Swamp is a NCWRP targeted local watershed.

Wilson should consider water quality impacts to Hominy Swamp during development.

2002 Water Quality Initiatives
The City of Wilson received a CWMTF grant to make upgrades to the WWTP.

Current Status
Hominy Swamp [AU# 27-86-8; C; Sw; NSW] from source to Contentnea Creek (9.9 miles) remains impaired due to a Poor benthic bioclassification at sites JB102 and JB103 (Figure 19). Hominy Swamp runs through the Town of Wilson and is highly impacted by urban nonpoint source runoff. The most upstream site (JB103) received very low habitat score for both the bug and the co-located fish site (JF46). The low habitat score reflects a stream having evidence of channelization with eroding banks and very little instream habitat. The benthic fauna was very sparse, dominated by highly tolerant worms and midges, with no EPT taxa. This resulted in a Poor rating at this site. The fish community was Not Rated at this site due to the fact that there are no criteria for the Coastal Plain ecoregion complete at this time, however, there were no intolerant fish found at this location. A greater percentage of tolerant fish were present at this site than at any other site in the Coastal Plain, except of at Big Chinquapin Branch (in subbasin 11).

The downstream site (JB102) location was chosen to see if the Bruce Foods Corporation spray fields were having an impact on Hominy Swamp. Bruce Foods Corp has a non-discharge spray irrigation system for wastewater disposal consisting of lagoons and spray fields. The Raleigh Regional Office found wastewater running off the fields and into Hominy Swamp and its tributaries. Measurements indicated low DO and high conductivity levels. The biologist found that this site was similar to the upstream location (~0.5 miles upstream). The habitat score was slightly higher as a result of a somewhat better riparian zone and canopy as well as more stable banks. The instream habitat conditions were much the same but with more sludge and silt along the banks. This site had an overall lower taxa richness and more tolerance species resulting in a Poor rating as well.

Hominy Swamp will remain on the 303(d) impaired waters list for impaired biological integrity.

Recommendations
More spray fields have been added to this area, resulting in a greater potential for runoff. DWQ recommends increasing the number of inspections in order to assure compliance.

It is estimated that 68 percent of Hominy Swamp is buffered with a 90 foot or greater average buffer width. The section runs directly through the city with a small amount of agriculture on the southern stretch where Hominy Swamp meets Contentnea Creek. This watershed would benefit greatly from the establishment and education of community conservation. This is a prime spot for funds such as the Community Conservation Assistance Program (CCAP).

Water Quality Initiatives
From September 2000 – December 2006, EQIP has funded 50 acres of long term no till, nutrient management, and pest management, and 0.5 acres of upland wildlife habitat management in this watershed

7.3.6 Nahunta Swamp [AU# 27-86-14]

2002 Recommendations
DWQ will continue to monitor Nahunta Swamp to assess water quality changes. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Nahunta Swamp. DWQ will contact the Division of Soil and

Water Conservation (DSWC) to evaluate the potential for installation of agricultural BMPs that would protect water quality and aquatic habitat in Nahunta Swamp.

Current Status

Nahunta Swamp [AU# 27-86-14; C; SW; NSW] from source to Contentnea Creek (27.1 miles) is Supporting aquatic life and recreation due to a Good-Fair benthic bioclassification at sites JB106 and JB107 as well as No Criteria Exceeded at the ambient monitoring station JA60 (Figure 19). Nahunta Swamp has a supplemental classification of swamp water so this area is not assessed for DO because swamp waters are know to have naturally occurring low DO levels. The minimum recorded DO levels at these was 1.6 mg/l. The recorded conductivity ranged from 65 to 173 µmhos/cm indicative of nonpoint source pollution influences. Nutrients were also elevated at this station. The fecal coliform bacteria levels were below the state standard.

The benthic site JB107 was requested by the Washington Regional Office in order to assess the aquatic health in the upper Nahunta watershed. A fish assessment (JF49) was also conducted at this same location. There are no NPDES dischargers or concentrated animal operations upstream of this monitoring site. The biologist noted that the quality of the instream habitat was low but that the streambanks and riparian zone were intact. The taxa found at this location were indicative of possible low DO and organic enrichment in this area.

The fish community (JF49) is currently Not Rated due to the fact that the Coastal Plain ecoregion assessment criteria is not complete. The fauna found at this site was typical of that found in many Coastal Plain streams. This fish site should be ratable during the next assessment period.

Benthic site JB106 has been sampled 6 times prior to the 2005 basinwide cycle. It was rated Fair in 1988, 1995, 1999 and 2000. It was rated Good-Fair in 1990 (twice) and again during this assessment period (2005). In 2005, this site had the highest taxa richness (96) and EPT taxa richness (19) ever recorded at this site. In fact, this site contained the highest diversity of macroinvertebrate fauna in subbasin 07. Twenty-four new taxa were found at this site in 2005. The improved water quality in this area could be accounted for possibly due to the extended drought experienced in the basin during this assessment period. This may have resulted in less nonpoint source runoff from the large number of concentrated animal operations in this area.

Nahanta Swamp will be removed from the 2008 303(d) impaired waters list for impaired biological integrity.

Recommendations

Local resource agencies are encouraged to install appropriate BMPs in this watershed to aid in water quality improvements.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

Water Quality Initiatives

From September 2000 – December 2006, over $108,000 of the Agriculture Cost Share Program funds were spent on BMP implementation in this watershed. Practices included 467 acres of 3 year conservation tillage, 397 acres of long term no-till, 53 acres of cropland conversion to grass, 36 acres of cropland conversion to trees, 20 acres of pastureland conversion to trees, 900 feet of diversions, 645 acres of conservation tillage, 5 acres of grassed waterways, 2 acres of field borders, 92 acres of riparian buffer, 1 incinerator, 1 hydrant, and 1 waste application equipment. Cumulatively, these practices affect 2,549 acres, saved 8,399 Tons of soil, 27,969 pounds of nitrogen, 8,474 pounds of phosphorus, 19,416 pounds of Waste-N managed, and 12,474 pounds of Waste-P managed.

7.3.7 Little Contentnea Creek [AU# 27-86-26]

2002 Recommendations

DWQ will continue to monitor Little Contentnea Creek to determine probable causes of impairment. 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 Contentnea Creek.

Current Status

Little Contentnea Creek [AU# 27-86-26; C; Sw; NSW] from source to Contentnea Creek is Impaired for aquatic life due to a Fair benthic bioclassification at JB104 (Figure 18). This site received a Fair in 2000 and 2001 as well. There were good snag and bank habitats although the stream was channelized and there were no pools. The low bioclassification is reflective of problems in the upper watershed. Low dissolved oxygen may also be contributing to the impairment.

Little Contentnea Creek has a supplemental classification of swamp water. Swamps waters are known to have naturally occurring low DO levels. The low DO levels within this watershed appear to be affecting the benthic fauna. The minimum recorded DO levels ranged from 0.7 to 2.3 mg/l at ambient monitoring stations JA63, JA64 and JA65. DO levels appear to improve somewhat downstream, closer to the confluence with Contentnea Creek. The recorded conductivity levels ranged between 50 and 1232 µmhos/cm. Nutrients were also elevated throughout this creek. Total Kjeldahl nitrogen ranged from 0.2 to 11 mg/l, ammonia ranged from 0.01 to 2.3 mg/l, nitrite + nitrate nitrogen ranged from 0.02 to 1.8 mg/l and total phosphorus ranged from 0.04 to 5.98 mg/l. There are a lot of concentrated animal feed operations (CAFOs) in this watershed than may be contributing to nonpoint source pollution. Better BMPs on these CAFOs spray fields or newer non-lagoon waste technology could possibly help to decrease the nutrient load making it into the nutrient sensitive waters of the Neuse River basin. These were some of the highest nutrient reading recorded in the Contentnea Creek watershed.

Little Contentnea Creek is supporting for recreational uses, however elevated fecal coliform bacteria were seen at JA63 and JA65, with levels above the state standard in 15 and 18 percent of the samples respectively.

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

Little Contentnea Creek will also remain on the 303(d) list for low DO standard violations. This Creek was added to the impaired waters list prior to the current swamp criteria. Swamp waters that were added to the impaired waters list will remain on the list until it can be scientifically proven that the cause of the low DO in these waters are in fact due to natural causes and not as a result of anthropogenic sources.

It is estimated that 80 percent of the streams in this watershed are buffered with a 100 foot or greater average buffer width. This area is mainly lower sloping agricultural land.

Recommendations
Local resource agencies are encouraged to install appropriate BMPs in this watershed to aid in water quality improvements.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

Water Quality Initiative
From September 2000 – December 2006, EQIP has funded: 1050 acres of nutrient management, 1047 acres of pest management, 98 acres of long term no till, 2445 feet of field borders, and 10.1 acres of grassed waterways. In this same time period, 41.5 acres of CRP CP 33 Upland Bird Habitat Buffer have been established.

7.4 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.

7.4.1 Toisnot Swamp (Silver Lake, Lake Wilson) [AU # 27-86-11-(1)]
Central Portion of Subbasin Watershed Map (Figure 19).

Current Status
Toisnot Swamp (Silver Lake, Lake Wilson) [AU # 27-86-11-(1); WS-III; NSW] from source to a point 0.6 miles upstream of Wilson County SR 1326 (18.4 miles) is Not Rated for aquatic life due to insufficient data to determine if the lake supports its designated uses. Seven samples were collected between May and August 2005. This does not meet the 10 sample minimum required to give a rating of supporting or impaired therefore, it is classified as not rated.

Nutrient concentrations in 2005 were high for total phosphorus (range 0.06 mg/L to 0.09 mg/L), total Kjeldahl nitrogen (range 0.62 mg/L to 0.95 mg/L), and total organic nitrogen (range 0.56 mg/L to 0.94 mg/L) indicating a potential for high algal activity. Some aquatic weeds and filamentous algae were found in a small area near the shoreline in the upstream end of the reservoir in May of 2005. The weeds were identified as water primrose (*Ludwigia hexapetala*) while the algae was identified as black mat algae (*Lyngbya wollei*). Water primrose is considered invasive and *Lyngbya wollei* is a noxious blue-green algae and is known to form thick, foul smelling mats that choke coves and cover shorelines. According to staff of the City of

Wilson, copper sulfate was used to treat the weeds and algae in June of 2005 and they were less prevalent after that date.

This section of Toisnot Swamp is starting to grow like Hominy Swamp. There are subdivisions or individual housing units in areas around both Lake Wilson and Silver Lake. Because of these developments, the amount of buffer in these areas is very little if any. Other than development the land is mostly agriculture. Using the 2004 orthoimagery, the streams in this watershed are estimated to be at least 50 percent buffered.

Recommendations

There is at least 3500 feet of stream in need of streambank restoration in this section of Toisnot Swamp. Wilson Technical Community College is located in the US 301 their property contains approximately 3500 feet of stream bank that is in definite need of restoration. DWQ recommends that the local resource agencies work with Wilson Technical Community College to proceed with this restoration project.

Local resource agencies are also encouraged to install appropriate BMPs in this watershed to aid in water quality improvements.

7.4.2 Toisnot Swamp [AU# 27-86-11-(5)b]

Toisnot Swamp [AU# 27-86-11-(5)b; C; Sw; NSW] from UT 0.9 miles south of US 301 to Contentnea Creek (12 miles) is Supporting aquatic life and recreation due to a Good-Fair benthic bioclassification at JB110 and No Criteria Exceeded at ambient monitoring station JA59 (Figure 19). The instream macroinvertebrate habitat was sparse at this location; however the biological integrity has steadily improved since the 1996 fair bioclassification at this site.

There are two fish community sites assessed on this segment of Toisnot Swamp. Both sites are currently Not Rated due to the fact that the Coastal Plain ecoregion assessment criteria is not complete. Site JF53 (upstream site) was last sampled in 1991. The diversity of fish species remained the same; however the total abundance was lower in 2005 with 14 of 22 fish species represented by only 1 or 2 fish per species. Fish community site JF52 (downstream site) was sampled during the past 3 basinwide cycles. In 2005, the numbers of fish and species declined from the 2000 totals. These fish sites should be ratable during the next assessment period.

These segments of Toisnot Swamp have a supplemental classification of swamp water so this area is not assessed for DO because swamp waters are know to have naturally occurring low DO levels. The minimum recorded DO levels at JA59 was 0.9 mg/l. The fecal coliform bacteria levels were below the state standard. The recorded conductivity reading ranged between 50 and 223 µmhos/cm indicating possible influences from non-point source pollution in this watershed.

This lower section of Toisnot Swamp is also growing. City and housing developments are encroaching further from the city. Around 75 percent of the streams in this watershed are buffered with a 100 foot or greater average buffer width. There are two active hog lagoons, four closed hog lagoons, and one active chicken operation in this watershed.

Water Quality Initiatives

From September 2000 – December 2006, EQIP has funded: 2 lagoon closures, 27 acres of upland wildlife habitat management, 880 acres of nutrient management and pest management, 124 acres of long term no till, 1.7 acres of grassed waterways, 96,500 feet of field borders, and 15 acres of waste utilization. There are 60 acres of CRP CP33 Upland Bird Habitat Buffer established in this watershed.

7.5 Additional Water Quality Issues within Subbasin 03-04-07

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.

7.5.1 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.

See section 7.3.4 (Contentnea Creek) within this chapter for site-specific fish tissue information collected near Snow Hill.

Chapter 8
Neuse River Subbasin 03-04-08
Including the: Core Creek and Neuse River

8.1 Subbasin Overview

Subbasin 03-04-08 at a Glance

Land Cover (percent)	
Forest/Wetland:	67.3
Surface Water:	1.2
Urban:	3.9
Cultivated Crop:	26.3
Pasture/ Managed Herbaceous:	1.2
Counties	
Craven, Jones and Pitt	
Municipalities	
Cove City and New Bern	
Stream Statistics	
Total Streams:	
Freshwater	129.8 mi
Saltwater	426.5 ac
Total Supporting:	
Freshwater	46.4 mi
Saltwater	426.5 ac
Total Impaired:	
Freshwater	3.0mi
Saltwater	0.0 ac
Total Not Rated:	
Freshwater	0.0 mi
Saltwater	0.0 ac
Total No Data:	
Freshwater	80.5 mi
Saltwater	0.0 ac

This subbasin consists of the Neuse River and its tributaries from Contentnea Creek to New Bern. Most of this subbasin lies within Craven County. The two largest tributaries in this subbasin are Core Creek and Bachelor Creek. The headwaters of Core Creek have been channelized to promote drainage.

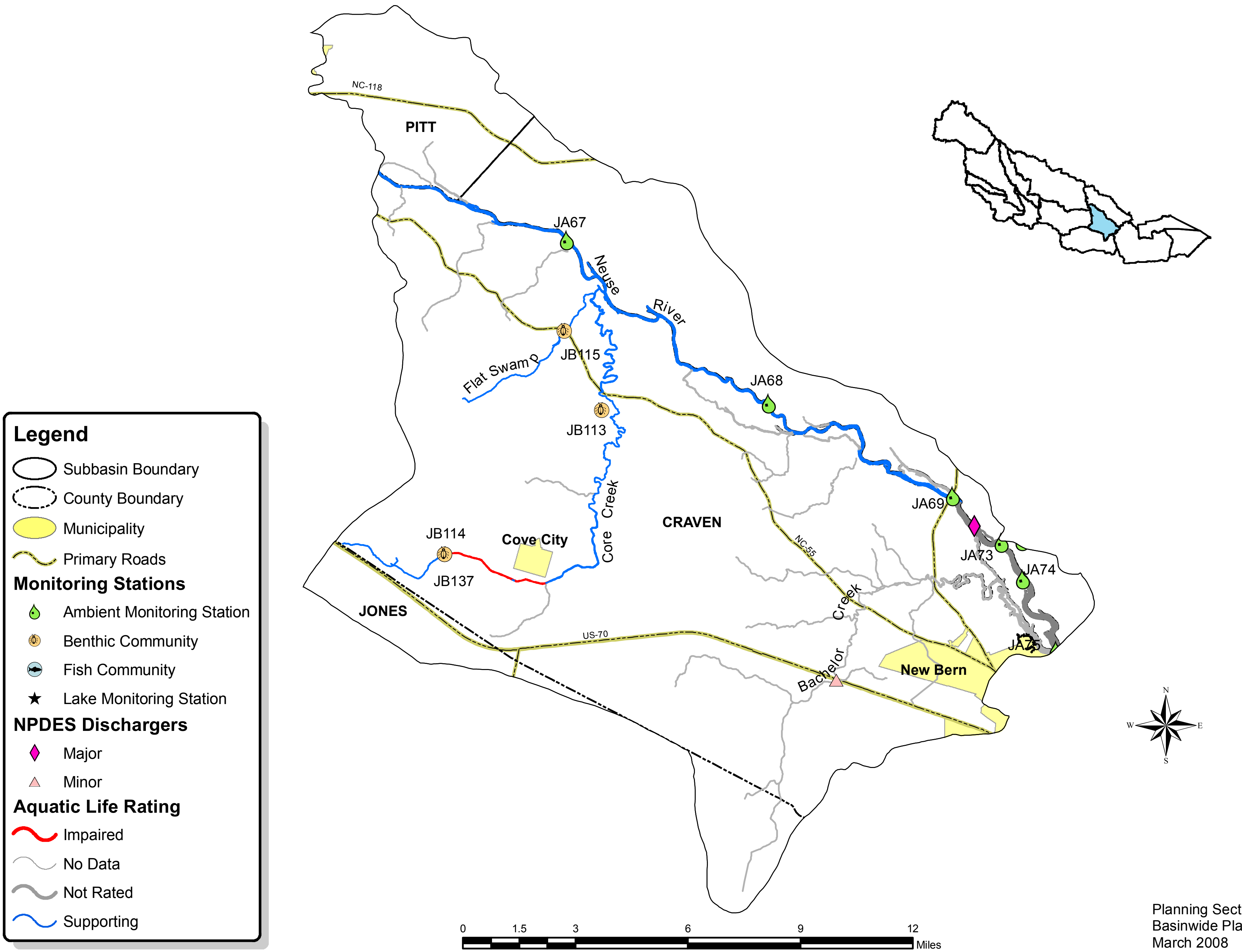
The majority of the population in this subbasin is found in and around the Town of New Bern. In the past decade New Bern's population has increased by 24.9 percent (5,748). Forest/wetlands cover about 66 percent of the land in this subbasin. Most of the remaining land cover is agriculture with a small portion of urban area. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 16.

There is 1 major (with two outfalls) and 1 minor NPDES wastewater discharge permits in this subbasin with a total permitted flow of 32.2 MGD (Figure 21). The largest is Weyerhaeuser New Bern Mill (32 MGD). There are also 9 individual NPDES stormwater permit in the subbasin. Refer to Appendix III for identification and more information on individual NPDES permit holders. New Bern has developed a stormwater program under Phase II and has a model stormwater ordinance as required by the Neuse NSW strategy stormwater rules (Chapter 18). There are 11 permitted animal operations in this subbasin.

There is a single new water quality impairments in this subbasin, a biological impairment based on a Severe swamp bioclassification in the upper portion of Core Creek. This site was assessed for the first time and had very poor instream macroinvertebrate habitat. The stream was channelized, had no riparian zone, eroding stream banks and the only instream habitat were undercut banks. The lower portion of Core Creek improved from a fair to a good-fair bioclassification.

In 2000, the NC Cooperative Extension Service initiated a 5 year, $1.3 million Core Creek Project funded by the Clean Water Management Trust Fund to restore degraded land for the ability to protect and restore water quality and acquire wetland easements for restoration of riparian buffers and wetlands in the Core Creek watershed. Over $106,000 of the Agriculture Cost Share Program funds were also spent on BMP implementation in this watershed between September 2000 and December 2006.

Figure 21 Neuse River Subbasin 03-04-08



Planning Section
Basinwide Planning Unit
March 2008

Table 24 Neuse River Basin — Subbasin (WBD-8 Number) 03020202 — DWQ Subbasin 03-04-08

Watershed (WBD-10 Number) 0302020206 Hog Island-Neuse River

Subwatershed (WBD-12 Number) 030202020601 Headwaters Core Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-90a1	Core Creek	From source to upstream crossing of SR 1239	C;Sw,NSW	03-04-08	3.4 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2004		1
27-90a2	Core Creek	From upstream crossing of SR 1239 to Grape Creek	C;Sw,NSW	03-04-08	3.0 FW Miles	5	**Habitat Degradation**: General Agriculture/Pasture; Industrial Site. **Nutrient Impacts**: ANOPS land app site; General Agriculture/Pasture; Industrial Site. **Toxic Impacts**: General Agriculture/Pasture; Industrial Site	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2004	2008	5
27-90b	Core Creek	From Grape Creek to Neuse River	C;Sw,NSW	03-04-08	15.4 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1

Subwatershed (WBD-12 Number) 030202020602 Outlet Core Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-90-3	Flat Swamp	From source to Core Creek	C;Sw,NSW	03-04-08	5.2 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1

Subwatershed (WBD-12 Number) 030202020603 Halfmoon Creek-Neuse River

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(85)	NEUSE RIVER (above model segment)	From mouth of Contentnea Creek to Streets Ferry	C;Sw,NSW	03-04-08	22.3 FW Miles	2		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
								Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Subwatershed (WBD-12 Number) 030202020607 Hog Island-Neuse River

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(96)a	NEUSE RIVER Estuary	From Streets Ferry to Bachelor Creek (river model segment)	SC;Sw,NSW	03-04-08	426.5 S Acres	2t		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
								Aquatic Life	Not Rated	Data Inconclusive	Copper	2006		3m
								Aquatic Life	Supporting	No Criteria Exceeded	Chlorophyll a	2006	2004	2t
								Aquatic Life	Not Rated	Data Inconclusive	Low pH	2006		3a
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	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.

A stressor study completed on Core Creek found high levels of nutrients and identified pesticides and organics in the sediment. This is likely due to runoff from the many agricultural fields in this area. These pesticides were related to fish kills in the Core Creek area on April 23, 2003 and May 3, 2003.

Agricultural activities have the greatest impact on the water quality in this subbasin. Additional agricultural BMPs should be utilized in the watershed to aid in water quality improvements.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure11. Table 24 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 for more information about use support methodology.

Waters in the following sections and in Table 24 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.

8.2 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. Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 25 for a summary of use support for waters in subbasin 03-04-08 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

8.3 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 303(d) 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.

Table 25 Summary of Use Support Ratings in Subbasin 03-04-08

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
Freshwater miles (streams)	49	3	2	46	6	0	81	130
Estuarine acres	427	0	0	427	100	0	0	427

% - Percent of total miles/acres.

8.3.1 Core Creek Watershed [AU# 27-90a1, 27-90a2 & 27-90b]

Previously, Core Creek [AU# 27-90b] from Grape Creek to Neuse River was added to the 1998 303(d) list of impaired waters for impaired biological integrity.

A TMDL stressor survey was completed on the Core Creek watershed. Agricultural practices dominated the land use in this watershed. Most of the residential development is located in the Cove City area. There was evidence of previous high flow events and streambank erosion at several stations throughout this watershed. Low DO levels and high conductivity reading were observed at several locations as well. Nutrient samples were collected at sites where periphyton was observed on the surface of rocks. Nutrient values were present in high amounts indicating enrichment possibly from fertilizers used on the agricultural fields in the area. Sediment pesticides and organics were assessed at one station. Several chlorinated and organophosphate pesticides and semi-volatile organics were identified. These pesticides and organics were related to fish kills in the Core Creek area on April 23, 2003 and May 3, 2003 (see information below).

The numerous agricultural fields located in the watershed contribute to significant sedimentation of Core Creek due to nonpoint source runoff after rainfall events. Additionally, nutrient inputs from farmland and a few animal operations probably contribute to nutrient enrichment and subsequent biological impacts or impairment.

2002 Recommendations
DWQ will continue to monitor Core Creek to evaluate impacts from nonpoint sources in the watershed. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Core Creek. Because of the presence of significant natural areas, important fisheries habitat and the noted water quality impairment, Core Creek is a NCWRP targeted local watershed.

2002 Water Quality Initiatives
There are two buffer acquisition projects and one restoration project funded through grants by CWMTF in this watershed.

Current Status
Core Creek [AU# 27-90a1; C; Sw; NSW] from source to upstream crossing of SR 1237 (3.4 miles) is supporting aquatic life due to a Moderate swamp bioclassification at site JB137. This is the first time this site has been analyzed. Benthic macroinvertebrates were collected using swamp stream methodology. Swamp streams are defined as those streams that are within the

Coastal Plain ecoregion and that normally have no visible flow during the summer months, but flowing water should be present in swamp streams during the winter months (generally sampled between February and March). The stream banks at site JB137 were stable and the riparian zone was intact and provided good instream shading. The EPT taxa were reflective of a relatively intolerant community for a swamp stream with such a low pH value (4.7).

Core Creek [AU# 27-90a2; C; Sw; NSW] from upstream crossing of SR1239 to Grape Creek (3.0 miles) is impaired for aquatic life due to a Severe swamp bioclassification at site JB114. This site was assessed for the first time using swamp stream criteria. This site is ~1 miles below site JB137. There is the Salt Wood Products waste site between the two sites. The stream at this site was channelized, had no riparian zone, eroding stream banks and the only instream macroinvertebrate habitat were undercut banks. The benthic community was similar to the upstream site, however the habitat was severely degraded which resulted in an overall severe/impaired rating.

This segment will be added to the 2008 303(d) impaired waters list for impaired biological integrity.

The most likely stressors to this system are lack of flow, which is normal for streams in this geographic region, lack of adequate macroinvertebrate habitat due to channelization (hydromodification) and periodic toxic inputs from agricultural activities and the Salt Wood Product site.

Core Creek [AU# 27-90b; C; Sw; NSW] from Grape Creek to Neuse River (15.4 miles) is currently supporting aquatic life due to a Good-Fair benthic bioclassification at site JB113. This site rated Poor or Fair during the last three basinwide cycles. The bioclassification increased to Good-Fair during this assessment period. The taxa present during this period suggested possible low DO and low flow conditions may still affect the benthic community at this site. The DO at the time of sampling was 4.2 mg/l and the pH value was 6.8.

This segment of Core Creek will be removed from the impaired waters list for impaired biological integrity.

Fish kills

There were two pesticide linked fish kills in this watershed in 2003. The first occurred on April 23, 2003 on Core Creek near Cove City. This affected several different species (Bluegill sunfish, Crappie, Largemouth bass, Carp and Bowfin) and killed about 1,200 total fish. It was determined that the fish kill was a result of a chlorpyrifos (Dursban) spill, a broad spectrum insecticide (organophosphate) that poses acute toxicity risks to aquatic organism. The second pesticide event occurred on Grape Creek near Cove City on May 3, 2003. This event killed 2000 fish of mixed species (Sunfish, Largemouth bass, Eel, Catfish, Bowfin and Carp). Water samples collected in the wake of both events showed chlorpyrifos levels as high as 5.1 µg/l in addition to the presence of fenamiphos (a highly toxic organophosphate) and malathion (organophosphate; one of the most commonly used pesticides in the US; commonly used for mosquito eradication). The Craven County Health Department posted a temporary human health advisory in Core and Grape Creek for swimming and fishing which was lifted in July of 2003 after levels were found to be below levels of concern for both ingestion and dermal exposure. The 2003 Annual Fish Kill Report can be found at http://h2o.enr.state.nc.us/esb/Fishkill/2003KillReport.pdf.

Recommendations
DWQ recommends continued implementation of agricultural BMPs in this watershed to continue the effort in reducing sedimentation and nutrient loading to the Neuse River Estuary.

Water Quality Initiatives
From September 2000 – December 2006, over $106,000 of the Agriculture Cost Share Program funds were spent on BMP implementation in this watershed. Practices included 1251 acres of 3 year conservation tillage, 35 acres of long term no-till, 53 acres of cropland conversion to trees, 356 acres of land smoothing, 217 acres of riparian buffer, and 2 incinerators. Cumulatively, these practices affect 1,251 acres, saved 2,236 tons of soil, 18,559 pounds of nitrogen, 220 pounds of phosphorus, 7,231 pounds of Waste-N managed, and 2,200 pounds of Waste-P managed.

In 2000, the NC Cooperative Extension Service initiated a 5 year; $1.3 million Core Creek Project funded by the Clean Water Management Trust Fund to restore degraded land for the ability to protect and restore water quality and acquired wetland easements for restoration of riparian buffers and wetlands. The project implemented and evaluated agricultural BMPs throughout the Core Creek watershed. At the conclusion of the project, nitrogen management plans and mapping systems were developed for over 44,000 acres of cropland, 106 water control structures were designed , built and installed to control drainage on over 6,200 acres and a 24 acre tract was enrolled into a conservation easement. Over 1,630 linear feet of stream and 10 acres of riparian wetlands were restored within the easement boundaries. Monitoring of the watershed indicated a 30 percent reduction in nitrogen loading after BMP installations (not including the stream and wetland restoration).

8.3.2 Neuse River [AU# 27-(85) & 27-(96)a]

2002 Recommendations
The Neuse River [AU# 27-(96)a] was impaired in 2002 due to high chlorophyll *a* levels in this segment and was included in the Neuse River Estuarine TMDL management strategy (from Streets Ferry bridge to upstream of the mouth of the Neuse River) .

Current Status
The Neuse River [AU# 27-(85); C; Sw; NSW] from mouth of Contentnea Creek to Streets Ferry (22.3 miles) is currently Supporting for both aquatic life and recreational uses due to No Criteria Exceedances at ambient monitoring stations JA67, JA68 and JA69. Elevated nutrients were detected in the Neuse River throughout this subbasin. DO levels ranged from 3.0 to 16.4 mg/l and a chlorophyll *a* maximum of 71 µg/l were recorded at these ambient monitoring stations (only a single exceedance of the standard were recorded at stations JA68 and JA69).

The Neuse River [AU# 27-(96)a; SC; Sw; NSW] from Streets Ferry to subbasin 03-04-08/ 03-04-10 boundary (226.5 saltwater acres) was included in the Neuse River Estuary TMDL management strategy (river segment). The TMDL seeks to reduce chlorophyll *a* levels by decreasing total nitrogen levels by 30 percent (see Chapter 24 for more details on the TMDL management strategy for the Neuse River Estuary).

This segment was previously impaired due to high chlorophyll *a* levels during the previous assessment period. The maximum chlorophyll *a* recorded at station JA73 was 26 µg/l during the current assessment period. Chlorophyll *a* levels were not monitored at station JA74. The lower estuarine segments remains impaired due to chlorophyll *a* violations. See Chapter 10 section 10.3.1 for the specific use support determination on this segment of the estuary. The estuary is discussed as a whole in Chapter 10.

Recommendations
DWQ will continue efforts to reduce the nitrogen load to the Neuse River Estuary.

8.4 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.

Only one other sample was collected during this assessment period.

Recommendations
Many of the streams within this subbasin are likely influenced by agricultural practices that occur within this watershed. DWQ recommends sampling Bachelor Creek during the next assessment period.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

8.5 Additional Water Quality Issues within Subbasin 03-04-08

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.

8.5.1 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.

Chapter 9
Neuse River Subbasin 03-04-09

Including the: Swift Creek, Clayroot Swamp and Creeping Swamp

9.1 Subbasin Overview

Subbasin 03-04-09 at a Glance

Land Cover (percent)

Forest/Wetland:	72.9
Surface Water:	0.3
Urban:	3.1
Cultivated Crop:	22.7
Pasture/ Managed Herbaceous:	1.0

Counties

Beaufort, Craven and Pitt

Municipalities

Greenville, Winterville, Vanceboro and Ayden

Stream Statistics

Total Streams:	
Freshwater	148.8 mi
Saltwater	8.0 ac
Total Supporting:	
Freshwater	25.4 mi
Saltwater	0.0 ac
Total Impaired:	
Freshwater	43.2 mi
Saltwater	8.0 ac
Total Not Rated:	
Freshwater	5.3 mi
Saltwater	0.0 ac
Total No Data:	
Freshwater	72.3 mi
Saltwater	0.0 ac

This coastal plain subbasin contains Swift Creek and its tributaries. Much of Swift Creek has been channelized. Due to the naturally slow subsurface drainage in this area, artificial drainage is common to allow the production of corn, peanuts and cotton. There are a few small towns located in this subbasin.

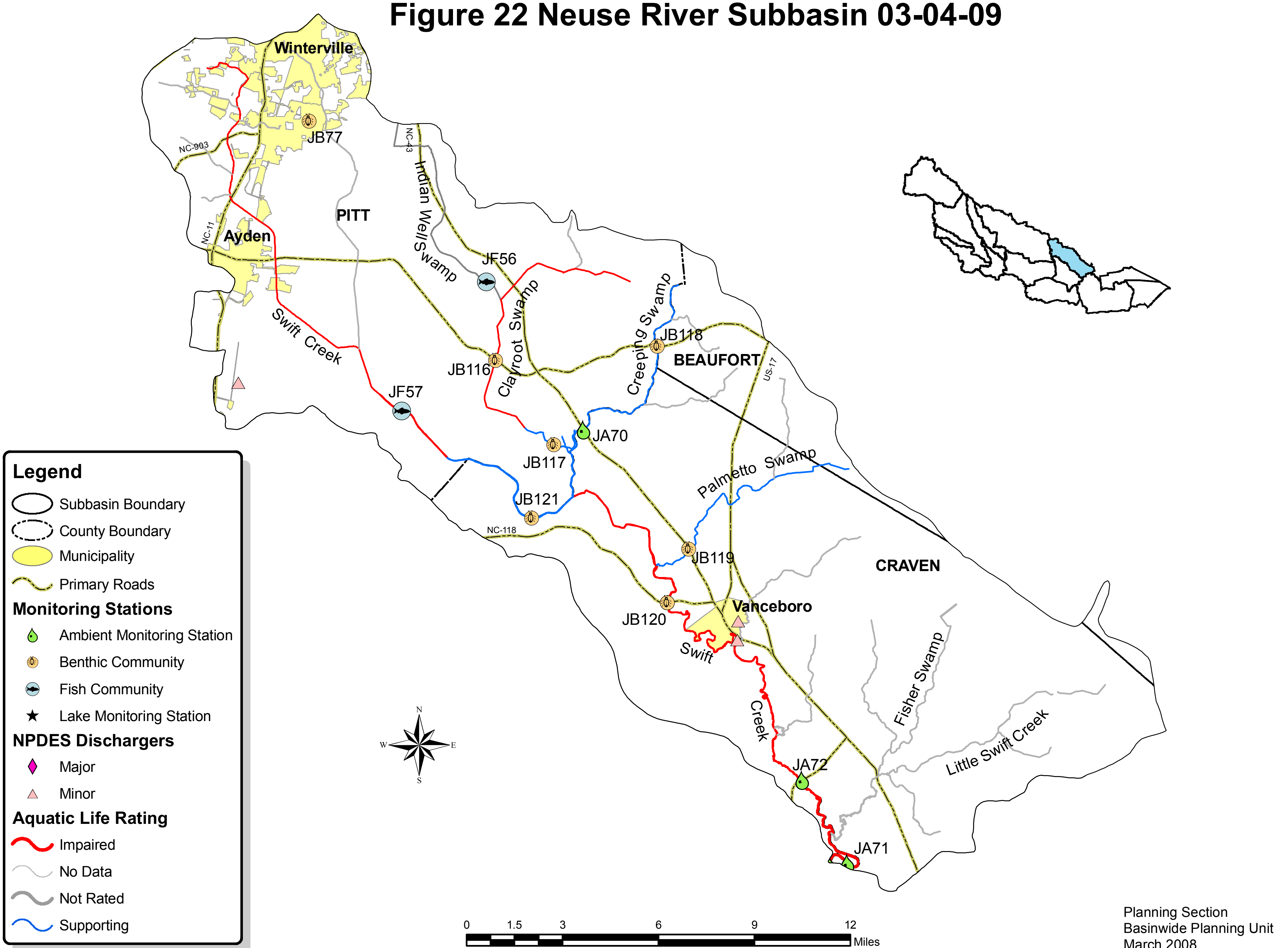
Most of the population in this subbasin is focused around Greenville. Within the past decade Greenville's population increased by 24.3 percent (14,904). The primary land use is agriculture (25 percent) and patchy forests (73 percent). There are many hog farms, mainly located in the northwest potion of this subbasin. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 16.

There are 3 minor NPDES wastewater discharge permits in this subbasin with a total permitted flow of 0.3 MGD. There are also 7 individual NPDES stormwater permit in the subbasin. Refer to Appendix III for identification and more information on individual NPDES permit holders. There are also 31 permitted animal operations in this subbasin.

There are no new water quality impairments in this subbasin. Water quality declined in several areas while the lower end of Clayroot Swamp improved from a poor to a good-fair benthic bioclassification. Clayroot Swamp like most of the other streams in this watershed has been altered to function as an agricultural drainage system. This was a common practice in certain areas of the coastal plain in order to grow crops as well as build homes and businesses in these areas. The structure and character of these swamps have been forever altered. It appears that the lack of available instream habitat may be the main stressor to this system. However, there are also possible water quality issues that may be adding to the stress on this system as seen by the high nutrient and conductivity levels as well as the excessive algal growth throughout this watershed.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 22. Table 26 contains a list of assessment unit numbers (AU#), 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 for more information about use support methodology.

Figure 22 Neuse River Subbasin 03-04-09



Planning Section
Basinwide Planning Unit
March 2008

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category

Watershed (WBD-10 Number) 0302020204 Clayroot Swamp-Swift Creek

Subwatershed (WBD-12 Number) 030202020401 Headwaters Swift Creek

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-97-(0.5)a1 From source to 5.3 miles upstream of Clayroot Swamp C;Sw,NSW	03-04-09	**Swift Creek** 19.3 FW Miles	5	**Habitat Degradation** General Agriculture/Pasture	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	1995	1998	5
				Nutrient Impacts General Agriculture/Pasture	Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a

Subwatershed (WBD-12 Number) 030202020403 Creeping Swamp

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-97-5-3 From source to Clayroot Swamp C;Sw,NSW	03-04-09	**Creeping Swamp** 8.1 FW Miles	2		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
					Aquatic Life	Not Rated	Data Inconclusive	Chlorophyll a	1998	1998	5
					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

Subwatershed (WBD-12 Number) 030202020404 Clayroot Swamp

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-97-5-2 From source to Clayroot Swamp C;Sw,NSW	03-04-09	**Indian Well Swamp** 7.9 FW Miles	3a		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
27-97-5a From source to SR 1925 C;Sw,NSW	03-04-09	**Clayroot Swamp** 9.5 FW Miles	5	**Habitat Degradation** Row Crop Agriculture; Stormwater Runoff; **Nutrient Impacts** Row Crop Agriculture; Stormwater Runoff	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2001	1998	5
27-97-5b From SR 1925 to Swift Creek C;Sw,NSW	03-04-09	**Clayroot Swamp** 3.4 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1

Subwatershed (WBD-12 Number) 030202020405 Clayroot Swamp-Swift Creek

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-97-(0.5)a2 From 5.3 miles upstream of Clayroot Swamp to Clayroot Swamp C;Sw,NSW	03-04-09	**Swift Creek** 5.3 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1

Watershed (WBD-10 Number) 0302020205 Swift Creek

Subwatershed (WBD-12 Number) 030202020501 Palmetto Swamp

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-97-5.3	**Palmetto Swamp**	From source to Swift Creek	C;Sw,NSW	03-04-09	8.6 FW Miles	2		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
Subwatershed (WBD-12 Number) 030202020503											**Town of Vanceboro-Swift Creek**			
27-97-(0.5)b	**Swift Creek**	From Clayroot Swamp to mouth of Bear Branch	C;Sw,NSW	03-04-09	14.4 FW Miles	5	**Habitat Degradation** Forest Harvesting General Agriculture/Pasture **Low Dissolved Oxygen**	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5
Subwatershed (WBD-12 Number) 030202020506											**Swift Creek**			
27-97-(6)	**Swift Creek**	From mouth of Bear Branch to Neuse River	SC;Sw,NSW	03-04-09	8.0 S Miles	5	**Habitat Degradation** General Agriculture/Pasture Stormwater Runoff **Low Dissolved Oxygen** **Nutrient Impacts** General Agriculture/Pasture Stormwater Runoff	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
								Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	1998	5
								Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	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.

Waters in the following sections and in Table 26 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.

9.2 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. Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 27 for a summary of use support for waters in subbasin 03-04-09 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

9.3 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 303(d) 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.

Table 27 Summary of Use Support Ratings in Subbasin 03-04-09

Units	Total Monitored Waters	Total Impaired Waters		Total Supporting Waters		Total Not Rated Waters	Total No Data	Total
	Miles	Miles	%	Miles	%	Miles	Miles	Miles
Freshwater (streams) Miles	77	43	29	25	17	8	72	149
Estuarine Miles	8	8	100	0	0.0	0	0	8

% - Percent of total miles/acres.

9.3.1 Clayroot Swamp Watershed [AU# 27-97-5a & 27-97-5b]

2002 Recommendations
DWQ will continue to monitor Clayroot Swamp. As part of the 303(d) list approach, DWQ will begin the process of identifying problem parameters that may be causing biological impairment in Clayroot Swamp. Because most of the Clayroot Swamp watershed is in agricultural land use, it is recommended that the Division of Soil and Water Conservation evaluate the potential for implementation of appropriate BMPs to reduce nutrient and sediment loading.

Current Status
Clayroot Swamp [AU# 27-97-5a]
Clayroot Swamp [AU# 27-97-5a; C; Sw; NSW] from source to SR1925 (9.5 miles) is currently Impaired for aquatic life due to a Fair benthic bioclassification at site JB116. The TMDL Unit of DWQ requested a sample in this reach of Clayroot Swamp as part of a 2001 CAWS project (Collaborative Assessment of Watersheds and Streams) for impaired streams. The goal was to identify the sources of impairment.

The Clayroot Swamp watershed is essentially a system of agricultural drainage ditches. The entire watershed is channelized. The predominate agricultural crop grown in this watershed is cotton with some soybean and corn as well. During both the reconnaissance survey and the sampling trip the water appeared turbid and nutrient-enriched, with the bottom substrate heavily covered with algae at most sites. The lower reaches of Clayroot Swamp are suffering from severe erosion of the sandy banks and seem to have higher flow velocities. As a result, sedimentation from the highly erodible sandy soils is a major concern. Significant sediment loading was observed.

During sampling, very little flow was observed at JB116. As a result of channelization, there is very little colonizable instream habitat present as well as high conductivities (122 µmhos/cm) and the abundance of algae growth suggesting nutrient enrichment.

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

Clayroot Swamp [AU# 27-97-5b]
Clayroot Swamp [AU# 27-97-5b; C; Sw; NSW] from SR1925 to Swift Creek (3.4 miles) is currently Supporting aquatic life due to a Good-Fair benthic bioclassification at site JB117. This is the normal basinwide site that has been assessed since 1991. This is the first time this site has received a supporting bioclassification. It last received a Poor rating in 2000. This site received a low habitat rating during this assessment period due to channel modifications, lack of colonizable habitat and stream cover as well as the left riparian area was replaced with a road. The conductivity was high (182 µmhos/cm) and filamentous algae was common, indicating nutrient enrichment. However, the big difference during this assessment period was the overall change in taxa richness. The total ETP taxa increased from 3 to 16 taxa, which accounted for the increase in the benthic bioclassification to Good-Fair. This site could easily slip back to an impaired status if improvements to the instream habitat are not obtained.

This segment will be removed from the 303(d) impaired waters list. However, this segment will be included in a TMDL management strategy for the upper portion of Clayroot Swamp.

Clayroot Swamp has been altered to function as an agricultural drainage system. This was a common practice in certain areas of the coastal plain in order to grow crops as well as build homes and businesses in these areas. The structure and character of this swamp has been forever altered. It appears that the lack of available instream habitat may be the main stressor to this system. However, there are also possible water quality issues that may be adding to the stress on this system as seen by the high conductivities and the excessive algal growth throughout this watershed.

Recommendations
DWQ continues to recommend that the Division of Soil and Water Conservation evaluate the potential for implementation of appropriate BMPs to reduce nutrient and sediment loading in this watershed.

Water Quality Initiatives
From September 2000 – December 2006, over $42,000 of the Agriculture Cost Share Program funds were spent on BMP implementation in this watershed. Practices included 196 acres of 3 year conservation tillage, 89 acres of long term no-till, 8 acres of cropland conversion to grass, 44 acres of cropland conversion to trees, 1,038 acres of nutrient scavenger crop, 13 acres of riparian buffer, and 21 acres of nutrient management. Cumulatively, these practices affect 1,683 acres, saved 4,078 Tons of soil, 4,411 pounds of nitrogen, 1,280 pounds of phosphorus, 704 pounds of Waste-N managed, and 501 pounds of Waste-P managed.

9.3.2 Creeping Swamp [AU# 27-97-5-3]

2002 Recommendations
DWQ will continue monitoring Creeping Swamp. Creeping Swamp is one of the few large non-channelized areas in the eastern part of the state and may serve as a reference reach. Because of the undisturbed nature and potential restoration sites, Creeping Swamp is a NCWRP targeted local watershed.

Current Status
Creeping Swamp [AU# 27-97-5-3; C; Sw; NSW] from source to Clayfoot Swamp (8.1 miles) is Supporting aquatic life and recreational uses due to a Moderate benthic swamp bioclassification at site JB118 and because No Criteria were Exceeded at ambient monitoring station JA70. This site was Not Rated during the last assessment period because no swamp benthic criteria were established at the time. A reassessment of the data indicated that this site was rated Natural during the 2000 sampling period. Four fewer taxa were collected in 2005, indicating a slight decrease in biological integrity. Creeping Swamp is currently on the 303(d) list for a chlorophyll *a* standard violation (noted as a historical listing decision). Currently, there were only 2 of 51 samples assessed that exceeded the state chlorophyll *a* standard of 40 µg/l (84 and 140 µg/l). The recoded DO levels ranged between 0.9 and 14.8 mg/l. Fifty percent of the readings were below 5.4 mg/l. Low DO levels are possibly caused by natural swamp conditions and may or may not affect the benthic organisms. The nutrient levels were also elevated within this watershed, with ammonia and phosphorus levels ranging between 0.01-3.8 and 0.38-4.2 mg/l respectively.

Fecal coliform bacteria levels were not above the state standard, however, they were elevated in 16 percent of the samples collected.

Creeping Swamp will be removed from the 2008 impaired waters list for chlorophyll *a* standard violation.

Recommendations
DWQ continues to recommend that the Division of Soil and Water Conservation evaluate the potential for implementation of appropriate BMPs to reduce nutrient and sediment loading in this watershed.

9.3.3 Swift Creek Watershed [AU# 27-97-(0.5)a1, 27-97-(0.5)a2, 27-97-(0.5)b, & 27-97-(6)]

Swift Creek (22.4 miles) was previously impaired from Clayroot Swamp to the Neuse River [27-97-(0.5)b, & 27-97-(6)] because of a Fair bioclassification. There was no data available above the confluence with Clayroot Swamp in order to make a use support decision during the last assessment period (1995-2000).

2002 Recommendations
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. Because upper Swift Creek watershed is in agricultural land use, it is recommended that the Division of Soil and Water Conservation (DSWC) evaluate the potential for implementation of appropriate BMPs to reduce nutrient and sediment loading.

Current Status
Swift Creek [AU# 27-97-(0.5)a1]
Swift Creek [AU# 27-97-(0.5)a1; C; Sw; NSW] from source to 5.3 miles upstream of Clayroot Swamp (19.3 miles) remains impaired for aquatic life due to a historic poor benthic assessment at station JB241. Fish site JF57 was sampled for the first time about 8 miles downstream from the historic JB241 station (NC 102). Fish could not be sampled at that NC 102 because the macrophytic growth was historically too dense to sample. The site could not be rated due to the fact that the criteria for Coastal Plain streams have not been completed. This segment of the stream was also channelized and received the second lowest habitat score of any fish community site in the Coastal Plain in 2005. Despite the habitat alterations, the fauna collected included many typical species found in Coastal Plain streams, however, no intolerant species were collected during this assessment period. This site should be ratable during the next assessment period.

Swift Creek [AU# 27-97-(0.5)a2]
Swift Creek [AU# 27-97-(0.5)a2; C; Sw; NSW] from 5.3 miles upstream of Clayroot Swamp to Clayroot Swamp (5.3 miles) is Supporting aquatic life due to a Good benthic bioclassification at site JB121. This was the first benthic sample collected at this site. This site (JB121) was requested by the Washington regional office to fill in a data gap above the normal basinwide benthic site (JB120). This section of the stream had been channelized in the past. The visible land use was mostly agriculture and forest. There was minimal instream habitat and the right streambank was lacking a riparian buffer. The DO level at the time of collection was 8.7 mg/l, the conductivity was elevated (117 µmhos/cm) and *Hydrilla* sp. was abundant. There were several intolerant taxa present that have not been seen at other locations on Swift Creek. This middle section seems to have the highest biological integrity of all sites sampled on Swift Creek.

The Good rating at this site is in contrast to historical samples collected on Swift Creek. At the historical benthic site (JB241) about 14 miles upstream of JB121 a rating of Fair and Poor were reported in 1991 and 1995 respectively.

Swift Creek segment AU# 27-97-(0.5)a2 will be removed from the 2008 303(d) list of impaired waters for impaired biological integrity due to a Good benthic rating at site JB121.

Swift Creek [AU# 27-97-(0.5)b]
Swift Creek [AU# 27-97-(0.5)b; C; Sw; NSW] from Clayroot Swamp to the mouth near Bear Branch (14.4 miles) is currently Impaired for aquatic life due to a Fair benthic bioclassification at site JB120. This site received a Fair rating in 1995 and in 2000 as well. There was an active clear-cut logging operation occurring on the right bank during the sampling period in 2005. Logging was occurring right up to the floodplain line. Immediately above this reach, Swift Creek has been channelized. Floating items tend to get caught up at the sample location, creating large mats of floating material resulting in a substrate made up of predominantly detritus and silt. The recorded DO at the time of sampling was extremely low (1.6 mg/l) the conductivity was high (184 µmhos/cm). The overall rating at this site essentially remained unchanged between 2000 and 2005. Two intolerant taxa were present, however the most abundant taxa indicate that Swift Creek may periodically have low DO, low flow and organic enrichment issues.

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

Swift Creek [AU# 27-97-(6)]
Swift Creek [AU# 27-97-(6); SC; Sw; NSW] from mouth near Bear Branch to Neuse River (8.0 miles) is currently Supporting aquatic life and recreational uses due to No Criteria Exceeded at ambient monitoring stations JA71 and JA72. The DO levels ranged from 0.7 to 15.7 mg/l. Waters with swamp classification often have naturally occurring low DO levels. High levels of macrophytic growth throughout Swift Creek can potentially cause large swings in DO levels. It is apparent from the algal growth that nutrient enrichment is an issue in this watershed. This could be seen by the excessive growth throughout the watershed as well a by the benthic species found at the macroinvertebrate sites and from the ambient monitoring data in the lower Swift Creek watershed. There was only a single chlorophyll *a* reading elevated at JA71 (furthest downstream ambient station) above the state standard of 40 µg/l. The maximum level recorded was 46 µg/l. Also, 3 percent of the samples exceeded the turbidity standard of 25 NTUs for SC waters with a maximum level recorded at 70 NTU.

This segment of Swift Creek will also remain on the impaired waters list for impaired biological integrity. No benthic or fish community assessment was completed in this segment during this data window.

Recommendations
A TMDL management strategy will be developed for the entire Swift Creek watershed.

DWQ continues to recommend that the Division of Soil and Water Conservation evaluate the potential for implementation of appropriate BMPs to reduce nutrient and sediment loading in this watershed.

Water Quality Initiatives

Swift Creek [AU#27-97-(0.5)a1 and 27-97-(0.5)a2]

From September 2000 – December 2006, over $224,000 of the Agriculture Cost Share Program funds were spent on BMP implementation in this watershed. Practices included 912 acres of three-year conservation tillage, 216 acres of long term no-till, 59 acres of cropland conversion to trees, 7,454 acres of land smoothing, 1,668 acres of nutrient scavenger crop, 60 acres of conservation tillage, 3 acres of grassed waterways, 17 acres of field borders, 10 acres of filter strip, 196 acres of riparian buffer, 1 water control structure, 10 rock-lined outlets, 12 grade stabilization structures, 2 incinerators, 1 hydrant, and 1 waste impoundment closure. Cumulatively, these practices affect 4,055 acres, saved 10,699 Tons of soil, 33,117 pounds of nitrogen, 2,954 pounds of phosphorus, 14,576 pounds of Waste-N managed, and 14,634 pounds of Waste-P managed.

Swift Creek [AU#27-97-(0.5)b and 27-97- (6)]

From September 2000 – December 2006, over $23,000 of the Agriculture Cost Share Program funds were spent on BMP implementation in this watershed. Practices included 169 acres of three-year conservation tillage, 45 acres of riparian buffers, 6 water control structures, and 2 incinerators. Cumulatively, these practices affect 492 acres, saved 621 Tons of soil, 9,313 pounds of nitrogen, 54 pounds of phosphorus, 12,050 pounds of Waste-N managed, and 6,552 pounds of Waste-P managed.

9.4 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.

Nothing noted in this segment.

Recommendations

Many of the streams within this subbasin are likely influenced by agricultural practices that occur within this watershed. DWQ would recommend sampling Little Swift Creek or Fisher Swamp during the next assessment period.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

9.5 Additional Water Quality Issues within Subbasin 03-04-09

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.

9.5.1 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.

Chapter 10
Neuse River Subbasin 03-04-10

Including the: Neuse River Estuary, South River, Trent River, Adams Creek and Broad River

10.1 Subbasin Overview

Subbasin 03-04-10 at a Glance

Land Cover (percent)

Forest/Wetland:	56.2
Surface Water:	26.1
Urban:	6.3
Cultivated Crop:	10.5
Pasture/ Managed Herbaceous:	0.9

Counties
Carteret, Craven and Pamlico

Municipalities
Arapahoe, Minnesott Beach, New Bern, Oriental and Havelock

Stream Statistics

Total Streams:	
Freshwater	97.5 mi
Saltwater	115,234.7 mi/112.7 ac
Total Supporting:	
Freshwater	17.1 mi
Saltwater	9.9 mi/58,300.6 ac
Total Impaired:	
Freshwater	0.0 mi
Saltwater	8.5 mi/53,897.4 ac
Total Not Rated:	
Freshwater	0.0 mi
Saltwater	5.3 mi
Total No Data:	
Freshwater	165.9 mi
Saltwater	94.2 mi/3,036.7 ac

Most of the waters in this subbasin are estuarine in nature, including the Neuse River and the downstream portion the main tributaries.

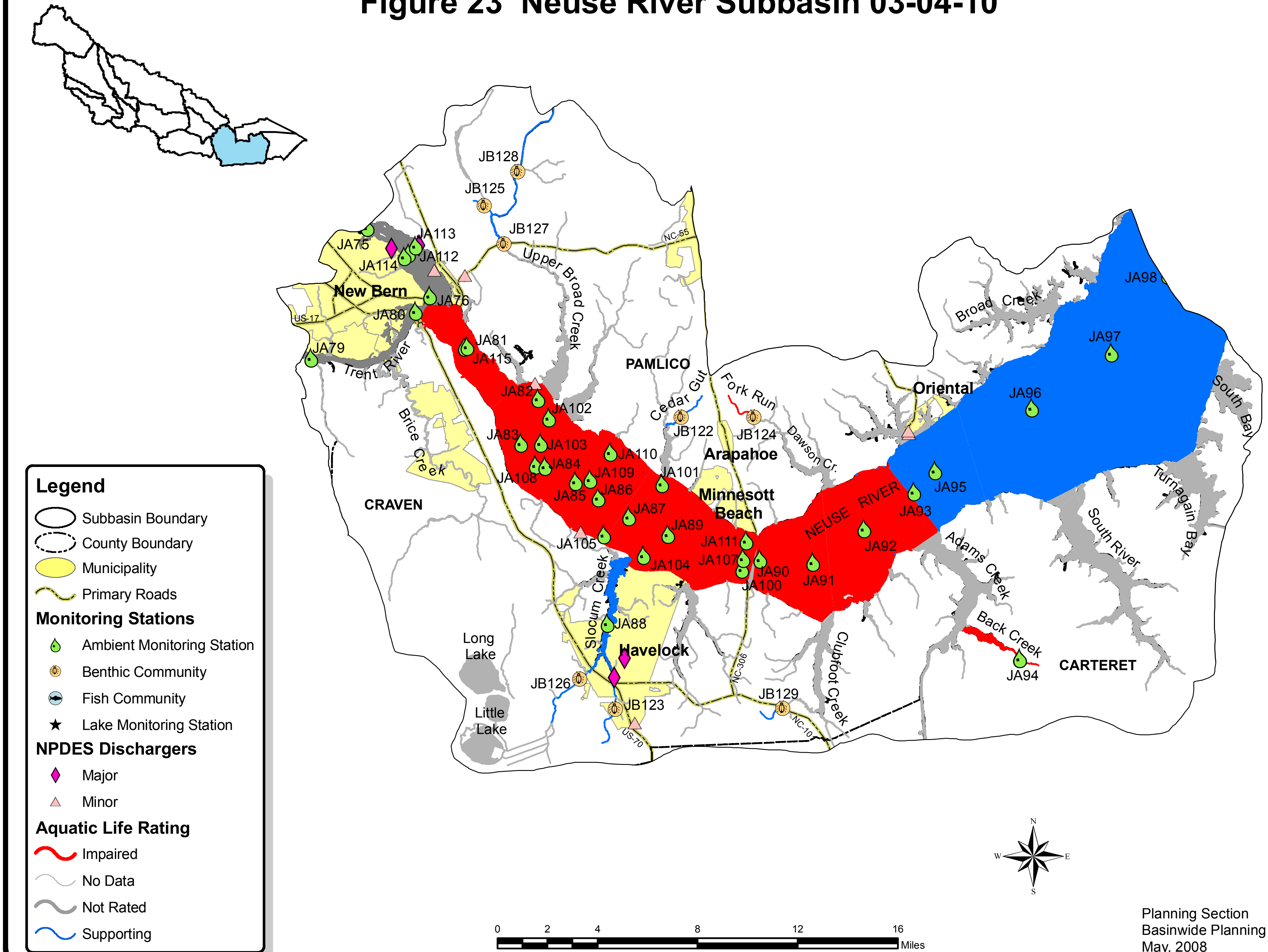
Due to the presents of the North Carolina Outer Banks water exchange with the Atlantic Ocean is slowed resulting in minimal discharge and a long hydraulic residence times within the estuary. Consequently, high nutrient laden water is retained within the estuary for long periods of time and thus becomes prone to phytoplankton bloom formation and fish kills.

There are a few small towns located within this subbasin. Moderate residential growth continues throughout most of the subbasin although the largest concentrations of suburban impacts are associated with New Bern, Havelock and Oriental. Within the past ten years, the population in New Bern and Havelock has increased by 24.9 percent (5,748) and 9.5 percent (2,142), respectively. The land cover for this subbasin is mostly a mix of forest and agriculture. Although large scale agricultural operations are common in the subbasin, there are also large tracts of protected forest and pocosin wetlands associated with Croatan National Forest and the Light Ground Pocosin. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 16.

There are 4 major and 10 minor NPDES wastewater discharge permits in this subbasin with a total permitted flow of 13.6 MGD. The largest are the New Bern WWTP (6.5 MGD) and the Cherry Point WWTP (3.5 MGD). There are also 20 individual NPDES stormwater permits in the subbasin. Refer to Appendix III for identification and more information on individual NPDES permit holders. New Bern and Havelock will be required to develop a stormwater program under Phase II and have submitted model stormwater ordinances as required by the Neuse NSW strategy stormwater requirements (Chapter 18). There are also 4 permitted animal operations in this subbasin.

The tributaries to the Neuse River sampled for macroinvertebrates were classified using swamp stream criteria. Several of the biologically monitored areas improved, possibly due to the drought that occurred in the area prior to the sampling period in 2005, resulting in lower amounts of contaminated runoff to these small tributaries.

Figure 23 Neuse River Subbasin 03-04-10



Planning Section
Basinwide Planning Unit
May, 2008

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Watershed (WBD-10 Number) 0302020206 Hog Island-Neuse River												
Subwatershed (WBD-12 Number) 030202020607 Hog Island-Neuse River												
27-(96)b1 From Bachelor Creek to the Trent River (River and part of Upper Model segment) SC;Sw,NSW	**NEUSE RIVER Estuary**	03-04-10	2,363.1 S Acres	**2t**	**Chlorophyll a**: General Agriculture/Pasture, Stormwater Runoff; **Low pH**: Natural Conditions; **Nutrient Impacts**: MS4 NPDES, WWTP NPDES	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
						Aquatic Life	Not Rated	Data Inconclusive	Copper	2006		3m
						Aquatic Life	Supporting	No Criteria Exceeded	Chlorophyll a	2006	2004	2t
						Aquatic Life	Not Rated	Data Inconclusive	Low pH	2006		3a
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
Watershed (WBD-10 Number) 0302020403 Lower Trent River												
Subwatershed (WBD-12 Number) 030202040305 City of New Bern-Trent River												
27-101-(31)b From boundary between subbasins 030410 and 030411 to mouth of Brice Creek SB;Sw,NSW	**Trent River**	03-04-10	509.7 S Acres	**4b**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards 1n3	2006		1
						Aquatic Life	Not Rated	Data Inconclusive	Chlorophyll a	2006	2004	4b
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
27-101-(39) From mouth of Brice Creek to Neuse River SB;Sw,NSW	**Trent River**	03-04-10	500.1 S Acres	**4b**		Aquatic Life	Not Rated	Data Inconclusive	Chlorophyll a	2006	2004	4b
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
Watershed (WBD-10 Number) 0302020404 Upper Broad Creek-Neuse River												
Subwatershed (WBD-12 Number) 030202040402 Headwaters Upper Broad Creek												
27-106-(1) From source to N. C. Hwy. 55 Bridge C;Sw,NSW	**Upper Broad Creek**	03-04-10	7.3 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
27-106-3 From source to Upper Broad Creek C;Sw,NSW	**Mill Swamp**	03-04-10	1.0 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
Subwatershed (WBD-12 Number) 030202040403 Outlet Upper Broad Creek												

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(104)a	**NEUSE RIVER Estuary**			**5**	**Chlorophyll a**	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
From a line across Neuse River from Johnson Point to McCotter Point to a line across Neuse River from 1.2 miles upstream of Slocum Creek to 0.5 miles upstream of Beard Creek (middle model segment)					Multiple Watershed Sources	Aquatic Life	Not Rated	Data Inconclusive	Copper	2006		3m
SB;Sw,NSW		03-04-10	13,736.0 S Acres		**High pH**	Aquatic Life	Impaired	Standard Violation	High pH	2006	2008	5
						Aquatic Life	Impaired	Standard Violation	Chlorophyll a	2006	2004	4a
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Subwatershed (WBD-12 Number) 030202040404 Northwest Creek-Neuse River

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(96)b2	**NEUSE RIVER Estuary**			**4a**	**Chlorophyll a**	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
From Trent River to a line across Neuse River from Johnson Point to McCotter Point (part of upper model segment)					Animals	Aquatic Life	Not Rated	Data Inconclusive	Copper	2006		3m
SC;Sw,NSW		03-04-10	3,473.6 S Acres		ANOPS land app site	Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
					Construction	Aquatic Life	Impaired	Standard Violation	Chlorophyll a	2006	2004	4a
					Failing Septic Systems	Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
					Forest Harvesting							
					General Agriculture/Pasture							
					Impervious Surface							
					Land Clearing							
					Multiple Watershed Sources							
					Road Construction							
					Row Crop Agriculture							
					Stormwater Runoff							
					WWTP NPDES							

Watershed (WBD-10 Number) 0302020405 Cherry Point-Neuse River

Subwatershed (WBD-12 Number) 030202040502 Point Marine Corps Air Station-Slocum Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-112	**Slocum Creek**			**2**		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
SC;Sw,NSW		03-04-10	659.1 S Acres									
27-112-1	**Southwest Prong Slocum Creek**			**2**	**Habitat Degradation**	Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
From source to Slocum Creek												
C;Sw,NSW		03-04-10	4.2 FW Miles									
27-112-2	**East Prong Slocum Creek**			**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
From source to Slocum Creek												
C;Sw,NSW		03-04-10	4.6 FW Miles									

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(104)b	**NEUSE RIVER Estuary**	From a line across Neuse River from 1.2 miles upstream of Slocum Creek to 0.5 miles upstream of Beard Creek to a line across Neuse River from Wilkinson Point to Cherry Point (bend model segment)	SB;Sw,NSW	03-04-10	10,756.9 S Acres	**5**	**Chlorophyll a** **High pH**	Aquatic Life	Impaired	Standard Violation	High pH	2006	2008	5
								Aquatic Life	Impaired	Standard Violation	Chlorophyll a	2006	2004	4a
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)			1

Subwatershed (WBD-12 Number) 030202040503 Beard Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-111-2	**Cedar Gut**	From source to Beard Creek	SC;Sw,NSW	03-04-10	2.1 S Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1

Watershed (WBD-10 Number) 0302020406 Town of Oriental-Neuse River

Subwatershed (WBD-12 Number) 030202040601 Dawson Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-121	**Gatlin Creek**	From source to Neuse River	SA;HQW,NSW	03-04-10	2.5 S Miles	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-125-(6)a	**Dawson Creek**	From mouth of Tarkiln Creek to 0.03 miles upstream of Neuse River	SA;HQW,NSW	03-04-10	121.2 S Acres	**5**	**Enterrococcus** **Fecal Coliform Bacteria** Swimmers	Recreation	Impaired	Standard Violation	Enterrococcus	2006	2008	5
								Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2008	5
								Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2008	4cs
27-125-(6)b	**Dawson Creek**	From 0.03 miles upstream of Neuse River to Neuse River	SA;HQW,NSW	03-04-10	1.0 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-125-2	**Fork Run**	From source to Dawson Creek	SC;NSW	03-04-10	2.6 S Miles	**5**	**Habitat Degradation** Row Crop Agriculture Stormwater Runoff **Nutrient Impacts** Row Crop Agriculture Stormwater Runoff	Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	2008	5

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(118)a1 NEUSE RIVER Estuary From a line across Neuse River from Wilkinson Point to Cherry Point to a line across the river From Adams Creek to Wiggins Point (part of lower model segment) SA;HQW,NSW 03-04-10 17,135.4 S Acres	4a	**Chlorophyll a** Multiple Watershed Sources **Fecal Coliform Bacteria** Stormwater Runoff	Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
			Aquatic Life	Not Rated	Data Inconclusive	Copper	2006		3m
			Aquatic Life	Impaired	Standard Violation	Chlorophyll a	2006	2008	4a
			Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
			Shellfish Harvesting	Supporting	Potential Standards Violation	Fecal Coliform (shellfish)	2006		3a
			Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-(118)a1a NEUSE RIVER Estuary at Camp Don Lee Swim beach at Camp Don Lee SA;HQW,NSW 03-04-10 1.0 S Acres	5	**Chlorophyll a** **Enterrococcus** Stormwater Runoff	Aquatic Life	Impaired	Standard Violation	Chlorophyll a	2006	2008	4a
			Recreation	Impaired	Standard Violation	Enterrococcus	2006	2008	5
			Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-(118)h NEUSE RIVER Estuary Public Beach area at mouth of Dawson Creek SA;HQW,NSW 03-04-10 1.7 S Acres	4cr	**Enterrococcus** Swimmers	Recreation	Impaired	Loss of Use	Recreation Advisory	2006	2008	4cr
			Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
Subwatershed (WBD-12 Number) 030202040602						**Clubfoot Creek**			
27-119 Cherry Branch From source to Neuse River SA;HQW,NSW 03-04-10 1.2 S Miles	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-120 King Creek From source to Neuse River SA;HQW,NSW 03-04-10 2.4 S Miles	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-122 Sassafras Branch From source to Neuse River SA;HQW,NSW 03-04-10 1.1 S Miles	4cs		Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-123 Clubfoot Creek From source to Neuse River SA;HQW,NSW 03-04-10 562.6 S Acres	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-123-1 Harlowe Canal From White Oak River Basin Boundary (Craven-Carteret County Line) to Clubfoot Creek SA;HQW,NSW 03-04-10 0.6 S Miles	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-123-2 Mortons Mill Pond From source to Clubfoot Creek SA;HQW,NSW 03-04-10 30.6 S Acres	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-123-2-1 West Prong Mortons Mill Pond From source to Mortons Mill Pond SA;HQW,NSW 03-04-10 1.4 S Miles	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
			Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-123-2-2 East Prong Mortons Mill Pond From source to Mortons Mill Pond SA;HQW,NSW 03-04-10 0.6 S Miles	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-123-3 Gulden Creek From source to Clubfoot Creek SA;HQW,NSW 03-04-10 34.9 S Acres	5	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2004	5
			Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-123-4 Mitchell Creek From source to Clubfoot Creek SA;HQW,NSW 03-04-10 117.5 S Acres	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-123-4-1 Big Branch From source to Mitchell Creek SA;HQW,NSW 03-04-10 1.6 S Acres	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-123-4-2 Snake Branch From source to Mitchell Creek SA;HQW,NSW 03-04-10 0.9 S Miles	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-124 Long Creek From source to Neuse River SA;HQW,NSW 03-04-10 67.7 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-126 Great Neck Creek From source to Neuse River SA;HQW,NSW 03-04-10 1.7 S Miles	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(118)a2	**NEUSE RIVER Estuary**	From a line across Neuse RiverFrom Adams Creek to Wiggins Point to Pamlico Sound (mouth of Neuse River described as a line running from Maw point to Point of Marsh)	SA;HQW,NSW	03-04-10	50,851.7 S Acres	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards 1n3	2006		1
								Aquatic Life	Not Rated	Data Inconclusive	Copper	2006		3m
								Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
								Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-(118)b	**NEUSE RIVER Estuary**	DEH prohibited area at mouth of Clubfoot Creek	SA;HQW,NSW	03-04-10	96.2 S Acres	**4cs**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-(118)f	**NEUSE RIVER Estuary**	Prohibited area at Cherry Branch Minnesott Ferry Landing south side of river	SA;HQW,NSW	03-04-10	93.5 S Acres	**4a**	**Chlorophyll a**	Aquatic Life	Impaired	Standard Violation	Chlorophyll a	2006	2008	4a
							Fecal Coliform Bacteria / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs

Subwatershed (WBD-12 Number) 030202040603 Greens Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-130	**Whittaker Creek**	From source to Neuse River	SA;HQW,NSW	03-04-10	96.1 S Acres	**4cs**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-(118)c	**NEUSE RIVER Estuary**	DEH prohibited area at mouth of Green Creek	SA;HQW,NSW	03-04-10	61.7 S Acres	**4cs**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs

Subwatershed (WBD-12 Number) 030202040604 Adams Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-127	**Courts Creek (Coaches Creek)**	From source to Neuse River	SA;HQW,NSW	03-04-10	43.1 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-128-1.5	**Jerry Bay**	From source to Adams Creek	SA;HQW,NSW	03-04-10	52.2 S Acres	**4cs**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-128-10	**Godfrey Creek**	From source to Adams Creek	SA;HQW,NSW	03-04-10	34.7 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-128-1a	**Adams Creek Canal (Intracoastal Waterway)**	From the White Oak River Basin Boundary 0.4 miles north of boundary	SA;HQW,NSW	03-04-10	12.5 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Closed Growing Area	2006	2004	4cs
27-128-1b	**Adams Creek Canal (Intracoastal Waterway)**	From 0.4 miles north of White Oak River Basin Boundary to Adams Creek	SA;HQW,NSW	03-04-10	126.3 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-128-2	**Isaac Creek**	From source to Adams Creek	SA;HQW,NSW	03-04-10	39.1 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-128-3a	**Back Creek (Black Creek)**	From source to Adams Creek excluding swimming area near mouth	SA;HQW,NSW	03-04-10	259.5 S Acres	**5**	**Chlorophyll a** Row Crop Agriculture **Fecal Coliform Bacteria** Animals Row Crop Agriculture **Low Dissolved Oxygen** Row Crop Agriculture **Low pH** Row Crop Agriculture **Nutrient Impacts** Row Crop Agriculture **Turbidity** Row Crop Agriculture	Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards 1n3	2006		1
								Aquatic Life	Not Rated	Data Inconclusive	Copper	2006		3m
								Aquatic Life	Not Rated	Potential Standards Violation	Low pH	2006		3a
								Aquatic Life	Not Rated	Potential Standards Violation	Low Dissolved Oxygen	2006		3a
								Recreation	Impaired	Standard Violation	Fecal Coliform (recreation)	2006	2008	5
								Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-128-3b	**Back Creek (Black Creek)**	Swimming area near mouth	SA;HQW,NSW	03-04-10	2.1 S Acres	**4cs**	**Fecal Coliform Bacteria** Animals Row Crop Agriculture	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-128-4	**Kearney Creek**	From source to Adams Creek	SA;HQW,NSW	03-04-10	4.0 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-128-5	**Kellum Creek**	From source to Adams Creek	SA;HQW,NSW	03-04-10	10.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-128-6 Cedar Creek From source to Adams Creek SA;HQW,NSW 03-04-10 108.9 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-128-6-1 Cullie Creek From source to Cedar Creek SA;HQW,NSW 03-04-10 4.4 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-128-6-2 Jonaquin Creek From source to Cedar Creek SA;HQW,NSW 03-04-10 35.9 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-128-7a Dumpling Creek From source to 0.1 miles upstream of Adams Creek SA;HQW,NSW 03-04-10 20.0 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-128-7b Dumpling Creek From 0.1 miles upstream of Adams Creek to Adams Creek SA;HQW,NSW 03-04-10 5.4 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-128-8 Sandy Huss Creek From source to Adams Creek SA;HQW,NSW 03-04-10 15.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-128-9 Delamar Creek From source to Adams Creek SA;HQW,NSW 03-04-10 11.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-128a Adams Creek From a line crossing Adams Creek at a point 406 meters south of mouth of Kellum Creek to a point 637 meters north of mouth Beck Creek exluding DEH prohibited area at mouth of Dumpling Creek to Neuse River SA;HQW,NSW 03-04-10 1,424.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-128b Adams Creek DEH prohibited area at mouth of Dumpling Creek SA;HQW,NSW 03-04-10 3.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-128c	**Adams Creek**			**4cs**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
DEH conditionally approved-closed area from source to a line crossing Adams Creek at a point 406 meters south of mouth of Kellum Creek to a point 637 meters north of mouth of Beck Creek												
SA;HQW,NSW		03-04-10	317.0 S Acres									

Watershed (WBD-10 Number) 0302020407 Neuse River

Subwatershed (WBD-12 Number) 030202040701 South River

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-131	**Garbacon Creek**			**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
From source to Neuse River												
SA;HQW,NSW		03-04-10	25.8 S Acres									
27-132	**Berrys Creek**			**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
From source to Neuse River												
SA;HQW,NSW		03-04-10	1.4 S Miles									
27-135-1	**West Fork South River**			**4cs**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
From source to South River												
SA;HQW,NSW		03-04-10	35.5 S Acres									
27-135-10	**Eastman Creek**			**5**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2004	5
From source to South River						Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
SA;HQW,NSW		03-04-10	95.6 S Acres									
27-135-11	**Little Creek**			**4cs**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
From source to South River												
SA;HQW,NSW		03-04-10	6.2 S Acres									
27-135-12	**Royal Creek**			**4cs**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
From source to South River												
SA;HQW,NSW		03-04-10	10.1 S Acres									
27-135-13	**Coffee Creek**			**4cs**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
From source to South River												
SA;HQW,NSW		03-04-10	6.1 S Acres									

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors	Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-135-14	**Dixon Creek**	From source to South River	SA;HQW,NSW	03-04-10	2.3 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-135-15	**Old House Creek**	From source to South River	SA;HQW,NSW	03-04-10	3.2 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-135-16	**Mulberry Creek**	From source to South River	SA;HQW,NSW	03-04-10	6.4 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-135-17a	**Big Creek**	From source to DEH prohibited area line	SA;HQW,NSW	03-04-10	59.6 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-135-17b	**Big Creek**	From DEH prohibited area line to South River	SA;HQW,NSW	03-04-10	58.4 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-135-18	**Hardy Creek**	From source to South River	SA;HQW,NSW	03-04-10	24.2 S Acres	**5**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2004	5
									Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-135-19	**Horton Bay**	From source to South River	SA;HQW,NSW	03-04-10	101.3 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-135-2	**East Fork South River**	From source to South River	SA;HQW,NSW	03-04-10	14.3 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-135-20	**Herring Pond**	Entire pond and connecting stream to South River	SA;HQW,NSW	03-04-10	11.1 S Acres	**2**			Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-135-2-1	**Rich Island Gut**	From source to East Fork South River	SA;HQW,NSW	03-04-10	0.1 S Miles	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-135-3	**Miry Gut**	From source to South River	SA;HQW,NSW	03-04-10	0.1 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-135-4	**Elisha Creek**	From source to South River	SA;HQW,NSW	03-04-10	2.2 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-135-5	**Neal Creek**	From source to South River	SA;HQW,NSW	03-04-10	2.9 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-135-6	**Duck Creek**	From source to South River	SA;HQW,NSW	03-04-10	2.6 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-135-7	**Buck Creek**	From source to South River	SA;HQW,NSW	03-04-10	6.4 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-135-8	**Doe Creek**	From source to South River	SA;HQW,NSW	03-04-10	4.9 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-135-9	**Southwest Creek**	From source to South River	SA;HQW,NSW	03-04-10	151.3 S Acres	**5**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2004	5
								Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-135a	**South River**	From source to a line crossing the South River at a point 97 meters north of mouth of Southwest Creek to a point 418 meters north of mouth of Doe Creek	SA;HQW,NSW	03-04-10	415.1 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-135b	**South River**	From a line crossing the South River at a point 97 meters north of mouth of Southwest Creek to a point 418 meters north of mouth of Doe Creek t Neuse River	SA;HQW,NSW	03-04-10	2,064.8 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs

Table 28 Neuse River Basin — *Subbasin (WBD-8 Number)* *03020204* — *DWQ Subbasin* **03-04-10**

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors	Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(118)e	**NEUSE RIVER Estuary**	DEH Conditionally approved-open area at mouth of the South River	SA;HQW,NSW	03-04-10	210.0 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2008	4cs

Subwatershed (WBD-12 Number) 030202040703 — Broad Creek

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors	Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-133a	**Pierce Creek**	From source to 0.04 miles upstream of Neuse River	SA;HQW,NSW	03-04-10	48.9 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-133b	**Pierce Creek**	From 0.04 miles upstream of Neuse River to Neuse River	SA;HQW,NSW	03-04-10	1.8 S Acres	**2**			Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-134-1	**Bright Creek**	From source to Orchard Creek	SA;HQW,NSW	03-04-10	10.9 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-134-2	**Pasture Creek**	From source to Orchard Creek	SA;HQW,NSW	03-04-10	20.3 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-134-3	**Old House Creek**	From source to Orchard Creek	SA;HQW,NSW	03-04-10	6.0 S Acres	**2**			Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-134a	**Orchard Creek**	From source to a line crossing Orchard Creek at a point 91 meters south of mouth of Bright Creek to a point 99 meters north of mouth of Pasture Creek	SA;HQW,NSW	03-04-10	37.1 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-134b	**Orchard Creek**	From a line crossing Orchard Creek at a point 91 meters south of mouth of Bright Creek to a point 99 meters north of mouth of Pasture Creek to Neuse River	SA;HQW,NSW	03-04-10	20.4 S Acres	**4cs**	**Fecal Coliform Bacteria**	Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-140	**Gum Tricket Creek**	From source to Neuse River	SA;HQW,NSW	03-04-10	10.5 S Acres	**2**			Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-141-1 From source to Broad Creek SA;HQW,NSW	**Ship Creek**	03-04-10	5.4 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-141-10 From source to Broad Creek SA;HQW,NSW	**Cedar Creek**	03-04-10	11.7 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-141-11 From source to Broad Creek SA;HQW,NSW	**Green Creek**	03-04-10	79.1 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-141-2 From source to Broad Creek SA;HQW,NSW	**Gideon Creek**	03-04-10	26.0 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-141-3 From source to Broad Creek SA;HQW,NSW	**Brown Creek**	03-04-10	122.4 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-141-3-1 From source to Brown Creek SA;HQW,NSW	**Spice Creek**	03-04-10	4.7 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-141-3-2 From source to Brown Creek SA;HQW,NSW	**Coffee Creek**	03-04-10	7.1 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-141-4 From source to Broad Creek SA;HQW,NSW	**Tar Creek**	03-04-10	44.3 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-141-5 From source to Broad Creek SA;HQW,NSW	**Pasture Creek**	03-04-10	2.1 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-141-6 From source to Broad Creek SA;HQW,NSW	**Parris Creek**	03-04-10	19.4 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-141-7 Burton Creek From source to Broad Creek SA;HQW,NSW 03-04-10 46.3 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-141-8 Pittman Creek From source to Broad Creek SA;HQW,NSW 03-04-10 65.8 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-141-9 Mill Creek From source to Broad Creek SA;HQW,NSW 03-04-10 12.3 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-141a Broad Creek From source to a line across Broad Creek from a point 331 meters east of mouth of Browns Creek to a point 145 meters east of mouth of Tar Creek SA;HQW,NSW 03-04-10 202.3 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-141b Broad Creek From a line across Broad Creek from a point 331 meters east of mouth of Browns Creek to a point 145 meters east of mouth of Tar Creek to the Neuse River SA;HQW,NSW 03-04-10 527.7 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-142 Piney Point Creek From source to Neuse River SA;HQW,NSW 03-04-10 13.0 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-144 Swan Creek From source to Neuse River SA;HQW,NSW 03-04-10 207.0 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-145 Wading Creek From source to Neuse River SA;HQW,NSW 03-04-10 9.0 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-146 Maw Bay From source to Neuse River SA;HQW,NSW 03-04-10 18.9 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-147 **Maw Point Creek** From source to Neuse River SA;HQW,NSW 03-04-10 7.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-(118)d **NEUSE RIVER Estuary** DEH prohibited area at mouth of Peirce Creek SA;HQW,NSW 03-04-10 7.7 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-(118)g **NEUSE RIVER Estuary** Prohibited area at mouth of Orchard Creek SA;HQW,NSW 03-04-10 8.2 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
Subwatershed (WBD-12 Number) 030202040704 Turnagain Bay-Rattan Bay									
27-136 **Brown Creek** From source to Neuse River SA;HQW,NSW 03-04-10 98.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-137 **Turnagain Bay** From source to Neuse River SA;HQW,NSW 03-04-10 1,556.8 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2008	4cs
27-137-1 **Sanborns Gut** From source to Trunagain Bay SA;HQW,NSW 03-04-10 3.7 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-137-2 **Big Gut** From source to Turnagain Bay SA;HQW,NSW 03-04-10 70.0 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-137-3 **Deep Gut** From source to Turnagain Bay SA;HQW,NSW 03-04-10 51.0 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-137-4 **Broad Creek** From source to Turnagain Bay SA;HQW,NSW 03-04-10 49.2 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-137-4-1 From source to Broad Creek SA;HQW,NSW	**Pitman Creek**	03-04-10	2.0 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-137-4-2 From source to Broad Creek SA;HQW,NSW	**Parsons Creek**	03-04-10	26.7 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-137-5 From source to Turnagain Bay SA;HQW,NSW	**Abraham Bay**	03-04-10	96.9 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2008	4cs
27-137-6 From source to Turnagain Bay SA;HQW,NSW	**Tump Gut**	03-04-10	20.9 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-137-7 From source to Turnagain Bay SA;HQW,NSW	**Mulberry Point Creek**	03-04-10	15.7 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-138 From source to Neuse River SA;HQW,NSW	**Cedar Bay**	03-04-10	267.4 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-139 From source to Neuse River SA;HQW,NSW	**Little Creek**	03-04-10	13.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-143 From source to Neuse River SA;HQW,NSW	**Rattan Bay**	03-04-10	369.8 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-143-1 From source to Rattan Bay SA;HQW,NSW	**South Bay**	03-04-10	527.1 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-143-2 From source to Rattan Bay SA;HQW,NSW	**East Bay**	03-04-10	174.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-143-3		**North Bay**	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
From source to Rattan Bay											
SA;HQW,NSW	03-04-10	126.9 S Acres									

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.

The Neuse River Estuary is one of the most highly monitored waters in the state and is assessed by several state agencies and universities. The estuary is mainly affected by nutrient inputs from the entire Neuse River basin watershed, resulting in elevated chlorophyll *a*, high pH and low dissolved oxygen levels throughout the Neuse River Estuary. Fecal coliform bacteria from local stormwater runoff are also resulting in shellfish closures in the estuary. The watershed sources of excess nutrients, comes from a range of sources such as agriculture and urban runoff as well as point source dischargers. Many sources have reduced the amount of nitrogen discharged to the Neuse River to comply with the Neuse River nutrient management strategy.

Nitrogen contributions from some sources were not specifically addressed in the original management strategy. Stormwater runoff from existing development, comprehensive stormwater controls on new development throughout the entire watershed as well as contributions from groundwater and atmospheric deposition were not individually targeted in the original management strategy. The contribution from several of these sources is still not fully understood. However, steps can be taken now by local governments to help further reduce nutrients delivered to the estuary. For example, this could be done via ordinance changes to reduce stormwater runoff, encouragement of low impact development, and increased local buffer protection (to greater than 50 feet).

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 13. Table 28 contains a list of assessment unit numbers (AU#), stream 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 for more information about use support methodology.

Waters in the following sections and in Table 28 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.

10.2 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. Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 29 for a summary of use support for waters in subbasin 03-04-10 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

10.3 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 303(d) 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.

Table 29 Summary of Use Support Ratings in Subbasin 03-04-10

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
Freshwater miles (streams)	17	0	0.0	17	18	0	80	98
Estuarine miles	19	9	8	10	9	0	94	113
Estuarine acres	112198	53,897	47	58,301	51	0	3,037	115,235

% - Percent of the total miles/acres.

10.3.1 Neuse River Estuary

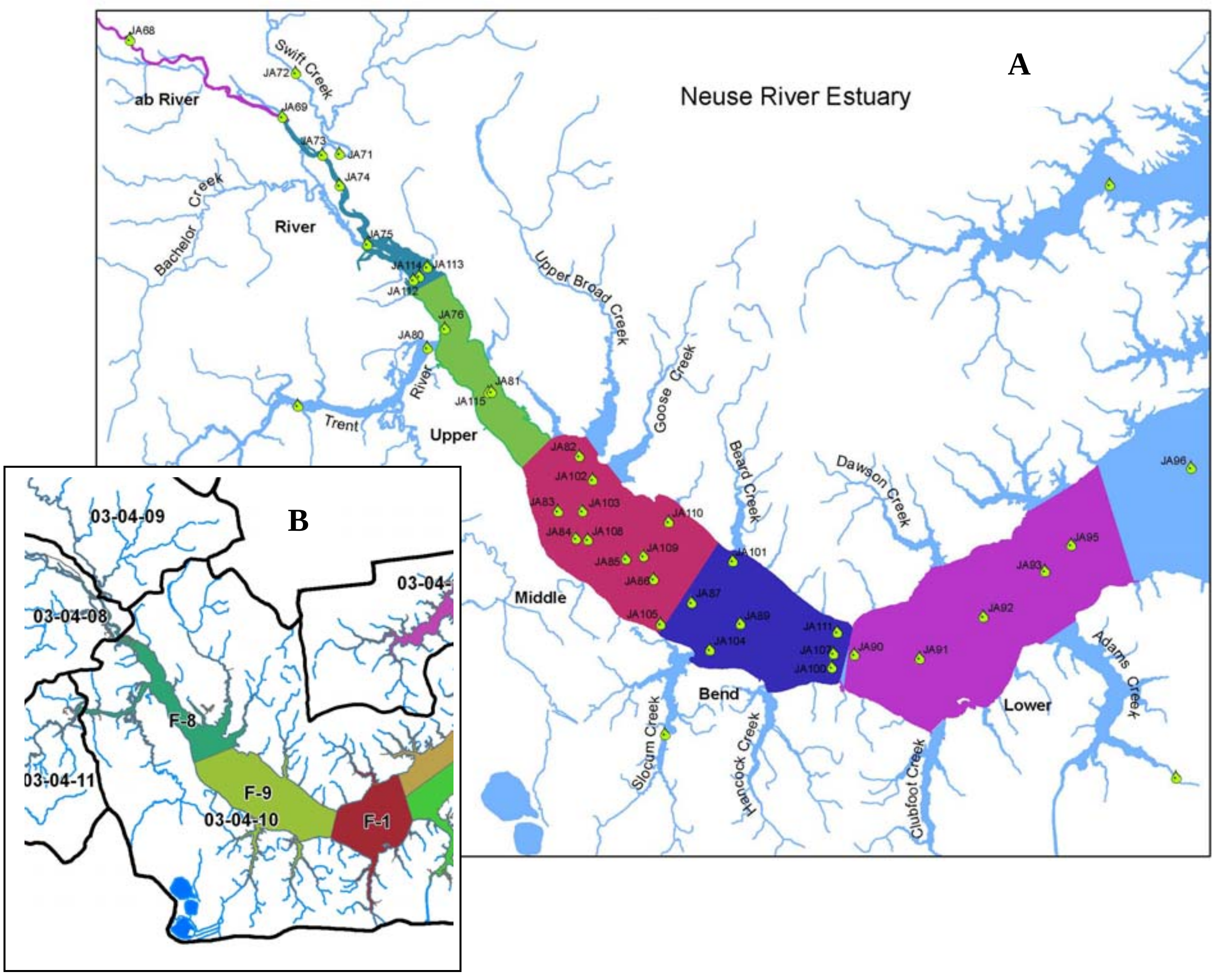
A few miles above New Bern the Neuse River takes on estuarine characteristics as it widens, it also remains shallow, frequently resulting in minimal discharge and long hydraulic residence times. The average annual residence time for water in the Neuse River Estuary is 68 days (Cross et. al, 2006). The Neuse River Estuary stretches to the southeast for 25 miles until it reaches Cherry Point, where it bends to the northeast and continues for 20 miles before meeting the Pamlico Sound.

A final TMDL for total nitrogen to the Neuse River Estuary was approved by the USEPA in March 2002. This TMDL addresses chlorophyll *a* levels as its endpoint, but seeks to manage total nitrogen, which is the nutrient that has the best potential to limit excessive growth of phytoplankton in the estuary. The TMDL target is to have less than or equal to 10 percent of the samples collected above the chlorophyll *a* state standard of 40 µg/l. Through modeling of the estuary, this was thought to be achievable by reducing total nitrogen loading to the estuary by 30 percent by both point and nonpoint sources (reduction from the 1991-1995 baseline total nitrogen loading). The Neuse River Estuary is divided into 5 model segments: River, Upper, Middle, Bend and Lower (Figure 24a). The TMDL reduction target scenarios focused mainly on the Upper, Middle, and Bend use support areas. The River and the Lower segments are the endpoints of the TMDL and were thought to have fewer chlorophyll *a* exceedances relative to the other areas. The original spatial extent of the chlorophyll *a* Impairment was based on the DEH Shellfish growing area for F-8 and F-9 only (this did not include the tributaries to this area) (Figure 24b).

The data used to assess the estuary for this assessment period was collected by multiple sources between January 2002 and December 2006. These sources were ModMon (University of North Carolina's Neuse River Estuary Modeling and Monitoring Project), North Carolina State University Center for Applied Aquatic Ecology and Division of Water Quality. Data were assessed station by station along the length of the estuary and were pooled at collocated DWQ/ModMon stations. The waters that exceed the state standard more than 10 percent of the time are considered impaired and not supporting their designated uses. Not all data types were available at all station locations.

This is the first complete evaluation of the estuary (headwater to mouth) and represents only the current impairment that existed during this assessment period. Since the full spatial extent of the chlorophyll *a* impairment was not assessed until this data window, DWQ can not determine if the chlorophyll *a* impairments have expanded or not due to the lack of sufficient data for comparison. There are segments described below that are being added or removed from the impaired waters list. This is does not necessarily represent a change in the water quality status in this area. The data collected during the next assessment period will give a better indication as to the changes that are taking place in the estuary. It is likely that the spatial extent of the chlorophyll *a* impairment will shift up and down in the estuary depending on several factors like major climatic events, river flows and nutrient contribution.

Figure 24 A.) Neuse River Estuarine TMDL Segments.
B.) Shellfish Growing area F-8 and F-9.



10.3.1a Neuse River Estuarine Assessment

pH Use Support Assessment Map (Figure 25).
Chlorophyll *a* Use Support Assessment Map (Figure 26).

Previously Reported Estuarine Status
1998 Status
The Neuse River was partially supporting from Streets Ferry (JA69) to Minnesott Beach (JA111) because of high chlorophyll *a* levels associated with overproduction of algae and subsequent low dissolved oxygen and fish kills. Over-production of algae was associated with high nutrient loading from both point and nonpoint sources in the entire basin.

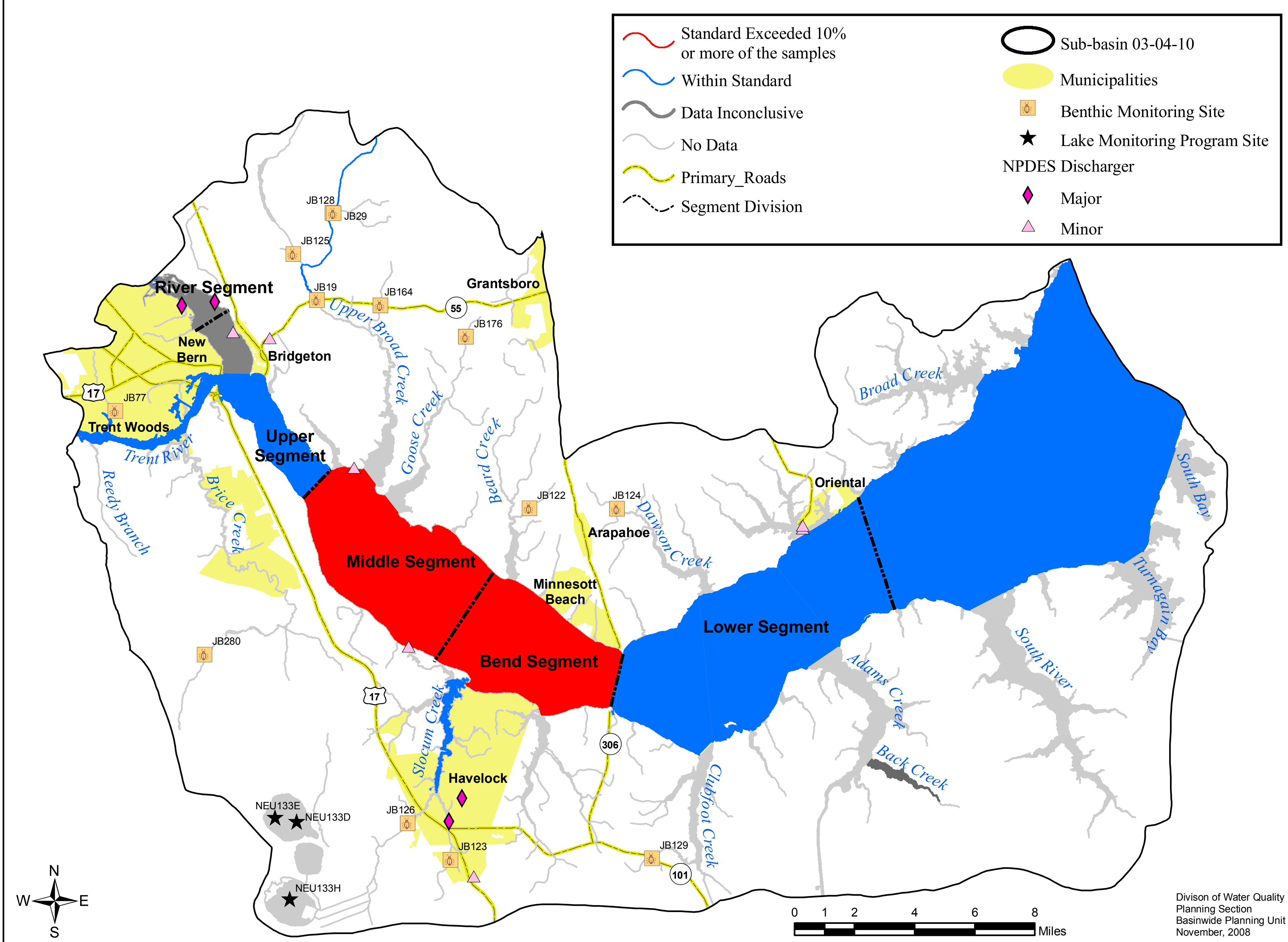
2002 Status
The Neuse River (30,330.9 acres plus 1,009.9 acres of the Trent River) was impaired from Streets Ferry (JA69) to Minnesott Beach (JA111). Thirteen ambient monitoring stations have been established in this segment of the Neuse River as part of ModMon. The Neuse Rapid Response Team, based in New Bern, has also been established to quickly investigate algal blooms and fish kills. Bottom dissolved oxygen has regularly been below 5 mg/l, although it is not known to what extent this is driven by nutrient loading from point and nonpoint sources.

Current Status (2002-2006)
Neuse River Estuary [AU# 27-(96)a (part in subbasin 08) & 27-(96)b1]
(River TMDL Segment)
The Neuse River [AU# 27-(96)a; SC; Sw; NSW] from Streets Ferry to Bachelor Creek (river model segment) (426.5 saltwater acres) and Neuse River Estuary [AU# 27-(96)b1 SC; Sw; NSW] from Bachelor Creek to the Trent River (part of river and part of upper model segment) (2,363.1 saltwater acres) is Not Rated because 6 of the 7 stations in this segment have pH readings below the state standard of 6.8 more than 10 percent of the time (Figure 24). This segment has a supplemental classification of swamp water so it is believed that the low pH is most likely due to natural conditions.

Previously this segment was impaired due to high chlorophyll *a* levels. However, during this assessment period the average daily chlorophyll *a* levels did not exceed the state standard of 40 µg/l more than 10 percent of the time and is therefore supporting for this parameter (Figure 26). On an individual site basis, the furthest downstream station (JA76; Union Point) in this segment exceeded the standard 9.7 percent of the time. The number of exceedances increased with increasing distance from the freshwater portion of the Neuse River. The highest recorded chlorophyll *a* level was 262 µg/l at ambient monitoring station J112 (Mills Branch).

This segment is no longer impaired due to chlorophyll *a* violations and will be moved from category 4a (impaired) to category 2t (supporting) on the 2008 Integrated Report (2008 IR) (link to 303(d)/IR website http://h2o.enr.state.nc.us/tmdl/General_303d.htm).

Figure 25 pH Assessment in the Neuse Estuary



Neuse River Estuary [AU# 27-(96)b2]
(Upper TMDL Segment)
The Neuse River Estuary [AU# 27-(96)b2; SC; Sw; NSW] from the Trent River to a line across Neuse River from Johnson Point to McCotter Point (part of upper model segment) (3,473.6 saltwater acres) is Impaired for aquatic life due to high chlorophyll *a* levels throughout this segment (Figure 25). Chlorophyll *a* was assessed at both JA81 and JA115 (Black Beacon Point) and exceeded the standard 12 and 23 percent of the time respectively. On an individual site basis, the highest recorded chlorophyll *a* level was 239 µg/l at site JA81.

Low and high pH readings were recorded within this section of the upper estuarine TMDL segment. The range of pH recorded in this segment was likely influence by the lower pH, lower saline water from upstream as well as higher pH levels directly resulting from the elevated phytoplankton activity occurring within this segment as seen by the chlorophyll *a* exceedances. This segment is currently supporting for pH (Figure 24).

This segment will remain in category 4a (impaired) on the 2008 Integrated Report.

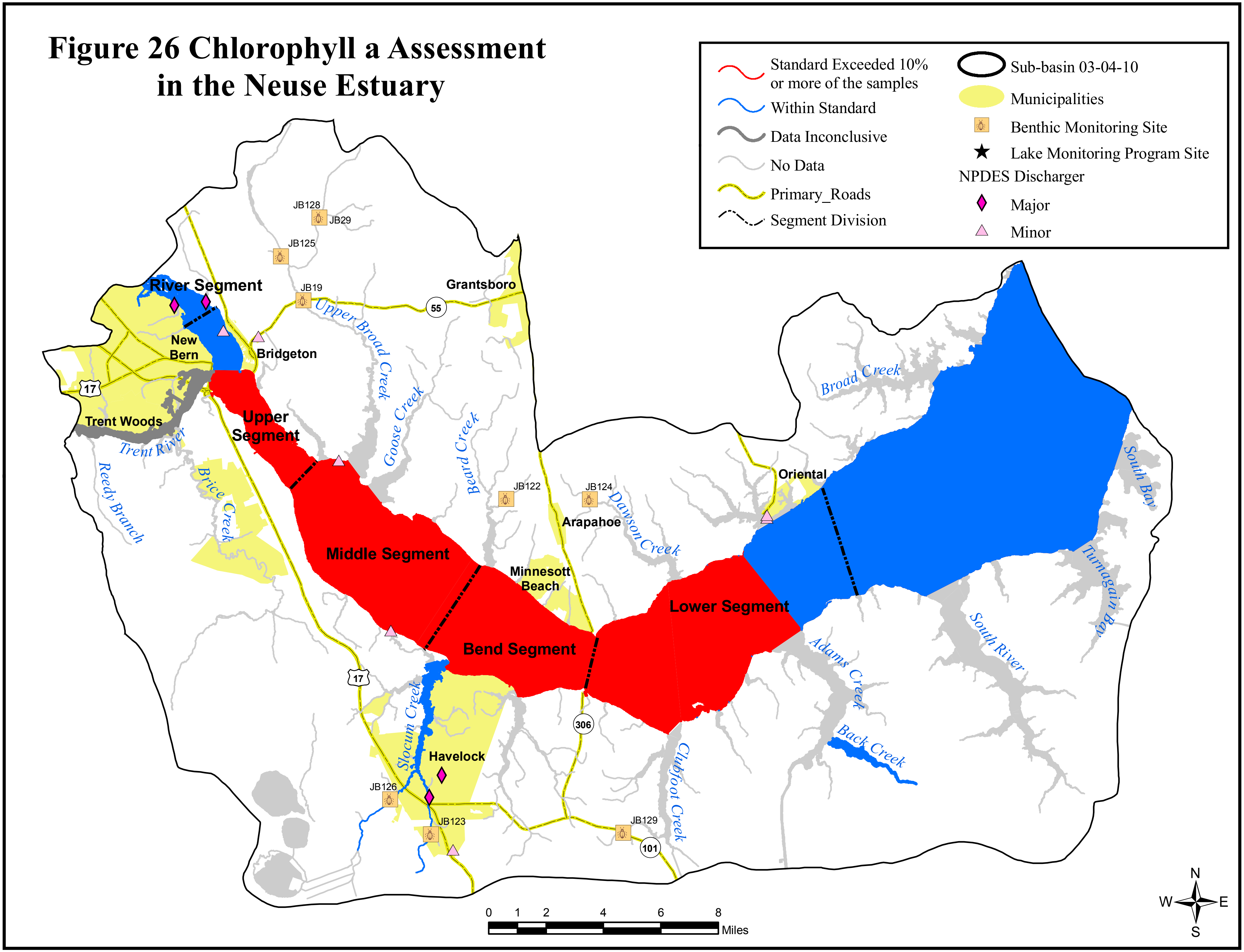
Neuse River Estuary [AU# 27-(104)a]
(Middle TMDL Segment)
The Neuse River Estuary [AU# 27-(104)a] from a line across Neuse River from Johnson Point to McCotter Point to a line across Neuse River from 1.2 miles upstream of Slocum Creek to 0.5 miles upstream of Beard Creek (middle model segment) (13,736 saltwater acres) is Impaired for aquatic life due to high chlorophyll *a* and high pH levels throughout this TMDL segment (Figure 24 and 25). Chlorophyll *a* was evaluated at all but a single station (JA86, Kennel Beach) within this segment. All 10 stations assessed exceeded the 40µg/l standard between 14 percent (JA85, channel marker 11) and 40 percent (JA109, Flanners Beach) of the time. The highest recorded chlorophyll *a* level was 808 µg/l at station JA83 (channel marker 17), this was also the highest chlorophyll *a* level recorded within the Neuse River Estuary.

The middle estuarine model segment experienced high pH levels with 8 of the 11 stations in this segment exceeding the state pH standard of no greater than 8.5 more than 10 percent of the time. These 8 stations exceeded the standard between 12 and 24 percent of the time. The three stations that did not exceed the pH standard more than 10 percent of the time were JA82, JA103 and JA109.

This is a new impairment for this segment and will be added to the 2008 303(d) list (category 5). Elevated pH levels are directly related to the elevated phytoplankton activity in this segment, therefore if the management strategy starts to reverse the algal productivity, the pH should naturally decline.

This segment will remain in category 4a (impaired) on the 2008 Integrated Report for the chlorophyll *a* standard violations.

Figure 26 Chlorophyll a Assessment in the Neuse Estuary



Neuse River Estuary [AU# 27-(104)b]
(Bend TMDL Segment)
The Neuse River Estuary [AU# 27-(104)b; SB; Sw; NSW] from a line across Neuse River from 1.2 miles upstream of Slocum Creek to 0.5 miles upstream of Beard Creek to a line across Neuse River from Wilkinson Point to Cherry Point (bend model segment) (10,756.9 saltwater acres) is Impaired for aquatic life due to high chlorophyll *a* and high pH levels throughout this TMDL segment (Figure 25 and 26). Chlorophyll *a* was evaluated at all but a single station (JA89, Cherry Point) within this segment. All 6 of the stations assessed exceeded the 40µg/l standard between 12 percent (JA111; Minnescott Beach) and 25 percent (JA107, Cherry Point Channel) of the time. The highest recorded chlorophyll *a* level was 236 µg/l at site JA87 (Arapahoe).

These waters experienced high pH levels, with 6 of the 7 stations in this segment exceeding the state pH standard of no greater than 8.5 more than 10 percent of the time. These 6 stations exceeded the standard between 12 and 29 percent of the time. Station JA89 (Cherry Point) was the only station in this segment not to exceed the 10 percent criterion; however, it exceeded the standard 9.2 percent of the time. This is a new impairment for this segment and will be added to the 2008 303(d) list (category 5). Elevated pH levels are directly related to elevated phytoplankton activity in this segment of the estuary as well.

This segment will remain in category 4a (impaired) on the 2008 Integrated Report for the chlorophyll *a* standard violations.

Neuse River Estuary [AU# 27-(118)a1, 27-(118)a1a & 27-(118)f]
(Lower TMDL Segment)
The Neuse River Estuary [AU# 27-(118)a1; SA; HQW; NSW] from a line across Neuse River from Wilkinson Point to Cherry Point to a line across the river at Adams Creek to Wiggins Point (17,135.4 saltwater acres), Neuse River Estuary at Camp Don Lee [27-(118)a1a; SA; HQW; NSW] swim beach at Camp Don Lee (Saltwater acre) and Neuse River Estuary [AU# 27-(118)f; SA; HQW; NSW] the prohibited area at Cherry Branch Minnesott Ferry Landing south side of river (93.5 saltwater acres) is Impaired for aquatic life due to high chlorophyll *a* throughout this segment (Figure 26). Chlorophyll *a* was assessed at 2 of the 3 stations and the exceedances occurred in 18 and 11 percent of the samples collected at JA90 (Minnesott Beach) and JA92 (Janeiro) respectively.

On an individual site basis, the highest recorded chlorophyll *a* level was 158 µg/l at site JA90 (Minnesott Beach). Chlorophyll *a* levels dropped linearly as the sampling stations moved down the estuary towards the Pamlico Sound. The pH followed a similar trend.

This segment was not previously impaired for chlorophyll *a* violations; however, it was included as part of the overall TMDL nutrient management strategy. It will remain in category 4a (impaired) of the 2008 Integrated Report.

Neuse River Estuary at Camp Don Lee [27-(118)a1a] is also Impaired for recreation due to elevated enterococcus bacteria levels detected by the DEH recreational beach water quality monitoring program. This impairment is discussed in greater detail in the Neuse River Estuarine Recreational Assessment below. This segment will be added to the 2008 303(d) (category 5) list of impaired waters.

Neuse River Estuary [AU# 27-(118)a2]
(Below Lower TMDL Segment)
The Neuse River Estuary[AU# 27-(118)a2; SA; HQW; NSW] from a line across the Neuse River from Adams Creek to Wiggins Point to the Pamlico Sound (50,851.7 saltwater acres) is currently Supporting aquatic life due to No Criteria Exceeded within this assessment unit. In this segment of the Neuse River Estuary, chlorophyll *a* was assessed at stations JA95 (Oriental) and JA97 (Piney Point) only and these stations exceeded the state standard 8 and 2 percent of the time respectively. On an individual site basis, the highest recorded chlorophyll *a* level was 152 µg/l at site JA95.

10.3.1b Chlorophyll *a* and pH Impairment Summary

During this assessment period the chlorophyll *a* impairment in the estuary has shifted somewhat downstream closer to the Pamlico Sound. The extent of the impairment currently extends from about the mid-Upper TMDL segment (at Trent River) through most of the Lower TMDL segment (at Adams Creek) where during the last assessment period the range of the impairment was the River TMDL segment through the Bend TMDL segment (Figure 26, Table 30). It is likely that the impairments will shift up and down in the estuary depending on stream flow rates during the assessment period.

There is also a new pH impairment from the Middle through the Bend TMDL segments (Figure 25). Elevated pH is a direct result from the high phytoplankton activity within this same region. It is likely that when the nitrogen loading to the estuary is reduced, the pH standard violations will decrease along with the chlorophyll *a* violations.

Table 30 Summary of Neuse River Estuarine Impairment.

AU #	TMDL Segment	Acreage	Aquatic Life Use Support Rating	Parameter of Interest	IR Category[α]
27-(96)a	River	426.5	Not Rated*	None	2t
27-(96)b1	River & Upper	2,363.1	Not Rated*	None	2t
27-(96)b2	Upper	3,473.6	Impaired	Chlorophyll *a*	4a
27-(104)a	Middle	13,736	Impaired	Chlorophyll *a*/pH	4a/5
27-(104)b	Bend	10,756.9	Impaired	Chlorophyll *a*/pH	4a/5
27-(118)a1	Lower	17,135.4	Impaired	Chlorophyll *a*	4a
27-(118)f	Lower	93.5	Impaired	Chlorophyll *a*	4a
27-(118)a1a	Lower	1	Impaired	Chlorophyll *a* /Enterrococcus	4a/5
27-(118)a2	Lower	50,851.7	Supporting	None	2

α See Chapter 23 for Integrated Report (IR) Category information.
* Low pH standard violations (pH< 6.8). However, Not Rated because this segment has a swamp stream classification which is known to have naturally low pH levels.

10.3.1c Neuse River Estuarine Recreational Assessment

All of the Neuse River Estuarine assessment units listed above are currently Supporting recreational uses due to the fact that the fecal coliform bacteria levels were below the state standard more than 80 percent of the time throughout this area except for the two areas listed below. The impairments listed below are based on DEH recreational assessment for enterococcus bacteria. The impairment is either the result of DEH posting a swimming advisory for more than 61 days over the 5 year assessment period or a geometric mean of greater than 35 enterococci/100 ml (based on 5 samples collected in a 30 day period).

Neuse River Estuary [27-(118)a1a & 27-(118)h]

The Neuse River Estuary [AU# 27-(118)h; SA; HQW; NSW] at the public beach area at the mouth of Dawson Creek (1.7 saltwater acres) is Impaired for recreational uses due to DEH posting swimming advisories for 266 days at station C92A. This is a high-use/Tier 1 site so it is tested weekly between April and September and every other week in October. The coastal recreational beach monitoring program uses enterococcus bacteria as the indicator species. The criteria for Tier 1 is a single sample maximum of 104 enterococci/100 ml water or a running monthly average (geometric mean) of 35 enterococci/100 ml water. There is a shoal located just off the beach access area that slows water exchange with the Neuse River possibly resulting in the increased levels of enterococcus bacteria. There are no stormwater outfalls entering this beach access area. According to local officials, one source of bacteria is likely from disposable diapers being left on the beach and in the water. This impairment extends up Dawson Creek AU# 27-125-(6)a (121.2 acres) and AU# 27-125-(6)b (1 acre) as well (see section 10.3.4).

The Neuse River Estuary [27-(118)a1a; SA; HQW; NSW] at the swim beach at Camp Don Lee (1.0 saltwater acres) is Impaired due to a single geometric mean of greater than 35 enterococci/100 ml (based on 5 samples collected in a 30 day period). This resulted from a single elevated reading in August 2003 (344 enterococci/100 ml) resulting in a geometric mean of 37.4.

DEH recreational closings and data can be found at http://www.deh.enr.state.nc.us/shellfish/Water_Monitoring/RWQweb/aboutus.htm. The state Division of Environmental Health tests water quality at ocean and sound beaches in accordance with federal and state laws. Enterococcus and fecal coliform, the bacteria group used for testing, is found in the intestines of warm-blooded animals. While they do not cause illness themselves, scientific studies indicate that enterococci and fecal coliform may indicate the presence of other disease-causing organisms. People swimming or playing in waters with bacteria levels higher than the action level have an increased risk of developing gastrointestinal illness or skin infections. This is a swimming advisory, not a beach closing. The sign posted reads as follows: ATTENTION - SWIMMING IN THIS AREA NOT RECOMMENDED. BACTERIA TESTING INDICATES LEVELS OF CONTAMINATION THAT MAY BE HAZARDOUS TO YOUR HEALTH. THIS ADVISORY AFFECTS WATERS WITHIN 200' OF THIS SIGN. OFFICE OF THE STATE HEALTH DIRECTOR

10.3.1d Neuse River Estuarine Nutrient Loading Analysis

Over the past decade, many research groups within NC have assessed instream nutrient concentration and loading trends within the Neuse River Estuary. A summary of these can be found in the Neuse River Nutrient Sensitive Waters Management Strategy Chapter 24 and Appendix V. It was not possible to directly compare all of the studies summarized due to the different sampling locations assessed throughout the estuary as well as the different data sources and analytical methods used.

DWQ assessed the total nitrogen (TN) loading at Fort Barnwell (JA 67) from 1991 to 2006 to determine if there has been a change in TN loading at the original instream TMDL assessment point. The TMDL targeted a total nitrogen load reduction of 30 percent from the baseline time period (1991- 1995) in order to achieve less than or equal to 10 percent exceedance of the state chlorophyll *a* standard of 40 µg/l in the Neuse River Estuary. The 30 percent TN load reduction was to be achieved by both point and nonpoint agricultural sources by 2003. Table 31 and

Figure 26 below represent the yearly loading of TN at Fort Barnwell. The average baseline (1991-1995) TN loading was 7,531,913 lbs/yr while the average TN loading post implementation (2003-2006) was 9,084,385 lbs/yr. This is a pre/post comparison of unadjusted annual mass loading of nitrogen to the estuary using DWQ ambient data collected at Fort Barnwell. It is important to note that this is not a statistical analysis and does not take variability or confidence intervals into account. Climatic variability plays an important role in the mobilization, processing, and delivery of nutrients to the estuary. The estuarine water quality response is affected by climatic events and this variability can obscure clear trends in nutrient loading especially over the short 4 year post implementation time period. The data indicate however, that given the fact that the point sources have significantly reduced their nitrogen loading direct to the estuary (direct end of pipe measurement to verify these reductions) the increased loading during higher flows or wetter year's supports that the additional loading during these wet years is likely coming from nonpoint sources. This assumption is supported by finding that Dr. Hans Paerl is reporting to DWQ (personal communication, paper in prep).

Table 31 Total nitrogen load in lbs/yr at Fort Barnwell Station JA67.

Year	TN (lbs/yr)	Year	TN (lbs/yr)
1991	5,986,785	1999	10,847,052
1992	10,279,950	2000	7,567,995
1993	9,456,118	2001	6,151,596
1994	5,122,031	2002	5,271,038
1995	6,814,683	2003	13,212,353
1996	11,861,989	2004	7,451,271
1997	7,198,315	2005	7,129,310
1998	9,352,000	2006	8,544,607

A Seasonal-adjusted statistical loading analysis from 1991-2006 for TN, NO_x, TKN and TP showed no significant trends (significance determined at 95 percent) except for TKN which increased approximately 45 percent with or without hurricanes Fran (1996) and Floyd (1999) data included (See Chapter 24 and Appendix V for more detailed information; DWQ trend report – Narayan Rajbhandari, October 24, 2007).

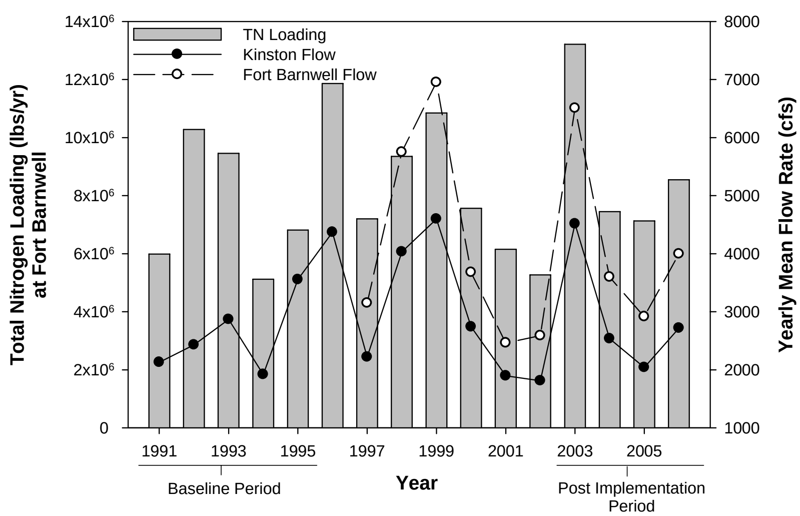


Figure 27 Plot of total nitrogen loading at Fort Barnwell and the yearly mean flow rated at Kinston and Fort Barnwell USGS gauging stations.

10.3.1e Point and Nonpoint Reductions Achieved

The Neuse nutrient management strategy rules were fully implemented by 2003. Both point source wastewater dischargers and nonpoint agricultural sources reduced their total nitrogen loading by greater than 30 percent. It is important to note that the point source reduction is based on a calculated loading reduction at Fort Barnwell and the agricultural reduction is an estimated edge of field reduction that may or may not result in a similar reduction instream. Table 32 lists the percent nitrogen reductions from the baseline average loading rates. Details on the nitrogen reduction strategy for both of these sources can be found in the Neuse River Nutrient Sensitive Waters Management Strategy Chapter 24.

Table 32 Percent total nitrogen reduction from baseline average (1991-1995) for wastewater treatment and agriculture sources.

Year	NRCA* Point Source	All NPDES Permitted Point Source^	Nonpoint Source (Agricultural**)
2000	41 %	NA	NA
2001	49 %	NA	34 %
2002	55 %	NA	37 %
2003	60 %	NA	42 %
2004	69 %	NA	44 %
2005	68 %	61 %	46 %
2006	70 %	65 %	43 %

* NRCA – Neuse River Compliance Association; estimated loading reductions at Fort Barnwell.
^ A complete set of loading data for the remaining NPDES point source permit holder outside of the NRCA was not available (NA) until 2005.
** Agricultural reductions estimated to be edge of field load reductions.

The goal of a 30 percent reduction in TN loading at Fort Barnwell and the reduction of chlorophyll *a* standard violations within the Neuse River Estuary have not been achieved to date, however, the efforts to reduce nitrogen from several sources has been very successful. Additional reductions are likely needed in areas that were not completely covered by the initial set of management rules. Figure 32 gives a strong indication that nonpoint source contribution of nitrogen is still a potential problem.

A Neuse nutrient management strategy analysis and opportunities for additional nutrient reductions are discussed in detail in the Neuse River Nutrient Sensitive Waters Management Strategy Chapter 24. Box and whisker plots were generated for several stations within the Neuse River Estuary for chlorophyll *a*, TN, TP, DO and pH and can be seen in Appendix V. The Environmental Sciences Section (ESS) also produced box and whisker plots for many stations throughout the Neuse Basin, these can be found in the Neuse River Basinwide Assessment Report April 2006 (http://h2o.enr.state.nc.us/esb/bar.html). The ESS report found that chlorophyll *a* concentrations in the Neuse River Estuary as a whole have not changed significantly during the past 25 years.

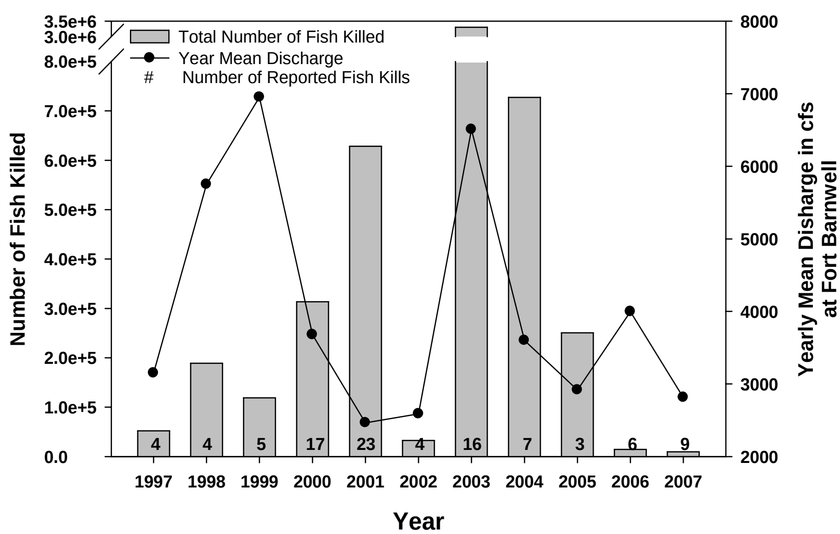
The estuary is a very complex and dynamic system and due to the decades of chronic overloading of nutrients and the likelihood of nutrient recycling, it may be some time before current reductions in nutrient loading will reflect in improved water quality.

10.3.1f Neuse River Estuarine Fish Kills

In 1996 the DWQ Environmental Sciences Section (ESS), in consultation with Regional Office staff, Wildlife Resources biologists, and Division of Marine Fisheries personnel instituted a new fish kill investigation procedure to be used by the DWQ Regional Offices and other agencies to collect and track information on fish kills throughout the state. A Neuse River Rapid Response Team (NRRT) based out of New Bern, NC was started in June 1997. Their primary charge was the rapid evaluation of acute water quality related events like fish kills and algal blooms. Figure 27 represents the fish kill information collected by the NRRT on the estuary using the fish kill procedures established by DWQ. The yearly flow rate at Fort Barnwell is also included on the figure.

It appears that the numbers of fish killed throughout the estuary have been dropping since 2003 and are now well below those reported back in the 1980's and 1990's. There were two large events in 2003 which accounted for the majority of the fish killed during that year. These two events happened within six days of each other at the end of August and the beginning of September and totaled 3,103,500 fish. The fish kills appear to be caused by upwelling or mixing of hypoxic/low dissolved oxygen bottom water resulting in very low dissolved oxygen levels throughout the water column, leading to large fish kills that affected most fish species in the area. See Appendix II for the Neuse River Estuarine Fish Kill Summary Report.

Figure 28	Number of fish killed and fish kill events reported by Neuse River Rapid Response Team in the Neuse River Estuary.



Algal blooms and low dissolved oxygen in the estuary can be significant factors contributing to the occurrence of fish kills. Hypoxic conditions are a common problem in the bottom waters of lakes and estuaries. The extent to which this is driven by excess nutrients and phytoplankton productivity in the Neuse River Estuary is not completely understood. As evident by the large fish kill events in 2003, low dissolved oxygen can have a detrimental effect on the biological community within the system. A decrease in nutrients would reduce the algal productivity, ultimately reducing the biological oxygen demand within the system, and potentially reducing the number of low dissolved oxygen and fish kill events.

After an extensive literature review and communication with many resource agency specialists in NC, the decrease in the number of fish killed over this time period could not be directly linked to improved water quality or possibly due to a decline in the overall fish population in the estuary.

For more information on the NRRT or on fish kills that have occurred in the estuary go to http://h2o.enr.state.nc.us/esb/nrrt.html. To report a fish kill or other water quality concerns, contact the NRRT at 888-764-7661 or 252-514-4748. All fish kills in the Neuse River Estuary should be reported to the NRRT as quickly as possible with your contact name and number and the location of the event.

The Department of Health and Human Services (DHHS) recommends taking the following health precautions around fish kills.

If you see a fish kill or more than a few fish or shellfish that are dead, dying, acting erratically or have sores, follow these common-sense precautions:

- Stay away from those waters while those conditions exist. Don't go in the water.
- Do not eat, use or collect any fish, crabs, other life or items from those waters.
- Do not let pets swim in or eat fish from those waters.

If you come in contact with the water where fish or shellfish are dead, dying, appear sick, or have sores:

- Remove wet clothing and keep separate from other items until it has been washed.
- Wash any body part (except the eyes) that comes in contact with the waters, using soap and clean water. Rinse eyes with lots of clear, clean water.
- Use waterproof gloves when handling pets and items that have come in contact with the waters.
- See your doctor or health provider if you experience any symptoms that might be caused by exposure to these waters.

This information can be found at http://www.epi.state.nc.us/epi/oee/protect.html.

10.3.1g Neuse River Estuarine Phytoplankton Blooms

Chlorophyll *a*, a pigment found in most plants, is a measurement or an indicator of the quantity of phytoplankton/algae in the water. DWQ taxonomists also assess samples to determine which phytoplankton species are blooming, the density or concentration of each species, and whether any of those found may be potentially toxic. Rapid algal growth is referred to as a "bloom." The physiochemical parameters in the Neuse River Estuary that affect bloom formation and intensity are temperature, salinity, stream flow velocity, nutrient concentration, and water column stratification.

Water column samples in the Neuse River Estuary are collected at least monthly by the Neuse Rapid Response Team (NRRT). Chlorophyll *a* levels and phytoplankton speciation and density counts are assessed. The NRRT also collects samples at reported fish kills and during algal bloom events. The number and locations of algal blooms recorded each year fluctuates based on whether field personnel or concerned citizens are in the right place at the right time to detect unusual dissolved oxygen levels, discolored water, or sick or dead fish. The majority of algal blooms recorded in the Neuse River Basin occur in the lower Neuse because NRRT monitors the area several times each month.

Algal blooms increase the oxygen concentration in the water column during the day. At night, the algae respire and deplete the available oxygen in the water column. Further, when algal blooms end or die off due to changes in the environmental conditions, decomposition of the algae depletes the water of oxygen and can lead to fish kills.

Several different types of phytoplankton are present in the Neuse River and include diatoms, dinoflagellates, and bluegreen algae (cyanobacteria). High concentrations of diatoms were recorded throughout 2000-2006. Diatoms were most common during spring and summer and were most often seen in three groups—small round cells (centric diatoms), chain forming species (*Chaetoceros, Skeletonema*), and long, thin cells (*Cylindrotheca*). Bluegreen algae such as *Pseudanabaena* and *Cylindrospermopsis* were most common during dry summer weather. Dinoflagellate blooms were common during winter and early spring and dominated by *Prorocentrum* and *Heterocapsa*. Summer dinoflagellate blooms were dominated by *Karlodinium*, *Scrippsiella*, and *Gyrodinium*.

A single toxic algal bloom was reported in the Neuse River Estuary between 2000 and 2006. The toxic dinoflagellate *Karlodinium veneficum* was discovered in the estuary at concentrations greater than 200,000 cells per milliliter by ModMon on October 19, 2006 (Hall et al, 2008). No fish kills were directly attributed to this bloom. A fish kill did occur a few days later; however, no instream karlotoxin concentrations were measured to verify the presence of the toxin in the water column at the time of the kill. See Figures 29 and 30 for the seasonal algal patterns at station JA85 in the estuary, and see Appendix II for the Neuse Basin 2000-2006 algal bloom report.

Algal Information Sheets on different algal groups and species found in North Carolina are available upon request from the Environmental Sciences Section Lab http://h2o.enr.state.nc.us/esb/algal.html.

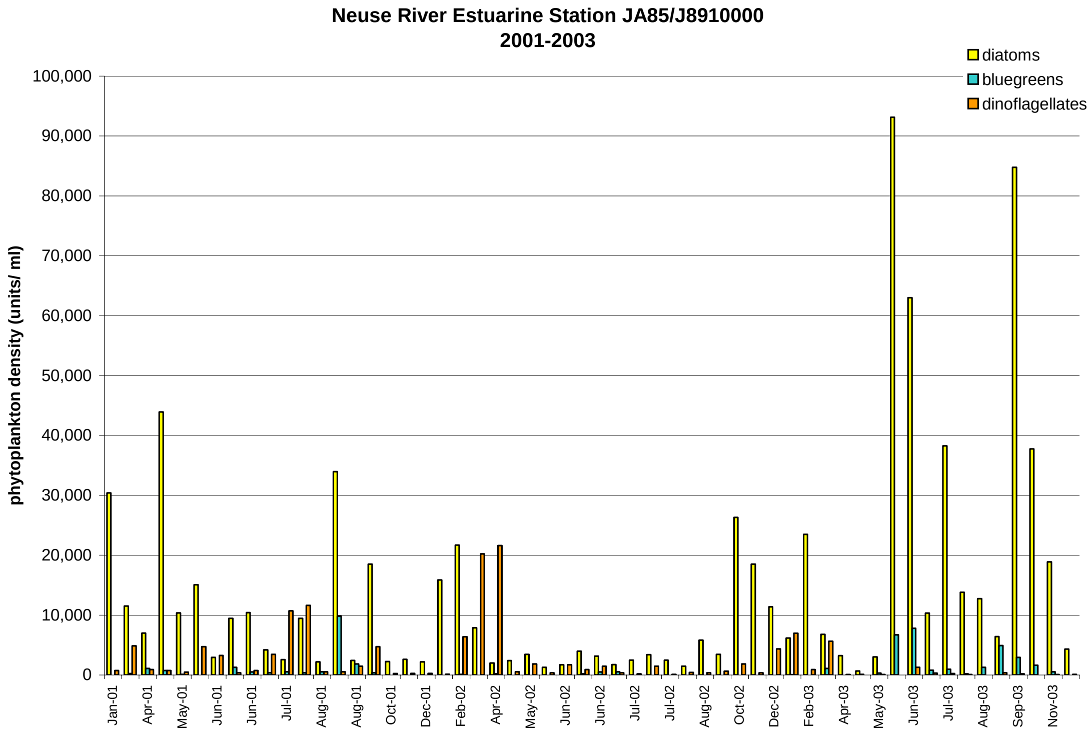


Figure 29 Seasonal algal patterns for station JA85 (Channel Marker 11 near Riverdale) in the Neuse River Estuary 2001-2003.

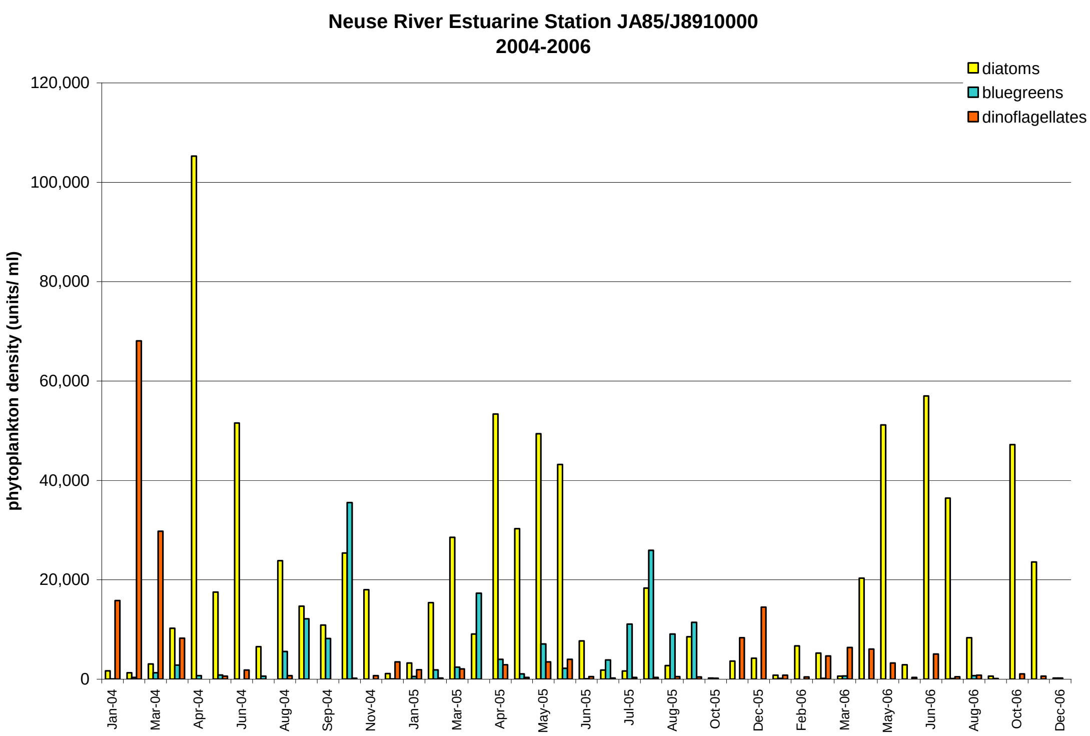


Figure 30 Seasonal algal patterns for station JA85 in the Neuse River Estuary 2004-2006. Note: the X axis scales are different between the two graphs.

10.3.2 Trent River [AU# 27-101-(31)b & 27-101-(39)]

Current Status

Trent River [AU# 27-101-(31)b and 27-101-(39); SB; Sw; NSW] from boundary between subbasins 030410 and 030411 to the Neuse River (1009.8 saltwater acres) is Not Rated for aquatic life due to the lack of chlorophyll *a* data at station JA80 (New Bern). Without chlorophyll *a* data at this station we can not determine whether this segment of the Trent River is meeting the state standard of 40µg/l or not. This section of the Trent River is included in the Neuse River Estuarine TMDL management strategy. The TMDL seeks to reduce chlorophyll *a* levels by decreasing total nitrogen levels by 30 percent. See section 10.3.1 for more details. The nutrients at these two stations ranged between 0.01-0.26 mg/l NH3, 0.01-0.82 mg/l NO3, 0.1-2.07 mg/l TKN and 0.04-0.61 mg/l TP. The nutrient levels were slightly higher at station JA80 (closer to the Neuse River) than JA79 (further up the Trent River).

This segment of the Trent River will remain on the 2008 Impaired Waters List (2008 Integrated Report under category 4b (impaired – other program expected to address parameter of interest)).

This segment of the Trent River is Supporting for recreational purposes; however, the fecal coliform bacteria levels were elevated at JA80, with 18 percent of the samples collected over the state standard of 400 CFU/100 ml. This station is closest to the marinas and Union Point Park, both of which have a lot of boat traffic, waterfowl and dogs associated with them which can result in higher fecal coliform counts. Station JA79 (Rhems) only had 2 percent of the samples collected above the state standard for fecal coliform bacteria.

Recommendations

DWQ would recommend stormwater BMPs to reduce the nutrient and fecal coliform bacteria contamination in this segment of the Trent River. It is important that the marinas in this area discourage the dumping of any type of waste into the Trent River. Agricultural BMPs would be appropriate further up in the Trent River watershed to reduce nutrient contribution to the Neuse River Estuary.

10.3.3 Fork Run [AU# 27-125-2]

Current Status

Fork Run [AU# 27-125-2; SC; NSW] from source to Dawson Creek (2.6 saltwater miles) is Impaired due to a Severe swamp benthic bioclassification at JB124. The visible land use is approximately 80 percent active crops and 20 percent residential. The riparian zone was wide and intact and the instream habitat was sparse. The reason for the severe swamp bioclassification was due to the low diversity and abundance of taxa found at this site. The most abundant taxa found at this location were an indicator of organic enrichment.

Fork Run will be added to the 2008 303(d) list of impaired waters for impaired biological integrity.

Recommendations

DWQ continues to recommend that the Division of Soil and Water Conservation evaluate the potential for implementation of appropriate BMPs to reduce nutrient and sediment loading in this watershed.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

Water Quality Initiatives
From September 2000 – December 2006, over $38,000 of the Agriculture Cost Share Program funds were spent on BMP implementation in this watershed. Practices included 240 acres of long term no-till, 13 acres of riparian buffer, and 11 water control structures. Cumulatively, these practices affect 338 acres, saved 816 Tons of soil, 4,614 pounds of nitrogen, and 267 pounds of phosphorus.

10.3.4 Dawson Creek [AU# 27-125-(6)a & 27-125-(6)b]

Dawson Creek [27-125-(6)a; SA; HQW;NSW] from the mouth of Tarkiln Creek to 0.03 miles upstream of Neuse River (121.2 acres) and Dawson Creek [27-125-(6)b; SA; HWQ; NSW] from 0.3 miles upstream of Neuse River to Neuse River (1 acre) is Impaired for Recreation due to DEH assessment of a geometric mean of greater than 35 enterococci/100 ml (based on 5 samples collected in a 30 day period) at station C92. This is a high-use/Tier 1 site so it is tested weekly between April and September and every other week in October. The coastal recreational beach monitoring program uses enterococcus bacteria as the indicator species. The criteria for Tier 1 is a single sample maximum of 104 enterococci/100 ml water or a running monthly average (geometric mean) of 35 enterococci/100 ml water. There is a shoal located just off the beach access area that slows water exchange with the Neuse River possibly resulting in the increased levels of enterococcus bacteria. There are no stormwater outfalls entering this beach access area. According to local officials, one source of bacteria is likely from disposable diapers being left on the beach and in the water. This impairment extends down to the Neuse River AU# 27-(118)h (1.7 acres) as well (see section 10.3.1c).

DEH recreational closings and data can be found at http://www.deh.enr.state.nc.us/shellfish/Water_Monitoring/RWQweb/aboutus.htm. The state Division of Environmental Health tests water quality at ocean and sound beaches in accordance with federal and state law. Enterococcus and fecal coliform, the bacteria group used for testing, is found in the intestines of warm-blooded animals. While they do not cause illness themselves, scientific studies indicate that enterococci and fecal coliform may indicate the presence of other disease-causing organisms. People swimming or playing in waters with bacteria levels higher than the action level have an increased risk of developing gastrointestinal illness or skin infections. This is a swimming advisory, not a beach closing. The sign posted reads as follows: ATTENTION - SWIMMING IN THIS AREA NOT RECOMMENDED. BACTERIA TESTING INDICATES LEVELS OF CONTAMINATION THAT MAY BE HAZARDOUS TO YOUR HEALTH. THIS ADVISORY AFFECTS WATERS WITHIN 200' OF THIS SIGN. OFFICE OF THE STATE HEALTH DIRECTOR

This segment of Dawson Creek is also Impaired for Shellfish Harvesting due fecal coliform bacteria standard violations in 17 percent of the samples. The state fecal coliform bacteria standard in SA waters is a geometric mean not to exceed 14 CFU/100 ml and not more than 10 percent of the samples to exceed 43 CFU/100 ml.

This segment of Dawson Creek is currently on the 303(d) list for shellfish harvesting and will be added to the list for enterococcus standard violations.

Recommendations
Waste containers, posted signs and public education is needed in order to inform the public to the hazards of leaving human and animal waste in the water.

10.3.5 Back Creek [AU# 27-128-3a & 27-128-3b]

Current Status
Back Creek [27-128-3a; SA; HQW; NSW] from source to Adams Creek excluding swimming area near mouth (259.5 saltwater acres) is Impaired for recreation due to fecal coliform bacteria standard violation at JA94. A 5-in-30 (5 samples collected over a 30 day period; required in order to impair waters of the state for recreational use) was completed in 2003 and found that 100 percent of the samples were over the state standard of 400 CFU/100 ml and the geometric mean of greater than 200 CFU/100 ml (geometric mean = 1032).

Back Creek [27-128-3a and 27-128-3b; SA; HQW; NSW] from source to Adams Creek (261.6 acres) is Impaired for shellfish harvesting. Back Creek is classified by DEH SS as prohibited in growing area F-2 due to potential fecal coliform bacteria levels.

Back Creek will remain on the state's 303(d) list of impaired waters for shellfish harvesting closure and will be added to the list for impaired recreation due to standard violations for fecal coliform bacteria.

Back Creek receives drainage from up to 2000 acres from the Open Grounds Farm in Carteret County. Data from ambient monitoring station JA94 indicates that the drainage from this farm is likely degrading the water quality in Back Creek.

The DO standard of less than 5 mg/l (standard for SA waters) was exceeded 29 percent of the time with a recorded minimum of 1.8 mg/l. The state standard for pH of less than 6.8 was exceeded in 22 percent of the samples. The turbidity (SA standard of 25 NTUs) and chlorophyll *a* readings were also elevated with exceedances of 9 and 7 percent respectively. Nutrient levels were also elevated in this creek.

Parameter	State SA Standard	2002 Plan Assessment 9/95-8/00 (% exceedance)	9/00-8/05 (% exceedance)	Current Assessment 1/1/02-12/31/06 (% exceedance)
Dissolved Oxygen	< 5 mg/l	42	21	29
pH	< 6.8	27	25	24
Turbidity	>25 NTU	0	7	9
Chlorophyll *a*	> 40 µg/l	NA	8	7

Current Assessment 1/1/2002 - 12/31/2006			
NH3 mg/l	NO3 mg/l	TKN mg/l	TP mg/l
0.02 - 0.9	0.02 - 1.6	0.54 – 2.7	0.06 - 0.6

Recommendations

This farm currently has a water management, nutrient management and pest management plan in place. DWQ recommends that they work with the Division of Soil and Water to evaluate the existing management plan and to determine what BMPs could be installed to improve the water quality in Back Creek. This creek could possibly benefit from a sediment basin to divert some farm drainage through.

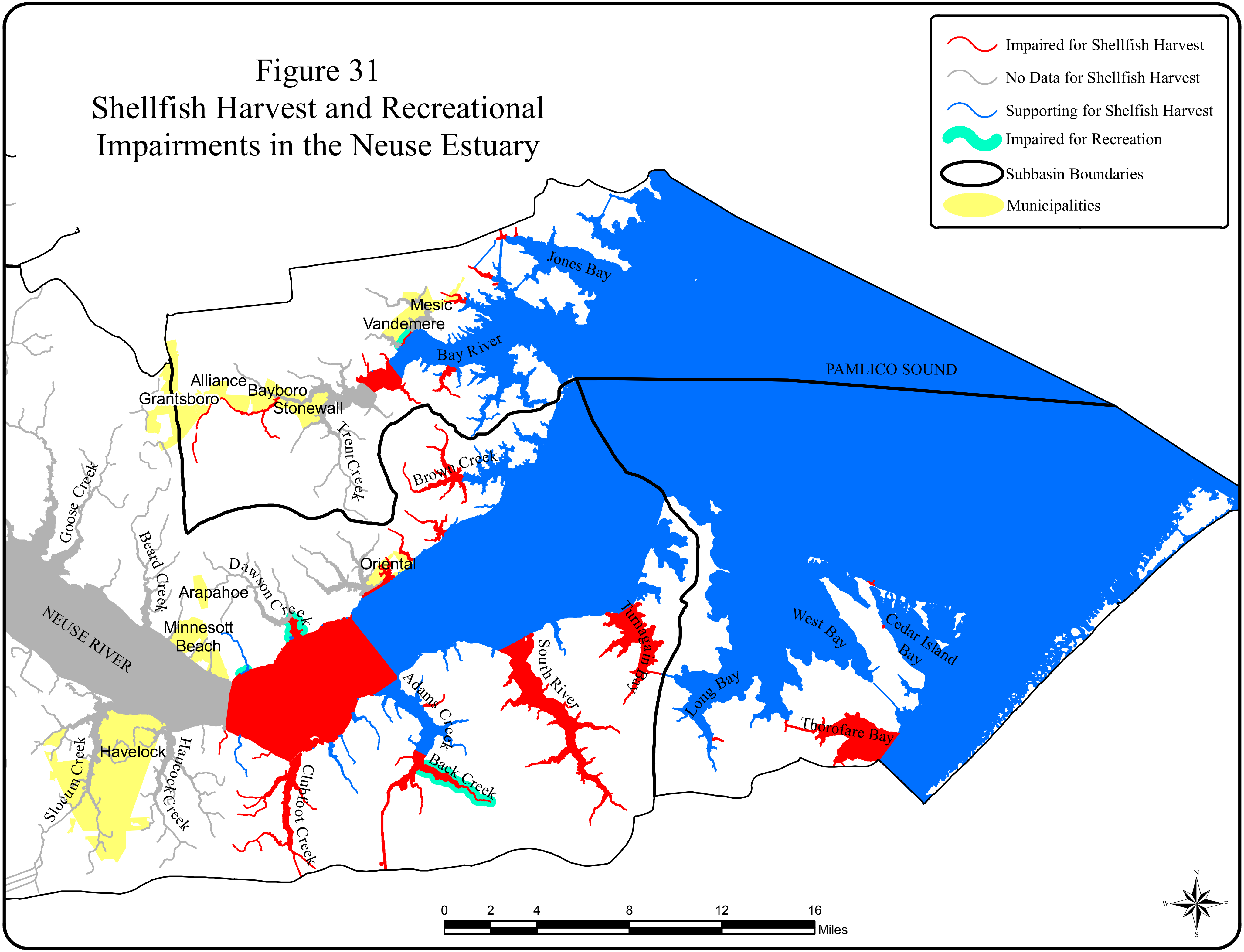
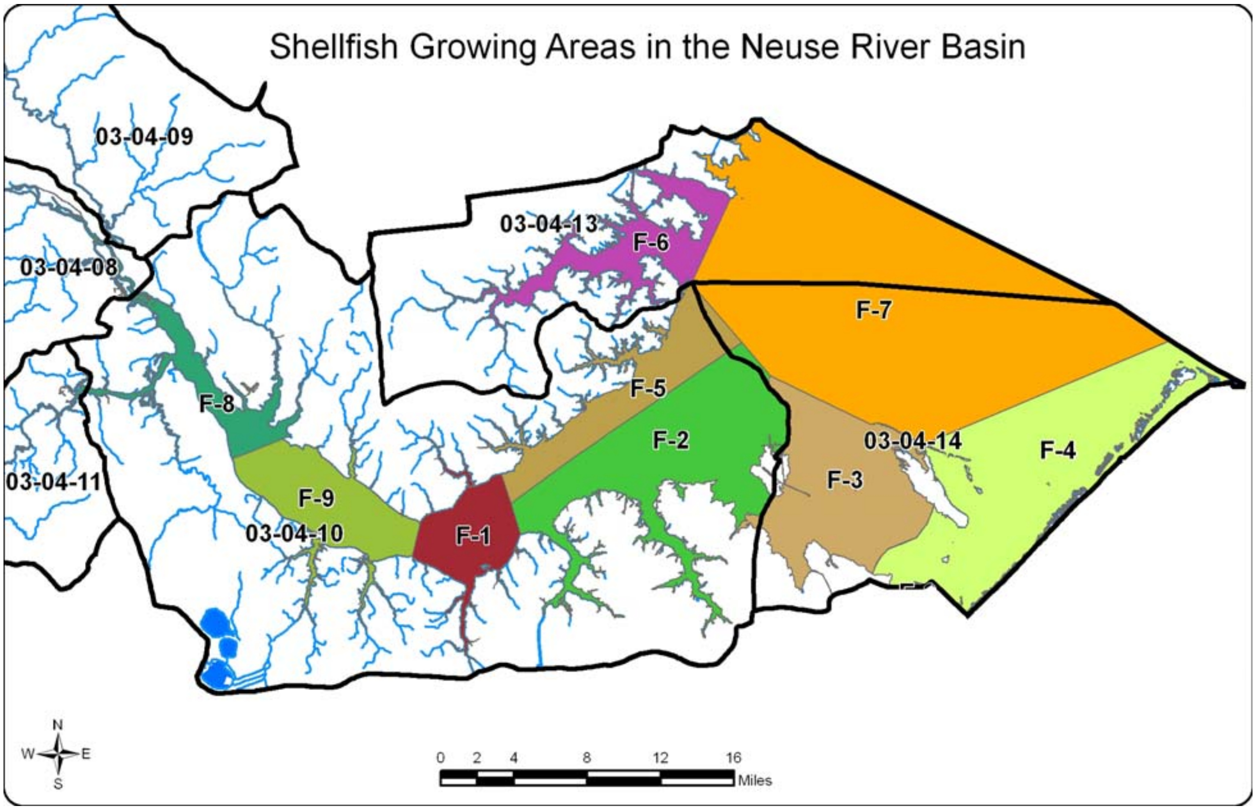


Figure 31
Shellfish Harvest and Recreational Impairments in the Neuse Estuary

Figure 32 Neuse River Basin shellfish growing area map.



10.3.6 Division of Environmental Health Growing Area F-1

Table 33 Shellfish Growing Area F-1 Classifications

Class SA Water	Assessment Unit #	AU Length	Growing Area Classification[1]	DWQ Shellfish Rating[2]	DEH Growing Area
NEUSE RIVER	27-(118)a1	23304.40	APP	S	F-1
NEUSE RIVER	27-(118)b	96.20	PRO	I	F-1
Cherry Branch	27-119	1.20	PRO	I	F-1
King Creek	27-120	2.35	APP	S	F-1
Gatlin Creek	27-121	2.47	APP	S	F-1
Clubfoot Creek	27-123	562.60	PRO	I	F-1
Harlowe Canal	27-123-1	0.64	PRO	I	F-1
Mortons Mill Pond	27-123-2	30.59	PRO	I	F-1
West Prong Mortons Mill Pond	27-123-2-1	1.40	PRO	I	F-1
East Prong Mortons Mill Pond	27-123-2-2	0.55	PRO	I	F-1
Gulden Creek	27-123-3	34.88	PRO	I	F-1
Mitchell Creek	27-123-4	117.46	PRO	I	F-1
Big Branch	27-123-4-1	1.59	PRO	I	F-1
Snake Branch	27-123-4-2	0.94	PRO	I	F-1
Long Creek	27-124	67.69	APP	S	F-1
Dawson Creek	27-125-(6)a	121.16	APP	S	F-1
Dawson Creek	27-125-(6)b	0.98	PRO	I	F-1
Courts Creek (Coaches Creek)	27-127	43.11	APP	S	F-1, F-2

1 - Growing Area Classifications: APP – Approved; CAO – Conditionally Approved-Open; CAC – Conditionally Approved-Closed; RES – Restricted; PRO- Prohibited.
2 - DWQ Shellfish Rating: S – Supporting; I - Impaired

Add link to Shellfish Sanitation Maps - http://www.deh.enr.state.nc.us/shellfish/maps.htm

The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area F-1. If the entire Class SA water is located within more than one growing area it is noted in Table 33 above. See growing area map above (Figure 32).

According to the ***Sanitary Survey of Neuse River Area, Area F-1,*** *(DEH. Shellfish Sanitation Unit, May 2002)*, there have been little water quality changes since the last survey. Rainfall normally has little effect on the approved waters of this area. Of the 13,700 total acres within this area, 1,200 acres are closed to shellfishing. Oyster and clam production is considered to be poor, with poor commercial value.

Total permanent population of this area is estimated at 2,600 people; however, summer populations can be double this estimate. Area F-1 is considered a slow to moderate growth area. The area contains 20 subdivisions, three of which have been developed since the 1998 survey. The Moorings, in upper Clubfoot Creek, has a 22-slip marina and multiple private docks. Mitchell Harbor, on Mitchell Creek, has a ten-slip docking facility and six private docks. Matthews Point Marina has 106 slips and a sewage pump out facility. A new 10-slip dock has just been constructed next to Matthews Point Marina.

Septic systems are not considered to be a problem within Area F-1. Camp Don Lee and Camp Sea Gull both operate small wastewater treatment facilities in the area; neither camp is considered to pose a significant threat to water quality. Camp Caroline, another summer camp in the area, is served by septic systems and was found to be operating satisfactorily.

The most significant threat to the water quality of Area F-1 is stormwater and runoff from farming. The major land use in the area continues to be agriculture (corn, soybeans, and cotton). Many of these farms contribute sediment to the growing area. Combined runoff from a large agricultural field and a trailer park in Blades was evident at the time of the survey and likely contributing to sediment and fecal loadings in Clubfoot Creek. Small horse farms are common throughout the area, but not a likely source of fecal contamination. A moderately sized ostrich farm near the head of Temple Creek was noted as likely having an impact on water quality. One small cattle farm in the headwaters of Mitchell Creek may also be having an impact. Other pollution sources include waterfowl and other wildlife. DEH did not recommend any changes in growing area classification at the time of the survey.

10.3.7 Division of Environmental Health Growing Area F-2

Table 34 Shellfish Growing Area F-2 Classifications

Class SA Water	Assessment Unit #	AU Length	Growing Area Classification[1]	DWQ Shellfish Rating[2]	DEH Growing Area
NEUSE RIVER	27-(118)a2	43836.30	APP	S	F-2, F-5
NEUSE RIVER	27-(118)e	210.00	CAO	I	F-2, F-5
NEUSE RIVER	27-(118)f	93.46	PRO	I	F-2
Courts Creek (Coaches Creek)	27-127	43.11	APP	S	F-1, F-2
Jerry Bay	27-128-1.5	52.23	PRO	I	F-2
Godfrey Creek	27-128-10	34.68	APP	S	F-2
Adams Creek Canal (Intracoastal Waterway)	27-128-1a	12.55	CAC	I	F-2
Adams Creek Canal (Intracoastal Waterway)	27-128-1b	126.30	PRO	I	F-2
Isaac Creek	27-128-2	39.13	PRO	I	F-2
Back Creek (Black Creek)	27-128-3a	259.52	PRO	I	F-2
Back Creek (Black Creek)	27-128-3b	2.15	PRO	I	F-2
Kearney Creek	27-128-4	3.96	PRO	I	F-2
Kellum Creek	27-128-5	10.48	APP	S	F-2
Cedar Creek	27-128-6	108.91	APP	S	F-2
Cullie Creek	27-128-6-1	4.43	APP	S	F-2
Jonaquin Creek	27-128-6-2	35.93	APP	S	F-2
Dumpling Creek	27-128-7a	20.00	PRO	I	F-2
Dumpling Creek	27-128-7b	5.41	APP	S	F-2
Sandy Huss Creek	27-128-8	15.51	APP	S	F-2
Delamar Creek	27-128-9	11.60	APP	S	F-2
Adams Creek	27-128a	1424.60	APP	S	F-2
Adams Creek	27-128b	3.20	APP	S	F-2
Adams Creek	27-128c	317.00	PRO	I	F-2
Garbacon Creek	27-131	25.82	APP	S	F-2
West Fork South River	27-135-1	35.50	PRO	I	F-2
Eastman Creek	27-135-10	95.60	PRO	I	F-2
Little Creek	27-135-11	6.15	CAO	I	F-2
Royal Creek	27-135-12	10.14	CAO	I	F-2
Coffee Creek	27-135-13	6.10	CAO	I	F-2
Dixon Creek	27-135-14	2.33	CAO	I	F-2
Old House Creek	27-135-15	3.17	CAO	I	F-2
Mulberry Creek	27-135-16	6.36	CAO	I	F-2
Big Creek	27-135-17a	59.60	PRO	I	F-2
Big Creek	27-135-17b	58.40	CAO	I	F-2
Hardy Creek	27-135-18	24.18	PRO	I	F-2
Horton Bay	27-135-19	101.28	CAO	I	F-2
East Fork South River	27-135-2	14.30	PRO	I	F-2
Herring Pond	27-135-20	11.05	APP	S	F-2
Rich Island Gut	27-135-2-1	0.09	PRO	I	F-2
Miry Gut	27-135-3	0.11	PRO	I	F-2
Elisha Creek	27-135-4	2.25	PRO	I	F-2
Neal Creek	27-135-5	2.88	PRO	I	F-2
Duck Creek	27-135-6	2.64	PRO	I	F-2
Buck Creek	27-135-7	6.37	PRO	I	F-2
Doe Creek	27-135-8	4.94	PRO	I	F-2
Southwest Creek	27-135-9	151.25	PRO	I	F-2
South River	27-135a	415.09	PRO	I	F-2

Class SA Water	Assessment Unit #	AU Length	Growing Area Classification[1]	DWQ Shellfish Rating[2]	DEH Growing Area
South River	27-135b	2064.82	PRO	I	F-2
Brown Creek	27-136	98.47	APP	S	F-2
Turnagain Bay	27-137	1556.75	CAO	I	F-2, F-3
Sanborns Gut	27-137-1	3.74	CAO	I	F-2
Big Gut	27-137-2	69.99	CAO	I	F-2
Deep Gut	27-137-3	51.00	CAO	I	F-2
Broad Creek	27-137-4	49.24	CAO	I	F-2
Pitman Creek	27-137-4-1	2.04	CAO	I	F-2
Parsons Creek	27-137-4-2	26.70	CAO	I	F-2
Abraham Bay	27-137-5	96.88	CAO	I	F-2
Tump Gut	27-137-6	20.86	CAO	I	F-2
Mulberry Point Creek	27-137-7	15.70	CAO	I	F-2
Cedar Bay	27-138	267.41	APP	S	F-2
Little Creek	27-139	13.54	APP	S	F-2
Rattan Bay	27-143	369.82	APP	S	F-2
South Bay	27-143-1	527.08	APP	S	F-2
East Bay	27-143-2	174.19	APP	S	F-2
North Bay	27-143-3	126.92	APP	S	F-2
PAMLICO SOUND	27-147.5b	84692.50	APP	S	F-2, F-3, F-4

1 - Growing Area Classifications: APP – Approved; CAO – Conditionally Approved-Open; CAC – Conditionally Approved-Closed; RES – Restricted; PRO- Prohibited.
2 - DWQ Shellfish Rating: S – Supporting; I - Impaired

The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area F-2. If the entire Class SA water is located within more than one growing area it is noted in Table 34 above. See growing area map above (Figure 17).

According to the ***Sanitary Survey of Merrimon-South River Area, Area F-2,*** *(DEH. Shellfish Sanitation Unit, June 2002)*, there has been a marked improvement in water quality since the last survey in 1999, possibly due to very dry weather in 2000 and 2001. Many stations now meet the approved area criteria that did not meet this criteria in the last survey. Of the 39,000 total acres of this area, 1,425 acres are closed to shellfish harvesting. Oyster and clam production are considered fair, with fair commercial value.

The watershed consists of approximately 100 square miles; most of it remote and inaccessible by automobile. Much of the area is under cultivation by Open Grounds Farm. Total population of this area is estimated at 1,350 people. Area F-2 is considered a slow to moderate growth area; however, the potential for future growth in this area is significant. There are approximately 350 lots within the area; only 129 (37 percent) are currently developed. There are no marinas in Area F-2, but abundant private docks exist along Adams Creek and its tributaries.

There were no noted septic system failures during the survey. Two gray water discharges were located in the South River community that could impact Hardy Creek. The survey was conducted during extremely dry conditions, and failures in older septic systems along Hardy Creek and Silver Dollar Road are probably not uncommon during normal wet weather conditions.

The most significant threat to the water quality of Area F-2 is stormwater and runoff from agriculture and silvaculture operations. Open Grounds Farm is the largest operation in the area, but smaller row crop and horse farms are also common. Other pollution sources include waterfowl and other wildlife. DEH did not recommend any changes in growing area classification at the time of the survey.

10.3.8 Division of Environmental Health Growing Area F-5

Table 35 Shellfish Growing Area F-5 Classifications

Class SA Water	Assessment Unit #	AU Length	Growing Area Classification[1]	DWQ Shellfish Rating[2]	DEH Growing Area
NEUSE RIVER	27-(118)a2	43836.30	APP	S	F-2, F-5
NEUSE RIVER	27-(118)c	61.70	PRO	I	F-5
NEUSE RIVER	27-(118)d	7.70	APP	S	F-5
NEUSE RIVER	27-(118)e	210.00	CAO	I	F-2, F-5
NEUSE RIVER	27-(118)g	8.21	PRO	I	F-5
Whittaker Creek	27-130	96.07	PRO	I	F-5
Pierce Creek	27-133a	48.91	PRO	I	F-5
Pierce Creek	27-133b	1.83	APP	S	F-5
Bright Creek	27-134-1	10.95	PRO	I	F-5
Pasture Creek	27-134-2	20.32	PRO	I	F-5
Old House Creek	27-134-3	6.03	APP	S	F-5
Orchard Creek	27-134a	37.10	PRO	I	F-5
Orchard Creek	27-134b	20.40	PRO	I	F-5
Gum Tricket Creek	27-140	10.53	APP	S	F-5
Ship Creek	27-141-1	5.39	PRO	I	F-5
Cedar Creek	27-141-10	11.70	APP	S	F-5
Green Creek	27-141-11	79.14	APP	S	F-5
Gideon Creek	27-141-2	25.97	PRO	I	F-5
Brown Creek	27-141-3	122.45	PRO	I	F-5
Spice Creek	27-141-3-1	4.69	PRO	I	F-5
Coffee Creek	27-141-3-2	7.07	PRO	I	F-5
Tar Creek	27-141-4	44.33	PRO	I	F-5
Pasture Creek	27-141-5	2.07	APP	S	F-5
Parris Creek	27-141-6	19.36	APP	S	F-5
Burton Creek	27-141-7	46.27	APP	S	F-5
Pittman Creek	27-141-8	65.84	APP	S	F-5
Mill Creek	27-141-9	12.28	APP	S	F-5
Broad Creek	27-141a	202.25	APP	S	F-5
Broad Creek	27-141b	527.66	PRO	I	F-5
Piney Point Creek	27-142	13.05	APP	S	F-5
Swan Creek	27-144	207.02	APP	S	F-5
Wading Creek	27-145	9.05	APP	S	F-5
Maw Bay	27-146	18.92	APP	S	F-5
Maw Point Creek	27-147	7.51	APP	S	F-5
Fisherman Bay	27-150-37	64.54	APP	S	F-5

1 - Growing Area Classifications: APP – Approved; CAO – Conditionally Approved-Open; CAC – Conditionally Approved-Closed; RES – Restricted; PRO- Prohibited.
2 - DWQ Shellfish Rating: S – Supporting; I - Impaired

The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area F-5. If the entire Class SA water is located within more than one growing area it is noted in Table 35 above. See growing area map above (Figure 17).

According to the ***Sanitary Survey of Oriental Area, Area F-5,*** *(DEH. Shellfish Sanitation Unit, April 2004)*, there have been some water quality improvements and degradation since the last survey. Oyster production is minimal and clam production is absent from the area.

The watershed draining to Area F-5 is approximately 80 square miles in size with 3,670 people, with an increasing number of subdivisions, marinas and docking facilities. The area around Oriental is experiencing the greatest amount of population growth and construction activities. This area is one of the largest sailing communities in the state.

The subdivisions located between Oriental and Whortonsville have not expanded significantly since the last survey; however, many of these subdivisions have 10-slip community docking facilities already built with more boats moored than the number of homes developed. DEH speculates that lots are being purchased solely for the docking capability for overnight docking and live-aboard usage. The proliferation of these docking facilities will undoubtedly have a cumulative effect on impacts to shellfish waters. Even though homebuilding has been slow, road construction and vegetative clearing on lots has increased stormwater runoff. Many subdivisions have begun construction activities in Area F-5. For example, Weyerhaeuser Properties sold the Gum Thicket area of 1,400 acres, including 23,000 linear feet of wetlands. Proposed plans for this acreage include 397 homesites, 83 patio homes, 120 condominiums, and a 400-slip upland marina with fuel and pump out facility. After this and other planned development occurs, water quality in the area is expected to decline and result in shellfish closures.

Marinas and docking facilities are prevalent in this area, with 18 marinas, numerous 10-slip docks and hundreds of individual docks to date. Of these, only Pecan Grove, Whittaker Creek Marina, and Oriental Harbor have stationary pump-out facilities. Several smaller marinas have portable pump-out facilities.

Other sources of water quality impacts in the watershed are from agriculture, ditching and wildlife. A multi-agency effort is underway to implement improved stormwater practices upstream in the area of New Bern.

Twelve of the 18 DEH sampling stations in area F-5 have shown water quality improvement since the last survey was conducted, four have shown degradation and two are unchanged. A portion of an approved area around Orchard Creek no longer meets approved criteria status and will be closed as a result of the recent survey. Therefore, an additional 50 acres will be closed. All stations in the prohibited area classification have improved, yet none meet the criteria for approved waters.

10.4 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.

10.4.1 Slocum Creek Watershed [AU# 27-112-1, 27-112-2 & 27-112]

Current Status

SW Prong Slocum Creek [AU# 27-112-1]

Southwest Prong Slocum Creek [AU# 27-112-1; C; Sw; NSW] from source to Slocum Creek (4.2 miles) is Supporting aquatic life due to a moderate swamp bioclassification at JB126. Land use upstream of this segment is entirely contained within the Croatan National Forest and its channelized headwaters originate in the Lakes Pocosin. The channel of this swamp stream was well defined and flow was very strong. Substrate was nearly all sand (70 percent) with the remainder comprised of silt (30 percent). The main habitat problems here were a lack of root mats and undercut banks. This site received a moderate swamp rating for the second consecutive assessment. During this assessment however, there was an increase in abundance of more intolerant EPT taxa.

East Prong Slocum Creek [AU# 27-112-2]

East Prong Slocum Creek [AU# 27-112-2; C; Sw; NSW] from source to Slocum Creek (4.6 miles) is Supporting aquatic life due to a moderate swamp bioclassification at JB123. The visible land use was mostly forest (70 percent) and residential (30 percent). The riparian zone was wide and intact with some erosional areas present. Instream habitat was suitable for macroinvertebrate colonization with an abundant of macrophytes, sticks, snags and logs. However, the snag habitat was mainly concentrated at two old beaver dam sites located within the reach.

Slocum Creek [AU# 27-112]

Slocum Creek [AU# 27-112; SC; Sw; NSW] from the source to Neuse River (659.1 saltwater acres) is Supporting due to No Criteria Exceeded at ambient monitoring station JA88. Turbidity was elevated in 7 percent of the samples. Fecal coliform bacteria levels were also above 400 CFU/100 ml in 16 percent of the samples. Nutrient levels were very high indicating anthropogenic sources of both nitrogen and phosphorus. The nutrients ranged between 0.01-2.19 mg/l for NH_3, 0.01-10 mg/l for NO_3, 0.1-2.11 mg/l for TKN and 0.03-1.7 mg/l for TP. This creek has a supplemental classification of swamp water, which is known to have naturally occurring low DO. Ninety percent of the readings recorded at this site were above 4.4 mg/l DO.

Slocum Creek is adjacent to the Cherry Point Marine Corps Air Station. The underlying surficial aquifer is contaminated due to the generation and storage of hazardous waste at the facility. There is currently a superfund site located on the air station. Slocum Creek receives surface water runoff as well as infiltration from surficial groundwater sources. Sediment samples collected in 1987 and 1990 from Slocum Creek were found to be contaminated with arsenic and PCBs. There is also an accumulation of water treatment alum sludge from past wastewater treatment operations. DWQ recommends not disturbing the sludge and sediment until such time as it can safely be removed and disposed of. The wastewater discharge for the Marine base has moved from Slocum Creek to the mainstem Neuse River.

10.5 Additional Water Quality Issues within Subbasin 03-04-10

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.

10.5.1 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.

Chapter 11
Neuse River Subbasin 03-04-11
Including the: Trent River, Beaver Creek and Musselshell Creek

11.1 Subbasin Overview

Subbasin 03-04-11 at a Glance

Land Cover (percent)

Forest/Wetland:	70.1
Water:	0.3
Urban:	1.5
Cultivated Crop:	24.7
Pasture/ Managed Herbaceous:	2.4

Counties
Craven, Jones, Lenoir and Onslow

Municipalities
Pink Hill, Pollocksville, Trenton and River Bend

Stream Statistics

Total Streams:	
Freshwater	295.8 mi
Saltwater	252.7 ac
Total Supporting:	
Freshwater	96.1 mi
Saltwater	0.0 ac
Total Impaired:	
Freshwater	18.1 mi
Saltwater	0.0 ac
Total Not Rated:	
Freshwater	5.3 mi
Saltwater	0.0 ac
Total No Data:	
Freshwater	165.9 mi
Saltwater	252.7 ac

This subbasin makes up the entire Trent River watershed and is mostly located in a flat swampy area that is poorly drained. The tributaries to the Trent River assessed during this assessment period were; Tuckahoe Creek, Beaver Creek, Musselshell Creek, Beaverdam Creek and Island Creek.

The population for this subbasin is focused mainly around the small towns of River Bend and Trenton. The primary land use here is agriculture and forest with the only suburban area concentrated around the Town of Trenton. There are numerous large scale animal operations in this subbasin, mainly concentrated in the Jones/Lenior County boundary area. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 16.

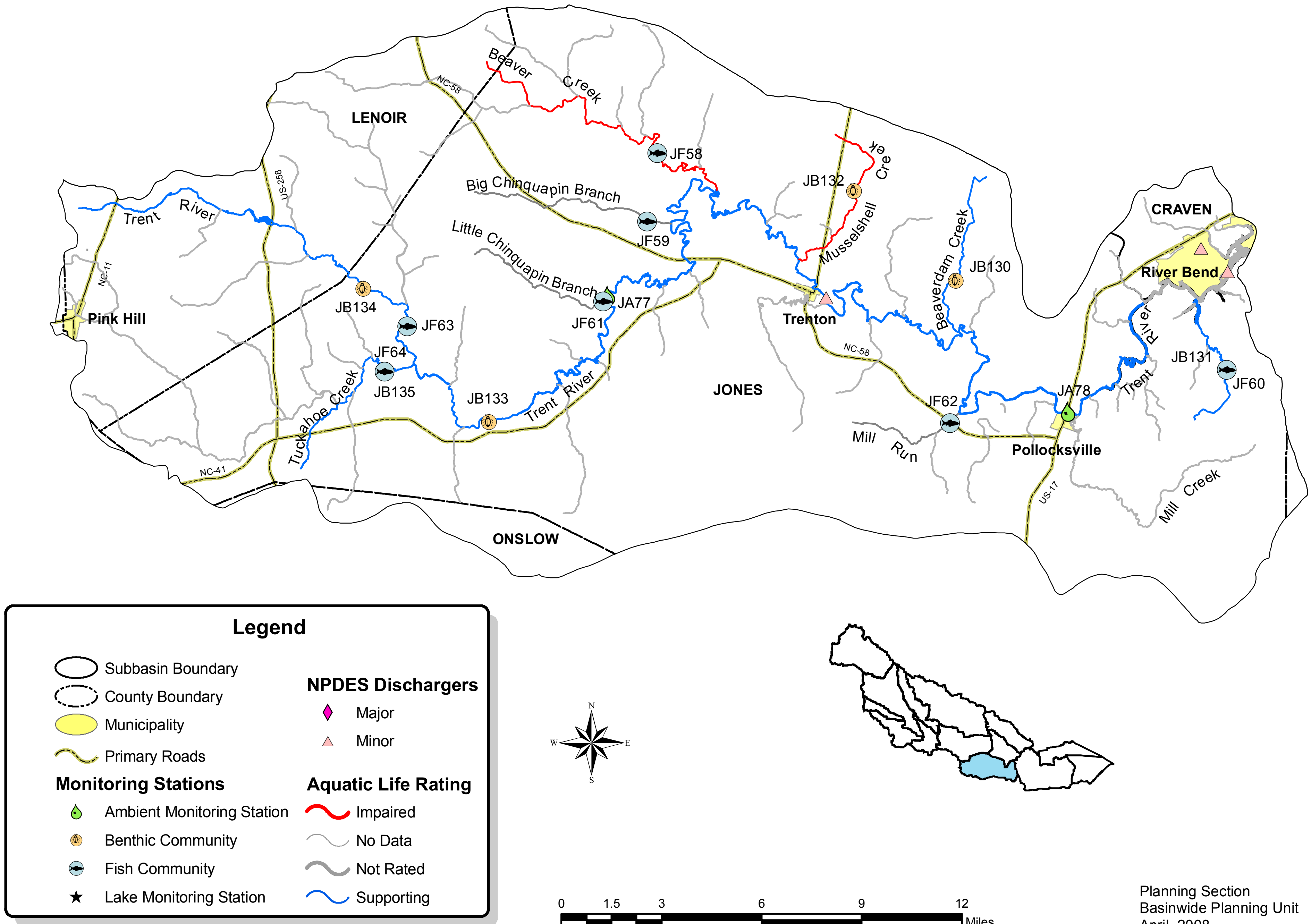
There are 3 minor NPDES wastewater discharge permits in this subbasin with a total permitted flow of 0.4 MGD. The largest discharger is River Bend WWTP (0.33 MGD). There are 2 individual NPDES stormwater permit in the subbasin. Refer to Appendix III for identification and more information on individual NPDES permit holders. There are also 68 permitted animal operations in this subbasin.

There is a single new water quality impairment in this subbasin, a biological impairment based on a severe swamp bioclassification in Musselshell Creek. Musselshell Creek like many of the other tributaries in this watershed is completely channelized and flows through agricultural fields. The benthic substrate in Musselshell Creek was nearly all silt (70 percent) and was thick enough to impede wading. This creek received one of the lowest habitat scores in the entire Neuse basin.

The water quality is heavily influenced by the many agricultural practices utilized in this watershed. There is a considerable need for additional agricultural BMPs. A trend analysis indicated that there was a significant increase in total phosphorus (TP) concentration in the Trent River between 1990 and 2005. This trend suggests that there was an average increase of 1.6 percent in TP concentration per year during this time period.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 33. Table 36 contains a list of assessment unit numbers (AU#) and length,

Figure 33 Neuse River Subbasin 03-04-11



Planning Section
Basinwide Planning Unit
April, 2008

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category

Watershed (WBD-10 Number) 0302020401 Upper Trent River

Subwatershed (WBD-12 Number) 030202040101 Headwaters Trent River

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-101-(1) From source to mouth of Deep Gully C;Sw,NSW	**Trent River**	03-04-11	77.4 FW Miles	**2b**		Aquatic Life	Not Rated	Data Inconclusive	Iron	2006		3m
						Aquatic Life	Supporting	No Criteria Exceeded	Low Dissolved Oxygen	2006	1998	2b
						Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
						Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
						Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1

Subwatershed (WBD-12 Number) 030202040103 Outlet Tuckahoe Swamp

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-101-5 From source to Trent River C;Sw,NSW	**Tuckahoe Creek**	03-04-11	6.5 FW Miles	**2**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1

Subwatershed (WBD-12 Number) 030202040106 Little Chinquapin Branch-Trent River

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-101-11 From source to Trent River C;Sw,NSW	**Little Chinquapin Branch**	03-04-11	5.2 FW Miles	**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a

Watershed (WBD-10 Number) 0302020402 Middle Trent River

Subwatershed (WBD-12 Number) 030202040201 Chinquapin Branch

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-101-14 From source to Trent River C;Sw,NSW	**Big Chinquapin Branch**	03-04-11	6.6 FW Miles	**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a

Subwatershed (WBD-12 Number) 030202040202 Rattlesnake Branch-Beaver Creek

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-101-15 From source to Trent River C;Sw,NSW	**Beaver Creek**	03-04-11	12.3 FW Miles	**5**	**Habitat Degradation** ANOPS land app site; General Agriculture/Pasture; Row Crop Agriculture	Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
						Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2000	1998	5

Subwatershed (WBD-12 Number) 030202040204 Town of Trenton-Trent River

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-101-17 From souce to Trent River C;Sw,NSW	**Musselshell Creek**	03-04-11	5.8 FW Miles	**5**	**Habitat Degradation** General Agriculture/Pasture	Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	1995		3a
						Aquatic Life	Impaired	Biological Criteria Exceeded	Ecological/biological Integrity Benthos	2005	2008	5

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Subwatershed (WBD-12 Number) 030202040205 Beaverdam Creek-Trent River												
27-101-21	**Beaverdam Creek**			**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
From source to Trent River												
C;Sw,NSW		03-04-11	6.0 FW Miles									
Subwatershed (WBD-12 Number) 030202040206 Town of Pollocksville-Trent River												
27-101-23	**Mill Run**			**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
From source to Trent River												
C;Sw,NSW		03-04-11	3.9 FW Miles									
Watershed (WBD-10 Number) 0302020403 Lower Trent River												
Subwatershed (WBD-12 Number) 030202040302 Island Creek-Trent River												
27-101-33	**Island Creek**			**2**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a
From source to Trent River						Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
C;Sw,NSW		03-04-11	6.1 FW Miles									

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.

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 for more information about use support methodology.

Waters in the following sections and in Table 36 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.

11.2 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, Poor, Natural, Moderate or Severe 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. Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 37 for a summary of use support for waters in subbasin 03-04-11 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

11.3 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 303(d) 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.

Table 37 Summary of Use Support Ratings in Subbasin 03-04-11

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
Freshwater miles (streams)	130	18	6	96	33	16	166	296
Estuarine acres	0	0	0.0	0	0.0	0	253	253

% - Percent of total miles/acres.

11.3.1 Musselshell Creek [AU# 27-101-17]

2002 Recommendations

Musselshell Creek was previously not rated due to the lack of approved swamp water criteria. DWQ biologists were able to reassess this site using the newly established criteria and found that this creek had a severe swamp benthic bioclassification in both 1995 and 2000. Habitat degradation was noted with infrequent pools, lack of instream habitat, little riparian area, eroding banks and channelized segments. There is extensive cotton farming in the watershed. DWQ will continue to monitor water quality in this creek to evaluate possible impacts from agriculture practices.

Current Status

Musselshell Creek [AU# 27-101-17; C; Sw; NSW] from source to Trent River (5.8 miles) is Impaired for aquatic life due to a Severe benthic bioclassification at site JB132.

This segment of Musselshell Creek is completely channelized and flows through an agricultural field. The benthic substrate was nearly all silt (70 percent) with sand (30 percent) comprising the remainder. The instream silt accumulation was thick enough to impede wading. Land use in this catchment is almost all agriculture with only small tracts of forest. Some logging has occurred in the lower portion of the watershed. There were numerous habitat problems at this site (e.g., channelization, lack of snags, streambank erosion, poor riparian area) and the habitat received one of the lowest habitat scores in the entire Neuse basin.

Musselshell Creek has been sampled twice previously using benthic swamp criteria. Sampling in 1995, 2000 and 2005 all produced a Severe swamp benthic bioclassifications with very low total and EPT taxa. These data clearly indicate a pollution tolerant invertebrate community. The taxa found were indicative of organic enrichment and low dissolved oxygen.

Musselshell Creek will be added to the 2008 303(d) list of impaired waters for impaired biological integrity.

Recommendations

DWQ recommends the Division of Soil and Water Conservation to evaluate the need for more agricultural conservation practices in this watershed including filter strips and conservation tillage.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

Water Quality Initiatives

The following BMPs were installed in this watershed though state and federal cost share assistance programs: water control structures affecting 134 acres, nutrient management plans covering 630.6 acres, and 39.5 acres of long-term no till.

The Agriculture Cost Share Program (ACSP) funded over $7,000 of the BMP listed above (September 2000 – December 2006). Cumulatively, the ACSP practices affected 64 acres, saved

63 Tons of soil, 1,431 pounds of nitrogen, 2,385 pounds of phosphorus, managed 98,928 pounds of waste- Nitrogen, and managed 5,312 pounds of waste-Phosphorus.

Additional lands within this watershed are using no-till practices without cost share assistance.

11.3.2 Beaver Creek [AU# 27-101-15]

Current Status
Beaver Creek [AU# 27-101-15; C; Sw; NSW] from source to Trent River (12.3 miles) is currently Not Rated for aquatic life due to a fish bioclassification rating at JF58. Coastal Plain criteria are not complete at this time so this segment could not be rated. This site on Beaver Creek was sampled for the first time for fish community assessments in 2005. The stream drains an agricultural area, row crops and confined animal operations, of northwestern Jones and northeastern Lenoir counties and there are no NPDES facilities within the stream's rural residential and agricultural watershed upstream of the monitoring site. This site was entrenched and may have been channelized a very long time ago. The instream and riparian habitats were of high quality with wooded buffers. The conductivity was also elevated at 260 µmhos/cm and is indicative of nonpoint source runoff. The fauna was typical of that found in many Coastal Plain streams.

This site was sampled for benthic macroinvertebrates during the last assessment period. It was given a Not Rated rating since the swamp stream criteria were not complete at that time. Upon reassessment of the data using the approved swamp stream criteria, this site was impaired due to a Severe benthic bioclassification. This site was assessed in 1991 using Coastal A stream criteria and received a Fair rating. It was later determined that this stream should be assessed using the swamp stream criterion instead.

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

Recommendations
DWQ recommends that the Division of Soil and Water Conservation evaluate the need for more agricultural conservation practices in this watershed including filter strips and conservation tillage.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

Water Quality Initiatives
The following BMPs were installed in Beaver Creek though state and federal cost share assistance programs: nutrient management plans covering 1,298 acres, field borders affecting 739 acres, grass waterways affecting 490 acres, 49.5 acres of cropland conversion to grass, 7.5 acres of cropland conversion to trees, water control structures affecting 440 acres, 247.8 acres of long-term no till, 136.1 acres of 3 year no-till, 1 acre of critical area planting, 2 incinerators, 2 waters conservation contracts and nutrient and pest management plans covering 208.6 acres.

The Agriculture Cost Share Program funded over $99,000 of the BMP listed above (September 2000 – December 2006). Cumulatively, the ACSP practices affected 3,387 acres, saved 5,730

Tons of soil, 36,494 pounds of nitrogen, 3,860 pounds of phosphorus, 67,879 pounds of Waste-N managed, and 7,247 pounds of Waste-P managed.

Additional lands within this watershed are using no-till practices without cost share assistance.

11.4 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.

11.4.1 Trent River [AU# 27-101-(1)]

Current Status
The Trent River [AU# 27-101-(1); C; Sw; NSW] is Supporting aquatic life and recreational uses due to a Good-Fair and Moderate benthic bioclassifications at sites JB133 and JB134 and because No Criteria were Exceeded at the ambient monitoring stations JA77 and JA78.

Benthic site JB134 is the furthest upstream site on the Trent River. This site was sampled (2000) during the last assessment period but was not rated due to the fact that the swamp stream criteria had not been completed before the final assessment was made for this basin. The rating would have been moderate which is consistent with the current rating. There were a few more tolerant taxa collected during this assessment period with some of these being indicators of organic enrichment. The land use in this catchment is comprised of scattered residential areas, agriculture, animal operations, and forest. There was also a new subdivision just upstream from the sampling site that was not there during the last assessment period and swine farm odors were noted at the time of sampling. The main habitat problems along this reach were the high percentage of silt substrate, and a lack of snags.

Benthic site JB133 near Comfort is an area comprised of similar land use as listed above. The main habitat issue in this reach of the stream was moderate streambank erosion and lack of large snags for instream macroinvertebrate habitat. This site was Not Rated during the last assessment period. It initially received a fair benthic rating and was scheduled for a follow up sample to confirm the impaired rating. This area had been hard hit by several hurricanes during the last assessment period. It was felt that the impairment might be the direct result of this stressor. Biologists were not able to resample this site due to low flow conditions in 2001 and was given a Not Rated assessment at that time. This site received a Good-Fair benthic bioclassification during this assessment period. There was an increase in the total and EPT taxa found as well as an increase in the number of intolerant taxa, which resulted in a more favorable rating. The improvement at this site could possibly be the result of lower flows throughout this assessment period. This area experienced several drought years and in catchments where non-point source pollution is the primary stressor, lower flows tend to improve water quality as fewer pollutants are washed from the land into streams.

Ambient monitoring data were collected at JA77 near Trenton and JA78 at Pollocksville. The data did not exceed any of the state standards. This segment of the Trent River has a supplemental classification of swamp water so there is no State DO standard; however both sites had ninety percent of the DO reading above 4.3 mg/l. A minimum DO reading of 2.9 mg/l was recorded at JA78. The conductivity was elevated at both sites with a range of readings between 34 and 1,525 µmhos/cm. Nutrient levels were also elevated at both sites. Chlorophyll *a* samples were collected at JA77 and none of the readings were above the state standard of 40 µg/l.

During the summer of 2008, dense areas of macrophytic algae were reported throughout the Trent River watershed. While this is outside the data window for this plan, it is important to point out that in order to support the macrophytic algal densities reported, this area is likely suffering from nutrient over enrichment. Dense macrophytic algae have not been reported in this area since 1999 when Hurricane Floyd flushed the system.

Trent River Trend Analysis

DWQ conducted a trends and annual load analysis at several stations throughout the basin. The stations chosen for assessment were those in close proximity to a USGS gauging station. All trends were assessed using flow and seasonal adjustments.

Station JA77 was chosen due to the close proximity of the USGS gauging station (#02092500) at SR 1129 near Trenton. Trends were done on data collected between 1990 and 2005. The analysis included trends on total nitrogen (TN), defined as the sum of total Kjeldahl nitrogen and nitrate-nitrogen, total phosphorus (TP), and temperature.

The results indicated that there was a significant increase in TP concentration in the Trent River at station JA77. This trend suggests that the average increase in TP concentration per year was 0.001 mg/l, which corresponds to an average median TP concentration increase of 1.6 percent per year during this time period (1990-2005).

In addition to TP, there was also a significant increase in surface water temperature with an average increase per year of 0.15 degrees Celsius in the Trent River. This corresponds to an average median temperature increase of 0.8 percent per year during the same time period (1990-2005).

TN did not show a significant trend for this time period.

Recommendations

DWQ recognizes the need to improve the assessment of the Trent River watershed in order to identify and reduce the excess nutrients that are likely responsible for the dense macrophytic algal growth within this watershed as well as contributing to the elevated productivity in the Neuse River Estuary.

DWQ continues to recommend that the Division of Soil and Water Conservation evaluate the potential for implementation of appropriate BMPs to reduce nutrient and sediment loading in this watershed.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North*

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

11.4.2 Big Chinquapin Branch [AU# 27-101-14]

Current Status

Big Chinquapin Branch [AU# 27-101-14; C; Sw; NSW] is currently Not Rated for aquatic life due to a fish bioclassification rating at JF59. Coastal Plain criteria are not complete at this time so this segment could not be rated. Big Chinquapin Branch was sampled for the first time for fish community assessments in 2005. This stream drains the agricultural area, row crops and confined animal operations of northwestern Jones County and there are no NPDES facilities within the stream's rural residential and agricultural watershed upstream of the monitoring site. This silt and sandy bottom, entrenched stream has been channelized and appeared to be maintained as a channelized waterbody. There were drag line or backhoe "teeth" marks along the stream bottom, bank, and into the limestone bedrock. Despite the channelization, the stream still maintained its sinuosity. There were no growths of macrophytes and coarse woody debris and snags were scarce. Big Chinquapin Branch had the highest conductivity (381 µmhos/cm) and lowest habitat score of any fish community site in the Coastal Plain in 2005. At the request of BAU staff, investigations by staff from the Washington Regional Office and from the Division of Soil and Water Conservation did not find any major spill or leakage from nearby farms in the past two years that may have accounted for the elevated conductivity measurement (David May and Joseph Gyamfi, pers. comm., February 23, 2006). There are several hog farms as well as chicken littler application fields in the western part of Jones County that could be contributing to nonpoint runoff in the watershed.

Recommendations

DWQ recommends the Division of Soil and Water Conservation to evaluate the need for more agricultural conservation practices in this watershed including filter strips and conservation tillage.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document
(http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

Water Quality Initiatives

The following BMPs were installed in this watershed though state and federal cost share assistance programs: water control structures affecting 370 acres, 298 acres of field borders, 130 acres of grassed waterways, 1.6 acres of cropland conversion to trees, 20.3 acres of cropland conversion to grass, nutrient management plans covering 68 acres, nutrient and pest management plans covering 316.8 acres, 320 acres of long-term no till, 67.7 acres of 3 year no-till, 1 incinerator and 1 litter spreader.

The Agriculture Cost Share Program funded over $30,000 of the BMP listed above (September 2000 – December 2006). Cumulatively, the ACSP practices affected 505 acres, saved 310 Tons of soil, 4,131 pounds of nitrogen, 72 pounds of phosphorus, 16,476pounds of Waste-N managed, and 44,520 pounds of Waste-P managed.

Additional lands within this watershed are using no-till practices without cost share assistance.

11.5 Additional Water Quality Issues within Subbasin 03-04-11

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.

11.5.1 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.

Chapter 12
Neuse River Subbasin 03-04-12
Including the: Neuse River

12.1 Subbasin Overview

Subbasin 03-04-12 at a Glance

Land Cover (percent)

Forest/Wetland:	51.7
Surface Water:	1.1
Urban:	4.1
Cultivated Crop:	41.0
Pasture/ Managed Herbaceous:	2.1

Counties
Johnston and Wayne

Municipalities
Goldsboro, Selma, Pine Level, Mount Olive and Princeton

Stream Statistics

Total Streams:	152.4 mi
Total Supporting:	20.0 mi
Total Impaired:	5.8 mi
Total Not Rated:	7.9 mi
Total No Data:	118.7 mi

Population growth in the subbasin is concentrated around Selma, Princeton, Pine Level and Goldsboro. Land use in this area is agriculture, animal operations and scattered tracts of forest.

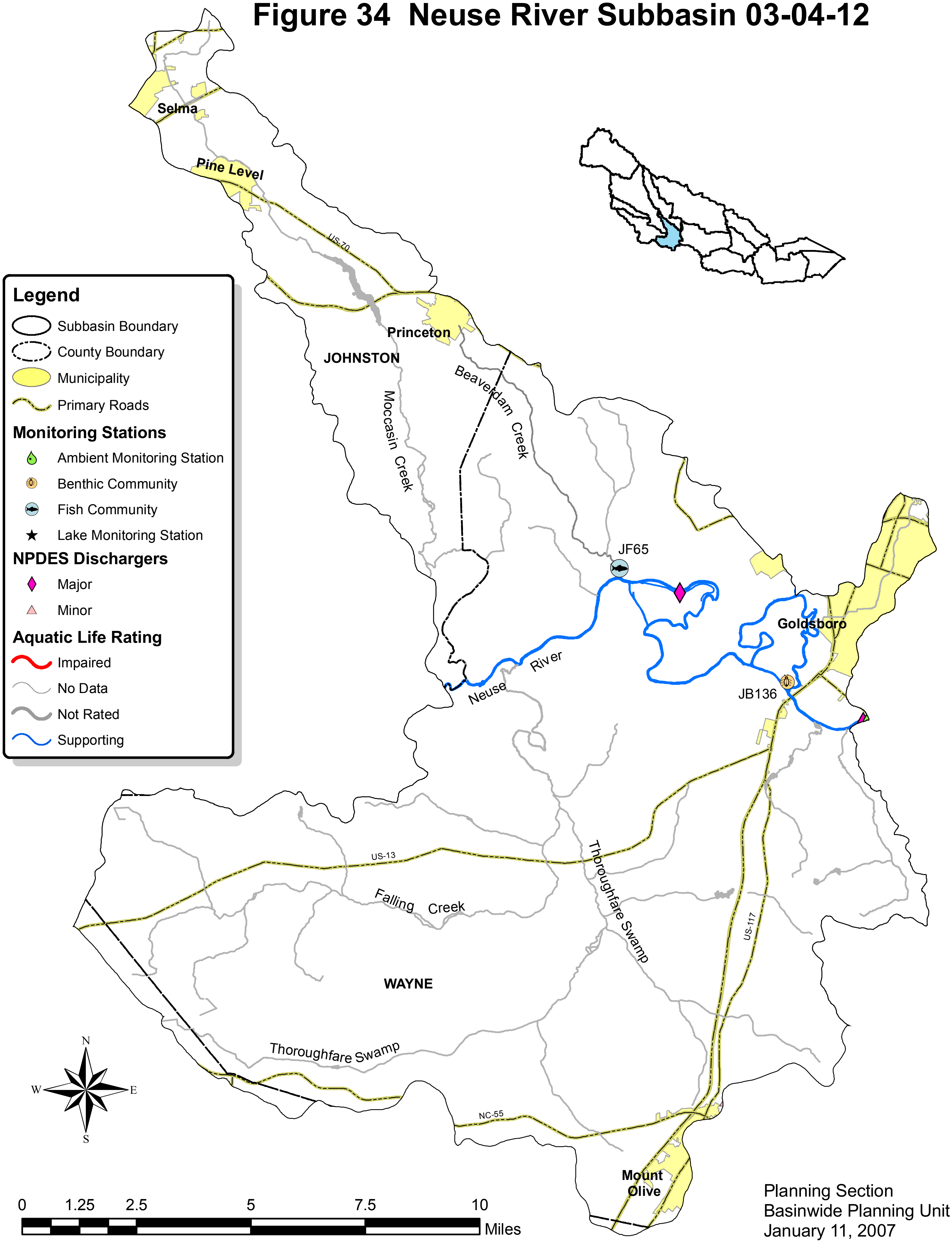
There are 1 major and 1 minor NPDES wastewater discharge permits in this subbasin. There are also 8 individual NPDES stormwater permit in the subbasin. Refer to Appendix III for identification and more information on individual NPDES permit holders. There are also 68 permitted animal operations in this subbasin.

This watershed is not well assessed. There was no ambient monitoring and only a single benthic sample assessed which improved to a good benthic bioclassification, up from good-fair in 2000. Water quality in this subbasin is likely affected by the large number of animal operations. Agricultural BMPs should be utilized to protect the water quality in these streams. It is also be important to incorporate urban BMPs in the areas of higher urban growth.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 34. Table 38 contains a list of assessment unit numbers (AU#) and length, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Refer to 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 38 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.

Figure 34 Neuse River Subbasin 03-04-12



Planning Section
Basinwide Planning Unit
January 11, 2007

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category

Watershed (WBD-10 Number) 0302020117 Moccasin Creek-Neuse River

Subwatershed (WBD-12 Number) 030202011704 Charles Branch-Beaverdam Creek

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-55 From source to Neuse River; WS-IV;NSW	03-04-12	**Beaverdam Creek** 7.9 FW Miles	**3a**		Aquatic Life	Not Rated	Data Inconclusive	Ecological/biological Integrity FishCom	2005		3a

Subwatershed (WBD-12 Number) 030202011705 Quaker Neck Lake-Neuse River

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-(49.5)b From subbasin 030402-030412 boundary to a point 0.8 mile upstream of Little River; WS-IV;NSW	03-04-12	**NEUSE RIVER** 18.5 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
27-(55.5) From a point 0.8 mile upstream of Little River to City of Goldsboro water supply intake (located 0.4 mile upstream of Little River); WS-IV;NSW,CA	03-04-12	**NEUSE RIVER** 0.5 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
27-(56)a From City of Goldsboro water supply intake to subbasin 030405-030412 boundary; C;NSW	03-04-12	**NEUSE RIVER** 5.8 FW Miles	**5**	**Mercury**	Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		1
					Fish Consumption	Impaired	Standard Violation	Mercury	2004	2004	5
27-59 From source to Neuse River; C;NSW	03-04-12	**Neuse River Cut-Off** 1.0 FW Miles	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Ecological/biological Integrity Benthos	2005		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.

12.2 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. Appendix X provides definitions of the terms used throughout this basin plan.

Refer to Table 39 for a summary of use support for waters in subbasin 03-04-12 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

12.3 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 303(d) 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.

Table 39 Summary of Use Support Ratings in Subbasin 03-04-12

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
Freshwater miles (streams)	34	6	4	20	13	8	119	152

% - Percent of total miles/acres.

There are no newly or previously impaired waters in the subbasin. Very few streams in this subbasin were evaluated during this assessment period. It is likely that the water quality in this subbasin is affected by the large number of animal operations.

Recommendations

DWQ would recommend sampling Moccasin Creek, Falling Creek and Thoroughfare Swamp during the next assessment period.

Local resource agencies are encouraged to install appropriate BMPs in this watershed to protect water quality.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North*

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

12.4 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.

12.4.1 Neuse River [AU# 27-(49.5)b, 27-(55.5), 27-(56)a & 27-59 (Cut-Off)]

Current Status

The entire length of the Neuse River in this subbasin including the Neuse River Cut-Off [AU#27-(49.5)b(WS-IV; NSW); 27-(55.5) (WS-IV; NSW; CA); 27-(56)a (C; NSW); 27-59 (C; NSW)] from subbasin 030402 boundary to subbasin 03-04-05 boundary (25.8 miles total) is Supporting for aquatic life due to a Good benthic bioclassification at JB136. This site has been sampled on three previous occasions with one sample (1991) receiving a Good bioclassification while samples in 1995 and 2000 resulted in Good-Fair bioclassifications. Land use in the immediate catchment includes urban and suburban areas of Goldsboro. Further upstream of this site, the catchment is mostly agricultural with scattered areas of forest. The primary habitat deficiencies noted were areas of streambank erosion and breaks in the riparian zone. The conductivity was elevated (160 µmhos/cm) reflecting this segment's proximity to Goldsboro. A rare mayfly (*Leptohyphes robacki*) was also collected at this site in 2005 and represents only the fifteenth total collection statewide of this taxon by DWQ biologists and is only the fourth record from the Neuse basin.

The improvement at this site could possibly be the result of lower flows in 2005 and perhaps throughout most of this assessment period. In catchments where non-point pollution is the primary stressor, lower flows tend to improve water quality as fewer pollutants are washed from the land into waterbodies. The six-month average stream discharge from May 2005 through October 2005 was 856 cubic feet per second (cfs) at the Neuse River (US 117) near Goldsboro. This average was significantly less than the six-month average stream discharge (2,073 cfs) from March 2000 through August 2000. The attenuated six month average discharge preceding the October 2005 sampling event relative to the greater flow preceding the August 2000 collection possibly explains the improved community metrics and bioclassification observed at the Neuse River (JB136) sampling site in 2005.

Neuse River - Fish Tissue Monitoring

All waters in the Neuse River basin are Impaired on an evaluated basis in the Fish Consumption category for mercury contamination. This is based on a fish consumption advice from the NC Department of Health and Human Services (NC DHHS). For more information on fish consumption advisories and advice, contact NC DHHS (http://www.schs.state.nc.us/epi/fish/current.html).

Largemouth bass, striped bass, sunfish, and catfish samples were collected from the Neuse River near Goldsboro and Kinston during 2000 and analyzed for mercury and heavy metal contaminants. The samples were collected as part of an eastern North Carolina mercury assessment.

Near Goldsboro, three largemouth bass, and one striped bass (4 of 21 total samples) contained mercury concentrations exceeding the state criteria of 0.4 ppm. Mercury levels in all samples ranged from 0.10 to 0.52 ppm. Results for other metals were non-detectable or below EPA and North Carolina screening values. Two additional largemouth bass samples were collected from the Goldsboro station during 2003 and analyzed for organics and PCB contaminants. The samples contained trace amounts of DDE, a DDT metabolite, and dieldrin but concentrations were well below US EPA, US FDA, and State of North Carolina criteria. PCB contaminants were not detected. For more information on fish tissue monitoring see the Environmental Sciences Section, Basinwide Assessment Report Neuse River Basin, 2006 (http://h2o.enr.state.nc.us/esb/Basinwide/Neuse06BasinReportFinal.pdf).

The Neuse River AU# 27-(56)a and AU# 27-(56)b (in subbasin 03-04-05) were added to the 2004 303(d) due to site specific fish tissue samples collected in 2000. DWQ is no longer assessing mercury impairments on a site specific basis. The entire basin is impaired on an evaluated basin and a state or regional/ecoregional TMDL approach will be taken to correct the high mercury levels in some of the states fish population. See section 12.5.1 below for more information.

Recommendations
In this highly agricultural subbasin, DWQ recommend that the local resources agencies implement appropriate BMPs to reduce nutrient and sediment loading in this watershed.

Further recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

12.5 Additional Water Quality Issues within Subbasin 03-04-12

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.

12.5.1 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.

Chapter 13
Neuse River Subbasin 03-04-13
Including the: Bay River and Pamlico Sound

13.1 Subbasin Overview

Subbasin 03-04-13 at a Glance

Land Cover (percent)

Forest/Wetland:	33.6
Surface Water:	49.8
Urban:	4.0
Cultivated Crop:	12.2
Pasture/ Managed Herbaceous:	0.4

Counties
Carteret and Pamlico

Municipalities
Alliance, Stonewall and Vandemere

Stream Statistics

Total Streams:	3.5 mi/83,445.9 ac
Total Supporting:	1.4 mi/80,429.8 ac
Total Impaired:	0.0 mi/1,214.7 ac
Total Not Rated:	0.0 mi/0.0ac
Total No Data:	2.1mi/1,801.4 ac

Population growth in the subbasin is minimal. Bayboro and Vandemere are the largest towns. The greatest residential concentration is the area on the south side of Bay River. Land use in the subbasin is mostly agricultural.

There is 1 minor NPDES wastewater discharge permit in this subbasin. The Bay River Metropolitan Sewer District (BRMSD) stopped discharging into the Bay River in 2000 and now all treated effluent is land applied on pine fields near the town of Arapahoe. The BRMSD reported no major problems aside from hurricanes. Refer to Appendix III for identification and more information on individual NPDES permit holders. There is also 1 permitted animal operation in this subbasin.

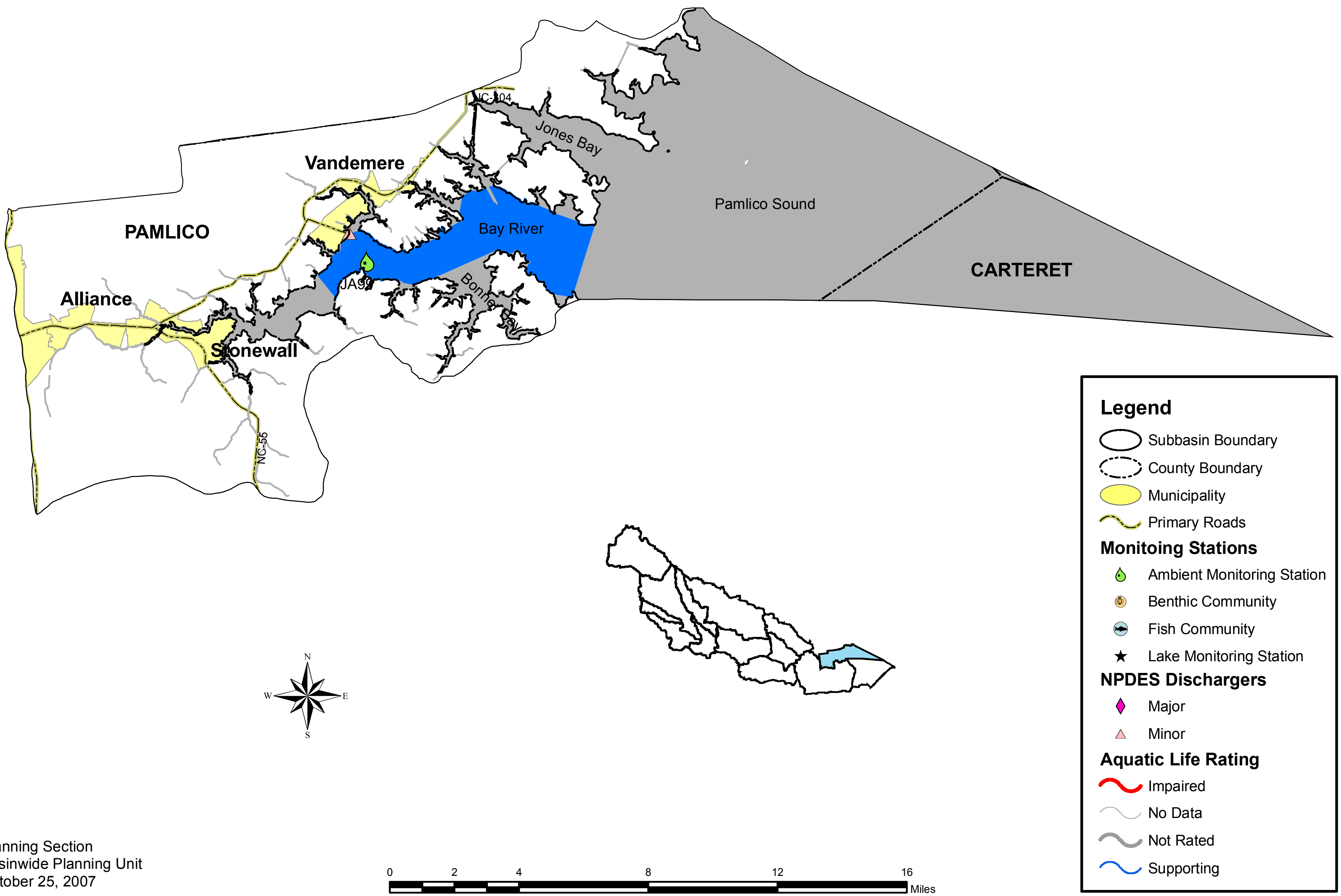
The North Carolina State Division of Environmental Health (DEH) is responsible for classifying coastal waters as to their suitability for shellfish harvesting, monitoring and issuing advisories for coastal recreational swimming areas. DEH assess the level of enterococcus or fecal coliform bacteria in the water column. These bacteria are found in the intestines of warm-blooded animals. While they do not cause illness themselves, scientific studies indicate that enterococci and fecal coliform bacteria may indicate the presence of other disease-causing organisms. DEH will post swimming advisories and close shellfish waters to harvesting in order to protect human health.

Marinas, domestic pets, migratory waterfowl and other wild animals contribute to the bacterial loading throughout much of this area. As result of these contributions, the shellfish area closure line in the Bay River and Ball Creek were shifted further downstream. An additional closure was added to Jones Bay, with the closure of the Intracoastal Waterway just north of the highway 33 bridge, as well as to just south of the intersection with Jones Bay and extends out into Jones Bay.

The Camp Vandemere public beach area (DEH station # C114) on the north side of the Bay River is also classified as impaired due to the excessive number of days that swimming advisories were posted by DEH.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 35. Table 40 contains a list of assessment unit numbers (AU#) and length, streams monitored, monitoring data types, locations and use support ratings for waters in the

Figure 35 Neuse River Subbasin 03-04-13



Planning Section
Basinwide Planning Unit
October 25, 2007

Assessment Unit Number / Description / Classification / DWQ Subbasin / Miles/Acres	Name	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
Watershed (WBD-10 Number) 0302010502 Pamlico Sound-Ocracoke Inlet										
Subwatershed (WBD-12 Number) 030201050201 Deep Cove-Middle Ground										
27-147.5a Northern portion Pamlico within Neuse River Basin subbasin 030413; SA;HQW,NSW; 03-04-13; 64,244.0 S Acres	**PAMLICO SOUND**	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-157 From source to Pamlico Sound; SA;HQW,NSW; 03-04-13; 176.1 S Acres	**Little Porpoise Bay**	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
Watershed (WBD-10 Number) 0302020408 Jones Bay-Bay River										
Subwatershed (WBD-12 Number) 030202040801 Upper Bay River										
27-150-3 From source to Bay River; SC;Sw,NSW; 03-04-13; 27.4 S Acres	**South Prong Bay River**	5	**Fecal Coliform Bacteria**	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
				Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2008	5
27-150-3-1 From source to South Prong Bay River; SC;Sw,NSW; 03-04-13; 1.3 S Acres	**Neal Creek**	4cs	**Fecal Coliform Bacteria**	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
Subwatershed (WBD-12 Number) 030202040802 Middle Bay River										
27-150-(9.5)a1 From 27-150-(9.5)b to a line crossing the Bay River from Newton Creek to a point 0.3 miles upstream of Moore Creek; SA;HQW,NSW; 03-04-13; 672.0 S Acres	**Bay River**	5	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2008	5
				Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-150-(9.5)a2 From a line crossing the Bay River from Newton Creek to a point 0.3 miles upstream of Moore Creek to Pamlico Sound; SA;HQW,NSW; 03-04-13; 8,304.9 S Acres	**Bay River**	2		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards 1n3	2006		1
				Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
				Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
				Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-(9.5)b1 DEH closed extending 366 meters east of SC SA line; SA;HQW,NSW; 03-04-13; 100.0 S Acres	**Bay River**	4cs	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs

Assessment Unit Number / Description / Classification / DWQ Subbasin / Miles/Acres	Name	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-150-(9.5)b2 DEH prohibited area along shore of Log Pond Creek area. SA;HQW,NSW 03-04-13 16.5 S Acres	**Bay River**	5	**Enterococcus**	Recreation	Impaired	Loss of Use	Recreation Advisory	2006	2004	4cr
				Recreation	Impaired	Standard Violation	Enterococcus	2006	2008	5
			Fecal Coliform Bacteria Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-150-10 From source to Bay River SA;HQW,NSW 03-04-13 32.5 S Acres	**Harper Creek**	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-150-11 From source to Bay River SA;HQW,NSW 03-04-13 0.9 S Acres	**Tempe Gut**	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-150-12 From source to Bay River SA;HQW,NSW 03-04-13 28.3 S Acres	**Moore Creek**	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-150-12-1 From source to Moore Creek SA;HQW,NSW 03-04-13 1.5 S Acres	**Chappel Creek**	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-150-13 From source to Bay River SA;HQW,NSW 03-04-13 3.8 S Acres	**Newton Creek**	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs

Subwatershed (WBD-12 Number) 030202040803 Lower Bay River

Assessment Unit Number / Description / Classification / DWQ Subbasin / Miles/Acres	Name	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-150-17 From source to Bay River SA;HQW,NSW 03-04-13 6.0 S Acres	**Little Pasture Creek**	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-18 From source to Bay River SA;HQW,NSW 03-04-13 12.8 S Acres	**Rice Creek**	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-19 From source to Bay River SA;HQW,NSW 03-04-13 4.3 S Acres	**Mesic Creek**	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-150-20-1 From source to Ball Creek SA;HQW,NSW	**Simpson Creek**	03-04-13	8.6 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2008	4cs
27-150-20-2 From source to Ball Creek SA;HQW,NSW	**Pasture Creek**	03-04-13	9.3 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-20-3 From source to Ball Creek SA;HQW,NSW	**Cabin Creek**	03-04-13	30.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-20a From source to 0.1 miles upstream of Pasture Creek SA;HQW,NSW	**Ball Creek**	03-04-13	32.4 S Acres	**5**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2008	5
						Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-150-20b From 0.1 miles upstream of pasture Creek to Bay River SA;HQW,NSW	**Ball Creek**	03-04-13	80.0 S Acres	**2**		Shellfish Harvesting	Not Rated	Data Inconclusive	Fecal Coliform (shellfish)	2006	2008	3a
						Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-21 From source to Bay River SA;HQW,NSW	**Harris Creek**	03-04-13	2.8 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-22 From source to Bay River SA;HQW,NSW	**Gascon Creek**	03-04-13	3.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-23 From source to Bay River SA;HQW,NSW	**Barnes Creek**	03-04-13	1.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-24 From source to Bay River SA;HQW,NSW	**Potter Creek**	03-04-13	13.7 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-25 From source to Bay River SA;HQW,NSW	**Oyster Creek**	03-04-13	19.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-150-26 From source to Bay River SA;HQW,NSW	**Bonner Bay**	03-04-13	865.3 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-1 From source to Bonner Bay SA;HQW,NSW	**Spring Creek**	03-04-13	279.0 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-1-1 From source to Spring Creek SA;HQW,NSW	**Richardson Creek**	03-04-13	8.9 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-1-2 From source to Spring Creek SA;HQW,NSW	**Maul Run**	03-04-13	1.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-1-3 From source to Spring Creek SA;HQW,NSW	**Horton Creek**	03-04-13	4.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-1-4 From source to Spring Creek SA;HQW,NSW	**Bryan Creek**	03-04-13	13.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-1-4-1 From source to Bryan Creek SA;HQW,NSW	**Ives Creek**	03-04-13	8.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-2 From source to Bonner Bay SA;HQW,NSW	**Long Creek**	03-04-13	356.8 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-2-1 From source to Long Creek SA;HQW,NSW	**Deep Oak Gut**	03-04-13	2.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-2-2 From source to Long Creek SA;HQW,NSW	**Cow Gallus Creek**	03-04-13	11.4 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-150-26-2-3 Dipping Vat Creek From source to Long Creek SA;HQW,NSW 03-04-13 26.9 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-3 Riggs Creek From source to Bonner Bay SA;HQW,NSW 03-04-13 115.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-3-1 Savannah Creek From source to Riggs Creek SA;HQW,NSW 03-04-13 11.0 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-3-2 Morris Creek From source to Riggs Creek SA;HQW,NSW 03-04-13 5.4 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-3-3 Raff Creek From source to Riggs Creek SA;HQW,NSW 03-04-13 10.9 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-26-4 Sheephead Creek From source to Bonner Bay SA;HQW,NSW 03-04-13 18.7 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-27 Little Bear Creek From source to Bay River SA;HQW,NSW 03-04-13 55.3 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-27-1 Blossum Pond Creek From source to Little Bear Creek SA;HQW,NSW 03-04-13 15.1 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-28-1 Bennett Creek From source to Bear Creek SA;HQW,NSW 03-04-13 15.7 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-150-28-2 Win Creek From source to Bear Creek SA;HQW,NSW 03-04-13 1.2 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-150-28-3 Plum Creek From source to Bear Creek SA;HQW,NSW 03-04-13 8.1 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-28-4 Riggs Creek From source to Bear Creek SA;HQW,NSW 03-04-13 23.2 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-28-5 Cox Creek From source to Bear Creek SA;HQW,NSW 03-04-13 3.4 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-28-6 Garden Creek From source to Bear Creek SA;HQW,NSW 03-04-13 6.4 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-28-7 Harper Creek From source to Bear Creek SA;HQW,NSW 03-04-13 4.1 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-28-8 Catchall Creek From source to Bear Creek SA;HQW,NSW 03-04-13 4.6 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-28a Bear Creek From source to DEH prohibited area line 42 meters south of confluence with Bennett Creek SA;HQW,NSW 03-04-13 199.9 S Acres	5	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2004	5
			Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-150-28b1 Bear Creek From DEH prohibited area line 42 meters south of confluence with Bennet Creek to Plum Creek SA;HQW,NSW 03-04-13 18.2 S Acres	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-150-28b2 Bear Creek From Plum Creek to Bay River SA;HQW,NSW 03-04-13 168.5 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-150-29 Chadwick Creek From source to Bay River SA;HQW,NSW 03-04-13 54.4 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-30 No Jacket From source to Bay River SA;HQW,NSW 03-04-13 13.3 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-31-1-1 Jumpover Creek From source to Intracoastal Waterway SA;HQW,NSW 03-04-13 7.7 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-31-1b Intracoastal Waterway From Jones Bay to Gale Creek except for prohibited area at head of Jones Bay SA;HQW,NSW 03-04-13 81.8 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-31-2 Raccoon Creek From source to Gale Creek SA;HQW,NSW 03-04-13 8.1 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-31-3 Whealton Creek From source to Gale Creek SA;HQW,NSW 03-04-13 7.6 S Acres	2		Shellfish Harvesting	Not Rated	Data Inconclusive	Fecal Coliform (shellfish)	2006		3a
			Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-31-4 Tar Creek From source to Gale Creek SA;HQW,NSW 03-04-13 3.8 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-31-5 Ditch Creek From source to Gale Creek SA;HQW,NSW 03-04-13 19.0 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-31-5-1 Ditch Creek Canal From Ditch Creek (Jones Bay) to Ditch Creek (Gale Creek) SA;HQW,NSW 03-04-13 0.5 S Miles	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-31a Gale Creek From source to DEH prohibited area line on west side of ICWW SA;HQW,NSW 03-04-13 29.4 S Acres	5	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2004	5
			Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-150-31b1 **Gale Creek** From DEH prohibited area line on west side to new prohibited area line 0.25 miles west of ICWW SA;HQW,NSW 03-04-13 16.7 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-150-31b2 **Gale Creek** From DEH prohibited area line on west side of ICWW to Bay River including east side of ICWW SA;HQW,NSW 03-04-13 172.0 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-32 **Sheeppen Creek** From source to Bay River SA;HQW,NSW 03-04-13 9.7 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-33 **Hogpen Creek** From source to Bay River SA;HQW,NSW 03-04-13 3.9 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-34 **Yaupon Creek** From source to Bay River SA;HQW,NSW 03-04-13 18.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-35 **Dump Creek** From source to Bay River SA;HQW,NSW 03-04-13 84.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-36 **Rockhole Bay** From source to Bay River SA;HQW,NSW 03-04-13 230.1 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-150-37 **Fisherman Bay** From source to Bay River SA;HQW,NSW 03-04-13 64.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Subwatershed (WBD-12 Number) 030202040804 **Jones Bay**

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-150-31-5-1 **Ditch Creek Canal** From Ditch Creek (Jones Bay) to Ditch Creek (Gale Creek) SA;HQW,NSW 03-04-13 0.5 S Miles	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-151 From source to Pamlico Sound SA;HQW,NSW	**Sound Bay**	03-04-13	53.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-152-1 From N. C. Hwy 304 Bridge to Jones Bay SA;HQW,NSW	**Intracoastal Waterway**	03-04-13	7.0 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-152-10 From source to Jones Bay SA;HQW,NSW	**Coot Creek**	03-04-13	0.3 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-152-2 From source to Jones Bay SA;HQW,NSW	**Henry Creek**	03-04-13	1.5 S Acres	**4cs**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-152-3 From source to Jones Bay SA;HQW,NSW	**Bills Creek**	03-04-13	8.1 S Acres	**5**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2004	5
						Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-152-4 From source to Jones Bay SA;HQW,NSW	**Doll Creek**	03-04-13	11.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-152-5 From source to Jones Bay SA;HQW,NSW	**Lambert Creek**	03-04-13	7.4 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-152-6 From source to Jones Bay SA;HQW,NSW	**Ditch Creek**	03-04-13	171.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-152-6-1 From source to Ditch Creek SA;HQW,NSW	**Sheepneck Creek**	03-04-13	15.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-152-6-2 From source to Ditch Creek SA;HQW,NSW	**Dowdy Creek**	03-04-13	7.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Table 40 Neuse River Basin — Subbasin (WBD-8 Number) 03020204 — DWQ Subbasin 03-04-13

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-152-7	**Drum Creek**	From source to Jones Bay	SA;HQW,NSW	03-04-13	59.0 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-152-8	**Little Eve Creek**	From source to Jones Bay	SA;HQW,NSW	03-04-13	24.9 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-152-9	**Little Drum Creek**	From source to Jones Bay	SA;HQW,NSW	03-04-13	20.6 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-152a	**Jones Bay**	From source to 0.2 miles downstream of ICWW	SA;HQW,NSW	03-04-13	17.3 S Acres	5	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2008	5
								Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-152b	**Jones Bay**	From 0.2 miles downstream of ICWW to Pamlico Sound	SA;HQW,NSW	03-04-13	2,865.7 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Subwatershed (WBD-12 Number) 030202040805 — Middle Bay

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-153	**Fishing Bay**	From source to Pamlico Sound	SA;HQW,NSW	03-04-13	63.0 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-154	**Middle Bay**	From source to Pamlico Sound	SA;HQW,NSW	03-04-13	535.5 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-154-1	**Capp Creek**	From source to Middle Bay	SA;HQW,NSW	03-04-13	11.0 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-154-1-1	**Leary Canal**	From Porpoise Creek to Capp Creek	SA;HQW,NSW	03-04-13	0.9 S Miles	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-154-2 From source to Middle Bay SA;HQW,NSW	03-04-13	**Preston Bay**	9.0 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-154-3 From source to Middle Bay SA;HQW,NSW	03-04-13	**Flower Bay**	21.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-154-4 From source to Middle Bay SA;HQW,NSW	03-04-13	**Roundabout Bay**	33.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-154-5 From source to Middle Bay SA;HQW,NSW	03-04-13	**Little Oyster Creek**	62.4 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-155 From source to Pamlico Sound SA;HQW,NSW	03-04-13	**Big Oyster Creek**	55.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-156 From source to Pamlico Sound SA;HQW,NSW	03-04-13	**Big Porpoise Bay**	661.7 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-156-1 From source to Big Porpoise Bay SA;HQW,NSW	03-04-13	**Porpoise Creek**	24.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	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.

subbasin. Refer to 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 40 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.

13.2 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 more information about the use support assessment, refer to 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 41 for a summary of use support for waters in subbasin 03-04-13 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

13.3 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 303(d) 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.

Table 41 Summary of Use Support Ratings in Subbasin 03-04-13

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
Estuarine miles	1	0	0.0	1	39	0	2	4
Estuarine acres	81,645	1,215	2	80,430	96	0	1,801	83,446

% - Percent of total miles/acres.

13.3.1 Bay River [AU# 27-150-(9.5)a2]

Current Status

Bay River [AU# 27-150-(9.5)a2; SA; HQW; NSW] from a line crossing Bay River from Newton Creek to a point 0.3 miles upstream of Moore Creek to Pamlico Sound (8,304.9 saltwater acres) is Supporting aquatic life and recreational uses due to No Criteria Exceeded at ambient monitoring station JA99. Water quality was generally good in this segment with only 2 percent of the samples exceeding the chlorophyll *a* standard of 40µg/l. None of the fecal coliform bacteria samples taken exceeded to state standard of 400 CFU/100ml. The geometric mean was 4 CFU/100ml.

This segment of Bay River is Impaired for shellfish harvesting due to fecal coliform bacteria levels above the state standard of 43 CFU/100ml in more than 10 percent of the samples collected in SA waters. There are 8 DEH SS stations within this segment and 4 of the 8 had exceedances of 10 percent or more during this assessment period. This impairment is based on actual fecal coliform bacteria data and not on DEH SS growing area classifications.

This section of the Bay River will be added to the 2008 303(d) list of impaired waters for shellfish harvesting closures: fecal coliform bacteria standard violation.

Recommendations
DWQ recommends the use of BMPs throughout this watershed to reduce stormwater runoff which carries bacteria which leads to shellfish harvesting and beach closures.

13.3.2 Bay River [AU# 27-150-(9.5)b2]

Current Status
Bay River [AU# 27-150-(9.5)b2; SA; HQW; NSW] from the DEH prohibited area along shore of Log Pond Creek area (16.5 saltwater acres) in Impaired for recreational purpose due to DEH posting a swimming advisory for more than 61 days over the 5 year assessment period and a geometric mean of greater than 35 enterococci/100 ml (based on 5 samples collected in a 30 day period).

The Camp Vandemere public beach area (DEH station # C114) on the north side of the Bay River had 64 days of swimming advisories posted by DEH. This same location had a geometric mean of greater than 35 enterococci/100 ml on more that one occasion. This is a Tier 2 site so it is monitored twice a month between April and October and once per month November through March. These beaches are monitored weekly after an advisory is issued until levels fall below the standard. The coastal recreational beach monitoring program uses enterococcus bacteria as the indicator species. The criteria for Tier 2 is a single sample maximum of 276 enterococci/100 ml water. Tier 2 beaches constitute areas such as those in the Intracoastal Waterway, tidal creeks and exposed shoals. People frequent Tier 2 beaches mostly on weekends and these sites are usually accessed by watercraft.

DEH recreational closings and data can be found at http://www.deh.enr.state.nc.us/shellfish/Water_Monitoring/RWQweb/aboutus.htm. The state Division of Environmental Health tests water quality at ocean and sound beaches in accordance with federal and state law. Enterococcus and fecal coliform, the bacteria group used for testing, is found in the intestines of warm-blooded animals. While they do not cause illness themselves, scientific studies indicate that enterococci and fecal coliform bacteria may indicate the presence of other disease-causing organisms. People swimming or playing in waters with bacteria levels higher than the action level have an increased risk of developing gastrointestinal illness or skin infections. This is a swimming advisory, not a beach closing. The sign posted reads as follows: ATTENTION - SWIMMING IN THIS AREA NOT RECOMMENDED. BACTERIA TESTING INDICATES LEVELS OF CONTAMINATION THAT MAY BE HAZARDOUS TO YOUR HEALTH. THIS ADVISORY AFFECTS WATERS WITHIN 200' OF THIS SIGN. OFFICE OF THE STATE HEALTH DIRECTOR.

13.3.3 Division of Environmental Health Growing Area F-6

Table 42 Shellfish Growing Area F-6 Classifications

Class SA Water	Assessment Unit #	AU Length	Growing Area Classification[1]	DWQ Shellfish Rating[2]	DEH Growing Area
PAMLICO SOUND	27-147.5a	64244.00	APP	S	F-3, F-6
Bay River	27-150-(9.5)a	672.02	PRO	I	F-6
Bay River	27-150-(9.5)a	8304.92	APP	S	F-6
Bay River	27-150-(9.5)b	100.00	PRO	I	F-6
Bay River	27-150-(9.5)b	16.50	PRO	I	F-6
Harper Creek	27-150-10	32.51	PRO	I	F-6
Tempe Gut	27-150-11	0.90	PRO	I	F-6
Moore Creek	27-150-12	28.35	PRO	I	F-6
Chappel Creek	27-150-12-1	1.48	PRO	I	F-6
Newton Creek	27-150-13	3.78	PRO	I	F-6
Little Pasture Creek	27-150-17	6.04	APP	S	F-6
Rice Creek	27-150-18	12.84	APP	S	F-6
Mesic Creek	27-150-19	4.26	APP	S	F-6
Simpson Creek	27-150-20-1	8.60	PRO	I	F-6
Pasture Creek	27-150-20-2	9.32	APP	S	F-6
Cabin Creek	27-150-20-3	30.49	APP	S	F-6
Ball Creek	27-150-20	32.42	PRO	I	F-6
Ball Creek	27-150-20	79.97	APP	S	F-6
Harris Creek	27-150-21	2.81	APP	S	F-6
Gascon Creek	27-150-22	3.24	APP	S	F-6
Barnes Creek	27-150-23	1.51	APP	S	F-6
Potter Creek	27-150-24	13.71	APP	S	F-6
Oyster Creek	27-150-25	19.56	APP	S	F-6
Bonner Bay	27-150-26	865.27	APP	S	F-6
Spring Creek	27-150-26-1	279.02	APP	S	F-6
Richardson Creek	27-150-26-1-1	8.88	APP	S	F-6
Maul Run	27-150-26-1-2	1.15	APP	S	F-6
Horton Creek	27-150-26-1-3	4.59	APP	S	F-6
Bryan Creek	27-150-26-1-4	13.17	APP	S	F-6
Ives Creek	27-150-26-1-4-1	8.55	APP	S	F-6
Long Creek	27-150-26-2	356.80	APP	S	F-6
Deep Oak Gut	27-150-26-2-1	2.22	APP	S	F-6
Cow Gallus Creek	27-150-26-2-2	11.41	APP	S	F-6
Dipping Vat Creek	27-150-26-2-3	26.90	APP	S	F-6
Riggs Creek	27-150-26-3	115.19	APP	S	F-6
Savannah Creek	27-150-26-3-1	11.03	APP	S	F-6
Morris Creek	27-150-26-3-2	5.39	APP	S	F-6
Raff Creek	27-150-26-3-3	10.86	APP	S	F-6
Sheephead Creek	27-150-26-4	18.65	APP	S	F-6
Little Bear Creek	27-150-27	55.33	APP	S	F-6
Blossum Pond Creek	27-150-27-1	15.09	APP	S	F-6
Bennett Creek	27-150-28-1	15.66	PRO	I	F-6

Class SA Water	Assessment Unit #	AU Length	Growing Area Classification[1]	DWQ Shellfish Rating[2]	DEH Growing Area
Win Creek	27-150-28-2	1.16	PRO	I	F-6
Plum Creek	27-150-28-3	8.13	APP	S	F-6
Riggs Creek	27-150-28-4	23.18	APP	S	F-6
Cox Creek	27-150-28-5	3.40	APP	S	F-6
Garden Creek	27-150-28-6	6.42	APP	S	F-6
Harper Creek	27-150-28-7	4.05	APP	S	F-6
Catchall Creek	27-150-28-8	4.59	APP	S	F-6
Bear Creek	27-150-28a	199.91	PRO	I	F-6
Bear Creek	27-150-28b	18.19	PRO	I	F-6
Bear Creek	27-150-28b	168.51	APP	S	F-6
Chadwick Creek	27-150-29	54.42	APP	S	F-6
No Jacket	27-150-30	13.32	APP	S	F-6
Jumpover Creek	27-150-31-1-1	7.71	APP	S	F-6
Intracoastal Waterway	27-150-31-1	2.04	PRO	I	F-6
Intracoastal Waterway	27-150-31-1	81.84	APP	S	F-6
Raccoon Creek	27-150-31-2	8.09	APP	S	F-6
Whealton Creek	27-150-31-3	7.57	APP	S	F-6
Tar Creek	27-150-31-4	3.85	APP	S	F-6
Ditch Creek	27-150-31-5	19.03	APP	S	F-6
Gale Creek	27-150-31a	29.40	PRO	I	F-6
Gale Creek	27-150-31b	16.65	PRO	I	F-6
Gale Creek	27-150-31b	172.01	APP	S	F-6
Sheeppen Creek	27-150-32	9.72	APP	S	F-6
Hogpen Creek	27-150-33	3.86	APP	S	F-6
Yaupon Creek	27-150-34	18.65	APP	S	F-6
Dump Creek	27-150-35	84.15	APP	S	F-6
Rockhole Bay	27-150-36	230.14	APP	S	F-6
Sound Bay	27-151	53.60	APP	S	F-6
Intracoastal Waterway	27-152-1	6.97	PRO	I	F-6
Coot Creek	27-152-10	0.31	APP	S	F-6
Henry Creek	27-152-2	1.49	PRO	I	F-6
Bills Creek	27-152-3	8.09	PRO	I	F-6
Doll Creek	27-152-4	11.17	APP	S	F-6
Lambert Creek	27-152-5	7.36	APP	S	F-6
Ditch Creek	27-152-6	171.21	APP	S	F-6
Sheepneck Creek	27-152-6-1	15.60	APP	S	F-6
Dowdy Creek	27-152-6-2	7.54	APP	S	F-6
Drum Creek	27-152-7	58.98	APP	S	F-6
Little Eve Creek	27-152-8	24.90	APP	S	F-6
Little Drum Creek	27-152-9	20.60	APP	S	F-6
Jones Bay	27-152	17.31	PRO	I	F-6
Jones Bay	27-152	2865.66	APP	S	F-6

1 - Growing Area Classifications: APP – Approved; CAO – Conditionally Approved-Open; CAC – Conditionally Approved-Closed; RES – Restricted; PRO- Prohibited.
2 - DWQ Shellfish Rating: S – Supporting; I - Impaired

The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area F-6. If the entire Class SA water is located within more than one growing area it is noted in Table 42 above. See shellfish harvesting use support and growing area map in Chapter 10 section 10.3.4 (Figures 17 and 18).

According to the ***Sanitary Survey of Neuse River Area, Area F-6,*** *(DEH. Shellfish Sanitation Unit, January 2006)*, there have been little water quality changes since the last survey. This area is located entirely in Pamlico County and includes waters of the Bay River, Jones Bay, Vandemere Creek, Ball Creek, Bonner Bay, Fisherman Bay, and Bear Creek, as well as a series of smaller creeks and tributaries. The watershed is approximately 60 square miles, and is dominated by agricultural and silviculture operations. Oyster production is fair but localized, and much of the commercial catch comes from the lower portion of the area.

Population in the region continues to grow at a slow rate. Bayboro and Vandemere are the largest towns and the greatest residential concentration is the area found on the south side of Bay River. With the exception of Hobucken, the area surrounding Jones Bay is predominantly rural, with most development concentrated along the main roads.

No new subdivisions have been built since the 2001 survey. A total of 14 new homes have been constructed within the growing area. Approximately 500 homes were destroyed in 2003 due to Hurricane Isabel. This is very low-lying area and most subdivisions have minimal stormwater control consisting of grassy swales and riprap retention. The initial impacts from lot clearing and road construction probably have the greatest impact on water quality in this region.

The Bay River Metropolitan Sewer District (BRMSD) continues to provide service for the towns of Bayboro and Vandemere, as well as along the main roads surrounding Bay River. The BRMSD stopped discharging into the Bay River and now all treated effluent is land applied on pine fields near the town of Arapahoe. The BRMSD reported no major problems aside from hurricanes. No failing on-site wastewater systems were found in throughout this growing area as well. Three stations were added in 2001 to monitor water quality after the removal of the WWTP discharge. Sampling was dropped in 2005 after sampling indicated no improvement in water quality.

A hobby farm located near Harper Point housed numerous birds and goats. This land is located adjacent to open shellfish waters, and there is a ditch draining the area around the animal pens. During the survey, this ditch appeared highly eutrophic. A herd of approximately 20 goats located on land near to marsh off of Old Hobucken Road is close to the Bear Creek closed shellfish area. Both of these farms are likely impacting water quality in there area.

There are numerous private docks and five larger marinas associated with commercial fishing operations, including Bayboro Harbor, Pamlico Packing, Pate Boatyard, Hobucken Marina, and R.E. Mayo Co.

Seasonally, a significant number of migratory waterfowl utilize the marshes, creeks, and impoundments of the region as temporary stopovers. Domestic pets and wild animals both contribute to fecal loading throughout much of this area.

Rainfall normally has little effect on the approved waters of this area except during extremely heavy rainfall evens (hurricanes or other severe coastal storm events) which cause temporary closures.

Water quality in the creeks and along the shore in area F-6 continues to decline and results from stations added recently indicate the need for further closures.

As result of the shellfish report, the closure line in the Bay River and Ball Creek were shifted further downstream. An additional closure was added to Jones Bay, with the closure of the

Intracoastal Waterway just north of the Highway 33 bridge, as well as to just south of the intersection with Jones Bay and will extend out into Jones Bay.

13.3.4 Division of Environmental Health Growing Area F-7

Table 43 Shellfish Growing Area F-7 Classifications

Class SA Water	Assessment Unit #	AU Length	Growing Area Classification[1]	DWQ Shellfish Rating[2]	DEH Growing Area
Fishing Bay	27-153	63.01	APP	S	F-7
Middle Bay	27-154	535.46	APP	S	F-7
Capp Creek	27-154-1	10.97	APP	S	F-7
Preston Bay	27-154-2	8.99	APP	S	F-7
Flower Bay	27-154-3	21.60	APP	S	F-7
Roundabout Bay	27-154-4	33.56	APP	S	F-7
Little Oyster Creek	27-154-5	62.39	APP	S	F-7
Big Oyster Creek	27-155	55.48	APP	S	F-7
Big Porpoise Bay	27-156	661.75	APP	S	F-7
Porpoise Creek	27-156-1	24.16	APP	S	F-7
Little Porpoise Bay	27-157	176.14	APP	S	F-7
West Bay	27-148	16359.32	APP	S	F-7

1 - Growing Area Classifications: APP – Approved; CAO – Conditionally Approved-Open; CAC – Conditionally Approved-Closed; RES – Restricted; PRO- Prohibited.
2 - DWQ Shellfish Rating: S – Supporting; I - Impaired

The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area F-7. If the entire Class SA water is located within more than one growing area it is noted in Table 43 above. See shellfish harvesting use support and growing area map in Chapter 10 section 10.3.4 (Figures 17 and 18).

There is no shoreline is shellfish growing Area F-7. DEH uses results from the surrounding growing areas to make decisions on Area 7. None of the recent 2006 sanitary surveys of Neuse River shellfish areas reported any changes made within the shellfish Area F-7

13.4 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.

There was only a single ambient monitoring station assessed by DWQ during this assessment period. DEH collect data for the assessment of the recreational and shellfish harvesting. These are reported above. All the waters within this subbasin are classified as SA or shellfish harvesting waters. These waters are affected by all potential bacterial contamination sources.

Recommendation
DWQ recommends the use of BMPs throughout this watershed to reduce stormwater runoff which carries bacteria which leads to shellfish harvesting and beach closures.

13.5 Additional Water Quality Issues within Subbasin 03-04-13

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.

13.5.1 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.

Chapter 14
Neuse River Subbasin 03-04-14
Including the: Thorofare and West Thorofare Bay

14.1 Subbasin Overview

Subbasin 03-04-14 at a Glance

Land Cover (percent)

Forest/Wetland:	16.6
Surface Water:	81.0
Urban:	0.1
Cultivated Cropland:	1.4
Pasture/ Managed Herbaceous:	0.1

Counties

Carteret and Pamlico

Stream Statistics

Total Streams:	18.6 mi/171,418.8 ac
Total Supporting:	168,883.3 ac
Total Impaired:	18.6 mi/2,535.5 ac
Total Not Rated:	0.0 mi/ 0.0 ac
Total No Data:	0.0 mi/ 0.0 ac

There is very little land area in this subbasin and no large communities.

There is 1 minor NPDES wastewater discharge permit in this subbasin and no permitted animal operations.

Based on shellfish harvesting data, there has been little water quality change since the last assessment. These areas are rather remote and are generally not affected by freshwater runoff due to the small watershed and lack of major tributaries.

The North Carolina State Division of Environmental Health (DEH) is responsible for classifying coastal waters as to their suitability for shellfish harvesting, monitoring and issuing advisories for coastal recreational swimming areas. In this subbasin DEH only monitors for shellfish harvesting. Shellfish closures are based on public health principles and are designed to prevent human illness associated with the consumption of shellfish. Shellfish area closures are based on fecal coliform bacteria concentrations. Marinas, domestic pets, migratory waterfowl and other wild animals contribute to the bacterial loading throughout much of this area.

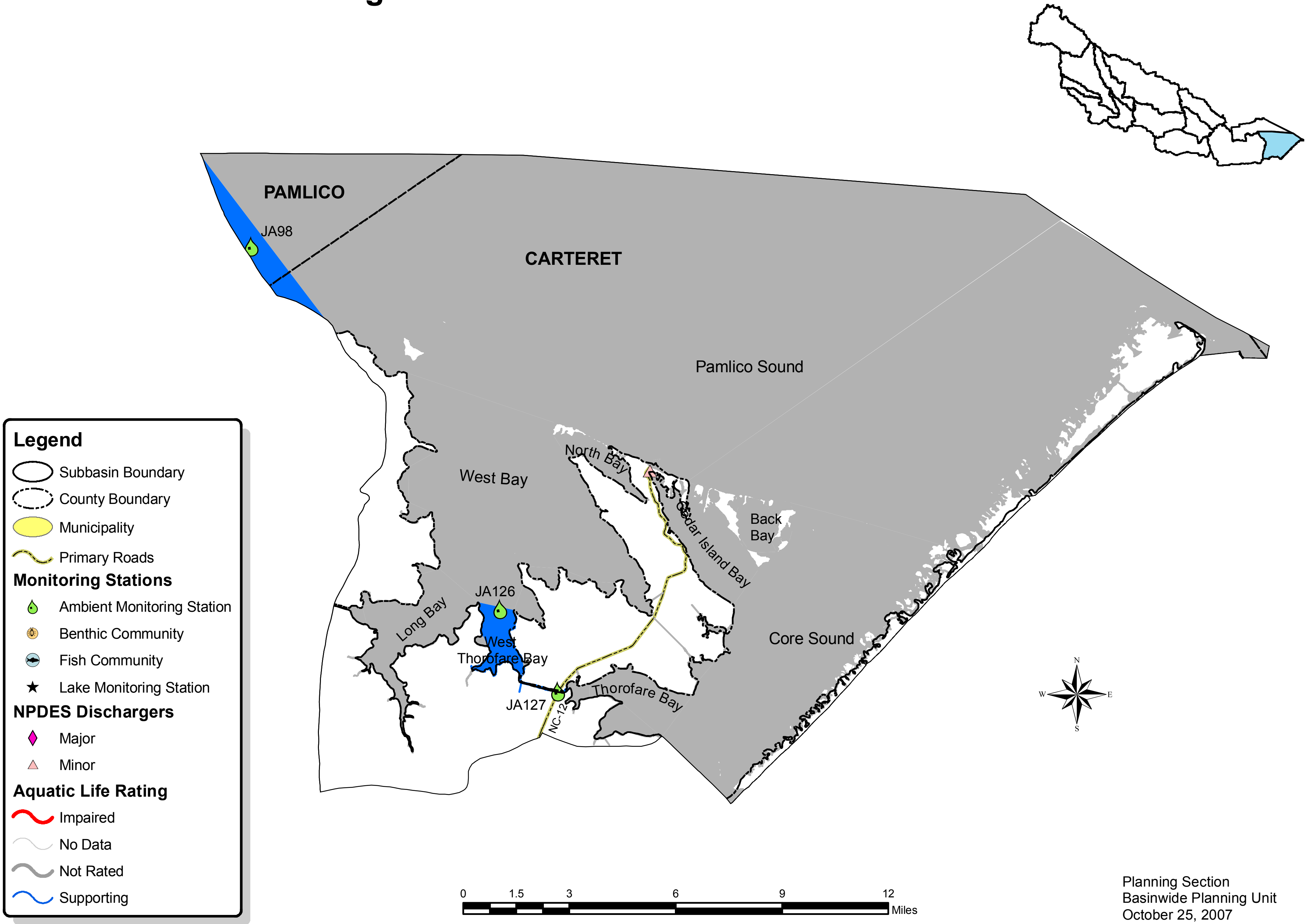
A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 36. Table 44 contains a list of assessment unit numbers (AU#) and length, streams monitored, monitoring data types, locations and use support ratings for waters in the subbasin. Refer to http://h2o.enr.state.nc.us/tmdl/General_303d.htm for more information about use support methodology.

Waters in the following sections and in Table 44 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.

14.2 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 more information about the use support assessment, refer to http://h2o.enr.state.nc.us/tmdl/General_303d.htm. Appendix X provides definitions of the terms used throughout this basin plan.

Figure 36 Neuse River Subbasin 03-04-14



Planning Section
Basinwide Planning Unit
October 25, 2007

Watershed (WBD-10 Number) 0302010502 Pamlico Sound-Ocracoke Inlet

Subwatershed (WBD-12 Number) 030201050206 Town of Portsmouth-Portsmouth Island

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-148.5	**Neuse-Southeast Pamlico Sound ORW Area**	All waters within a line beginning at the southwest tip of Ocracoke Island, and extending northwest along the Tar-Pamlico River Basin and Neuse River Basin boundary line to Lat. 35 06'50", Long 76 06'30", thence in a southwest direction to Ship Point	SA;ORW,NSW	03-04-14	38,582.8 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Watershed (WBD-10 Number) 0302010504 Cape Lookout Shoals-Core Banks

Subwatershed (WBD-12 Number) 030201050401 Core Banks-Drum Inlet

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-149	**Core Sound**	From Northeastern limit of White Oak River Basin (a line from Hall Point to Drum Inlet) to Pamlico Sound	SA;ORW,NSW	03-04-14	18,201.7 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-1	**Thorofare Bay**	From source to Core Sound	SA;ORW,NSW	03-04-14	1,674.5 S Acres	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2008	4cs
27-149-1-1	**Thorofare**	From West Thorofare Bay to Thorofare Bay	SA;HQW,NSW	03-04-14	34.9 S Acres	4cs	**Fecal Coliform Bacteria** Stormwater Runoff **Nickel**	Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
								Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-149-1-2	**Merkle Hammock Creek**	From source to Thorofare Bay	SA;NSW,ORW	03-04-14	186.0 S Acres	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2008	4cs
27-149-1-3	**Barry Bay**	From source to Thorofare Bay	SA;ORW,NSW	03-04-14	606.6 S Acres	4cs	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2008	4cs
27-149-2	**Rumley Bay**	From source to Core Sound	SA;ORW,NSW	03-04-14	167.7 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number / Name / Description / Classification / DWQ Subbasin / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-149-2-1 **John Day Ditch** From source to Rumley Bay SA;HQW,NSW 03-04-14 2.4 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-3 **Lewis Creek** From source to Core Sound SA;ORW,NSW 03-04-14 72.3 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-3-1 **Southwest Prong Lewis Creek** From source to Lewis Creek SA;ORW,NSW 03-04-14 11.8 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-3-2 **Big Gut** From source to Lewis Creek SA;HQW,NSW 03-04-14 1.9 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-4 **Cedar Island Bay** Entire Bay, including all inlets, coves, and bays, not otherwise named in the schedule of classifications SA;ORW,NSW 03-04-14 2,857.0 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-4-1 **Great Pond** From source to Cedar Island Bay SA;ORW,NSW 03-04-14 3.0 S Acres	5	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2008	5
			Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-149-4-2 **Back Bay** Entire Bay, including all inlets, coves, and bays, not otherwise named in the schedule of classifications SA;ORW,NSW 03-04-14 850.6 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-4-2-1 **Great Pond** From Pamlico Sound to Back Bay SA;ORW,NSW 03-04-14 42.5 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-4-2-10 **Hog Island Narrows** From Cedar Island Bay to Back Bay SA;ORW,NSW 03-04-14 11.5 S Acres	2		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-149-4-2-2	**Noras Cove**	Entire Cove	SA;ORW,NSW	03-04-14	29.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-4-2-3	**End of Island Slough**	From Pamlico Sound to Back Bay	SA;ORW,NSW	03-04-14	2.8 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-4-2-4	**Snake Gut**	From Pamlico Sound to Back Bay	SA;ORW,NSW	03-04-14	4.8 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-4-2-7	**Drum Pond**	From source to Back Bay	SA;ORW,NSW	03-04-14	0.3 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-4-2-8	**Goose Bay**	Entire Bay	SA;ORW,NSW	03-04-14	33.4 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-4-2-8-1	**Oyster Creek**	From Core Sound to Goose Bay	SA;ORW,NSW	03-04-14	45.8 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-149-4-2-9	**Great Ditch**	From Core Sound to Goose Bay	SA;ORW,NSW	03-04-14	47.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Watershed (WBD-10 Number) 0302020407 Neuse River

Subwatershed (WBD-12 Number) 030202040704 Turnagain Bay-Rattan Bay

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-148-1-6-1a	**Old Canal**	From Turnagain Bay to 0.6 miles towards Stump Bay	SA;HQW,NSW	03-04-14	6.4 S Acres	**4cs**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Cond Approved-Open Growing Area	2006	2004	4cs
27-148-1-6-1b	**Old Canal**	From Stump Bay to 0.4 miles towards Turnagain Bay	SA;HQW,NSW	03-04-14	4.0 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Watershed (WBD-10 Number) 0302020409 Neuse River-Pamlico Sound

Subwatershed (WBD-12 Number) 030202040901 West Thorofare Bay-Long Bay

Assessment Unit Number / Description / Classification	Name	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-148 From source to Pamlico Sound SA;HQW,NSW	**West Bay**	03-04-14	16,359.3 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-1 From source to West Bay SA;HQW,NSW	**Long Bay**	03-04-14	3,227.8 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-1-1 From source to Long Bay SA;HQW,NSW	**Flag Creek**	03-04-14	4.7 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-1-2 From source to Long Bay SA;HQW,NSW	**Golden Creek**	03-04-14	9.7 S Acres	**5**	**Fecal Coliform Bacteria** Stormwater Runoff	Shellfish Harvesting	Impaired	Standard Violation	Fecal Coliform (shellfish)	2006	2004	5
						Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-148-1-3 From source to Long Bay SA;HQW,NSW	**Benneys Creek**	03-04-14	2.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-1-4 From source to Long Bay SA;HQW,NSW	**Henrys Creek**	03-04-14	2.7 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-1-5 From source to Long Bay SA;HQW,NSW	**Fur Creek**	03-04-14	7.3 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-1-6 From source to Long Bay SA;HQW,NSW	**Stump Bay**	03-04-14	101.8 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-1-6-1b From Stump Bay to 0.4 miles towards Turnagain Bay SA;HQW,NSW	**Old Canal**	03-04-14	4.0 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-148-1-7	**Piney Island Bay**	From source to Long Bay	SA;HQW,NSW	03-04-14	57.7 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-1-8	**Owens Bay**	From source to Long Bay	SA;HQW,NSW	03-04-14	74.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-1-9	**Jacks Bay**	From source to Long Bay	SA;HQW,NSW	03-04-14	61.0 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-2-1	**Bull Creek**	From source to West Thorofare Bay	SA;HQW,NSW	03-04-14	13.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-2-2	**Cadduggen Creek**	From source to West Thorofare Bay	SA;HQW,NSW	03-04-14	2.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-2-3	**Goose Bay**	From source to West Thorofare Bay	SA;HQW,NSW	03-04-14	46.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-2a	**West Thorofare Bay**	From source 0.4 miles downstream of source	SA;HQW,NSW	03-04-14	1.8 S Acres	**4cs**	**Fecal Coliform Bacteria** / Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
27-148-2b	**West Thorofare Bay**	From 0.03 miles downstream of source to West Bay	SA;HQW,NSW	03-04-14	1,016.3 S Acres	**2**		Aquatic Life	Supporting	No Criteria Exceeded	Water Quality Standards Aquatic Life	2006		1
								Recreation	Supporting	No Criteria Exceeded	Fecal Coliform (recreation)	2006		1
								Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-3	**Merkle Bay**	From source to West Bay	SA;HQW,NSW	03-04-14	336.1 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Subwatershed (WBD-12 Number) **030202040902** **Cedar Island-West Bay**

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-147.5b	**PAMLICO SOUND**	Southern portion Pamlico within Neuse River Basin subbasin 030414 with the exception of DEH prohibited area at mouth of Cedar Island Ferry Harbor	SA;HQW,NSW	03-04-14	84,692.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-10	**North Bay**	From source to West Bay	SA;HQW,NSW	03-04-14	958.4 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-4	**Deep Bend**	From source to West Bay	SA;HQW,NSW	03-04-14	241.2 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-5	**Nameless Bay**	From source to West Bay	SA;HQW,NSW	03-04-14	75.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-6	**Green Point Cove**	From source to West Bay	SA;HQW,NSW	03-04-14	100.3 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-7	**Dowdy Bay**	From source to West Bay	SA;HQW,NSW	03-04-14	157.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-8	**Point of Island Bay**	From source to West Bay	SA;HQW,NSW	03-04-14	115.5 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
27-148-9	**Newstump Bay**	From source to West Bay	SA;HQW,NSW	03-04-14	176.6 S Acres	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1

Subwatershed (WBD-12 Number) 030202040903 Portsmouth Island-Pamlico Sound

Assessment Unit Number	Name	Description	Classification	DWQ Subbasin	Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-147.5c	**PAMLICO SOUND**	DEH prohibited area at Cedar Island Ferry Harbor in southern portion Pamlico within Neuse River Basin subbasin 030414	SA;HQW,NSW	03-04-14	12.5 S Acres	**4cs**	**Fecal Coliform Bacteria** Marina Stormwater Runoff	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-149-4-2-5		**Fullers Ditch**	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
From Pamlico Sound to Back Bay											
SA;ORW,NSW	03-04-14	6.9 S Acres									
27-149-4-2-6		**The Passage**	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
From Pamlico Sound to Back Bay											
SA;ORW,NSW	03-04-14	70.6 S Acres									
27-149-4-2-6-1		**Deep Slough**	**2**		Shellfish Harvesting	Supporting	No Criteria Exceeded	Approved Growing Area	2006		1
From Pamlico Sound to The Passage											
SA;ORW,NSW	03-04-14	3.8 S Acres									

Subwatershed (WBD-12 Number) 030202040904 Neuse River-Pamlico Sound

Assessment Unit Number / Description / Classification	DWQ Subbasin	Name / Miles/Acres	Overall Category	Potential Stressors / Potential Sources	Use Support Category	Use Support Rating	Reason for Rating	Parameter of Interest	Collection Year	Listing Year	IR Category
27-147.5c		**PAMLICO SOUND**	**4cs**	**Fecal Coliform Bacteria**	Shellfish Harvesting	Impaired	Loss of Use	Prohibited Growing Area	2006	2004	4cs
DEH prohibited area at Cedar Island Ferry Harbor in southern portion Pamlico within Neuse River Basin subbasin 030414				Marina							
				Stormwater Runoff							
SA;HQW,NSW	03-04-14	12.5 S Acres									

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.

Refer to Table 45 for a summary of use support for waters in subbasin 03-04-14 (see Chapter 23, Section 23.3 for description of the IR category (for each parameter of interest) and Overall (river segment) category).

14.3 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 303(d) 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.

Table 45 Summary of Use Support Ratings in Subbasin 03-04-14

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
Estuarine River miles	19	19	100.0	0	0.0	0	0	19
Estuarine acres	171,419	2,536	1	168,883	99	0	0	171,419

% - Percent of total miles/acres.

14.3.1 Division of Environmental Health Growing Area F-3

Table 46 Shellfish Growing Area F-3 Classifications

Class SA Water	Assessment Unit #	AU Length	Growing Area Classification[1]	DWQ Shellfish Rating[2]	DEH Growing Area
Turnagain Bay	27-137	1556.75	CAO	I	F-2, F-3
PAMLICO SOUND	27-147.5a	64244.00	APP	S	F-3, F-6
PAMLICO SOUND	27-147.5b	84692.50	APP	S	F-2, F-3, F-4
Long Bay	27-148-1	3227.79	APP	S	F-3
Flag Creek	27-148-1-1	4.74	APP	S	F-3
Golden Creek	27-148-1-2	9.70	APP	S	F-3
Golden Creek	27-148-1-2	9.70	APP	S	F-3
Benneys Creek	27-148-1-3	2.60	APP	S	F-3
Henrys Creek	27-148-1-4	2.75	APP	S	F-3
Fur Creek	27-148-1-5	7.33	APP	S	F-3
Stump Bay	27-148-1-6	101.83	APP	S	F-3
Old Canal	27-148-1-6-1a	6.43	CAO	I	F-3
Old Canal	27-148-1-6-1b	4.05	APP	S	F-3
Piney Island Bay	27-148-1-7	57.75	APP	S	F-3
Owens Bay	27-148-1-8	74.46	APP	S	F-3
Jacks Bay	27-148-1-9	61.00	APP	S	F-3
Bull Creek	27-148-2-1	13.18	APP	S	F-3
Caddugen Creek	27-148-2-2	2.52	APP	S	F-3

Class SA Water	Assessment Unit #	AU Length	Growing Area Classification[1]	DWQ Shellfish Rating[2]	DEH Growing Area
Goose Bay	27-148-2-3	46.22	APP	S	F-3
West Thorofare Bay	27-148-2a	1.82	PRO	I	F-3
West Thorofare Bay	27-148-2b	1016.35	APP	S	F-3
Merkle Bay	27-148-3	336.14	APP	S	F-3
Deep Bend	27-148-4	241.24	APP	S	F-3
Nameless Bay	27-148-5	75.46	APP	S	F-3
Green Point Cove	27-148-6	100.28	APP	S	F-3
Dowdy Bay	27-148-7	157.61	APP	S	F-3
Point of Island Bay	27-148-8	115.48	APP	S	F-3
Newstump Bay	27-148-9	176.60	APP	S	F-3
Thorofare	27-149-1-1	34.92	PRO	I	F-3, F-4

1 - Growing Area Classifications: APP – Approved; CAO – Conditionally Approved-Open; CAC – Conditionally Approved-Closed; RES – Restricted; PRO- Prohibited.
2 - DWQ Shellfish Rating: S – Supporting; I - Impaired

The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area F-3. If the entire Class SA water is located within more than one growing area it is noted in Table 46 above. See shellfish harvesting use support and growing area map in Chapter 10 section 10.3.4 (Figures 17 and 18).

According to the ***Sanitary Survey of Neuse River Area, Area F-3 & F-4,*** *(DEH. Shellfish Sanitation Unit, September 2006)*, there have been little water quality changes since the last survey. These areas are rather remote and are generally not affected by freshwater runoff due to the small watershed and lack of major tributaries. Rainfall normally has little effect on the approved waters of this area except during extremely heavy rainfall evens (hurricanes or other severe coastal storm events), which cause temporary closures.

Area F-3 is composed of waters of the West Bay area and covers approximately 30 square miles. This area is predominately marsh and open water, with little human presence (permanent population is less than 100) that is not expected to change in the future. Oyster production is considered fair, and there is no commercial clam production in the West Bay area.

There are no marinas, however there is one large docking facility at Piney Island as well as a smaller docking area and boat ramp on the mainland. The wastewater treatment facility on Piney Island appears to be functioning well as were all the individual onsite wastewater system in the area F-3.

Stormwater runoff from a small portion of Open Grounds Farm drains into the head of Long Bay, and could contain high levels of bacteria and nutrients. Given this area is predominately marsh and open water, there are an abundant of waterfowl and small mammals that may contribute fecal coliform bacteria to this watershed as well.

Assessment of the shellfish harvesting area F-3 resulted in little change in bacterial water quality.

14.3.2 Division of Environmental Health Growing Area F-4

Table 47 Shellfish Growing Area F-4 Classifications

Class SA Water	Assessment Unit #	AU Length	Growing Area Classification[1]	DWQ Shellfish Rating[2]	DEH Growing Area
PAMLICO SOUND	27-147.5b	84692.50	APP	S	F-2, F-3, F-4
PAMLICO SOUND	27-147.5c	12.50	PRO	I	F-4
Neuse-Southeast Pamlico Sound ORW Area	27-148.5	38582.81	APP	S	F-4
North Bay	27-148-10	958.44	APP	S	F-4
Core Sound	27-149	18201.66	APP	S	F-4
Thorofare Bay	27-149-1	1674.52	CAO	I	F-4
Thorofare	27-149-1-1	34.92	PRO	I	F-3, F-4
Merkle Hammock Creek	27-149-1-2	185.99	CAO	I	F-4
Barry Bay	27-149-1-3	606.61	CAO	I	F-4
Rumley Bay	27-149-2	167.69	APP	S	F-4
John Day Ditch	27-149-2-1	2.45	APP	S	F-4
Lewis Creek	27-149-3	72.30	APP	S	F-4
Southwest Prong Lewis Creek	27-149-3-1	11.77	APP	S	F-4
Big Gut	27-149-3-2	1.91	APP	S	F-4
Cedar Island Bay	27-149-4	2856.95	APP	S	F-4
Great Pond	27-149-4-1	2.97	PRO	I	F-4
Back Bay	27-149-4-2	850.55	APP	S	F-4
Great Pond	27-149-4-2-1	42.54	APP	S	F-4
Hog Island Narrows	27-149-4-2-10	11.49	APP	S	F-4
Noras Cove	27-149-4-2-2	29.56	APP	S	F-4
End of Island Slough	27-149-4-2-3	2.76	APP	S	F-4
Snake Gut	27-149-4-2-4	4.80	APP	S	F-4
Fullers Ditch	27-149-4-2-5	6.92	APP	S	F-4
The Passage	27-149-4-2-6	70.65	APP	S	F-4
Deep Slough	27-149-4-2-6-1	3.83	APP	S	F-4
Drum Pond	27-149-4-2-7	0.26	APP	S	F-4
Goose Bay	27-149-4-2-8	33.35	APP	S	F-4
Oyster Creek	27-149-4-2-8-1	45.82	APP	S	F-4
Great Ditch	27-149-4-2-9	47.62	APP	S	F-4

1 - Growing Area Classifications: APP – Approved; CAO – Conditionally Approved-Open; CAC – Conditionally Approved-Closed; RES – Restricted; PRO- Prohibited.
2 - DWQ Shellfish Rating: S – Supporting; I – Impaired.

The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area F-4. If the entire Class SA water is located within more than one growing area it is noted in Table 47 above. See shellfish harvesting use support and growing area map in Chapter 10 section 10.3.4 (Figures 17 and 18).

According to the ***Sanitary Survey of Neuse River Area, Area F-3 & F-4,*** *(DEH. Shellfish Sanitation Unit, September 2006)*, there have been little water quality changes since the last survey. These areas are rather remote and are generally not affected by freshwater runoff due to the small watershed and lack of major tributaries. Rainfall normally has little effect on the approved waters of this area except during extremely heavy rainfall evens (hurricanes or other severe coastal storm events), which cause temporary closures.

Area F-4 consists of the waters of Thorofare Bay, Cedar Island, Back Bay, eastern Core Sound and the southern portion of the Pamlico Sound. There are approximately 300 square miles of water and marshland that is rather isolated and remote. The eastern boundary of the area contains a chain of uninhabited barrier islands. This area in the past has been one of the better oyster producing regions of the state. Clam production continues to be good. The permanent population in this area is just over 300, and little to no population growth can be expected in the future.

There is one marina within the F-4 area, the Cedar Island Community Harbor. This marina had 75 slips in the past but due to storm damage, as of the 2006 survey, there are only 45 slips.

A boat basin is maintained adjacent to the Quality Seafood Fish House. There are a total of eight boat slips within the basin. There area several floor drains in and around the processing area of the fish house that drain directly onto the basin without treatment. The stormwater from the surrounding area drains into the basin as well. This basin is closed to shellfish harvesting.

The Cedar Island Ferry Terminal is also located at the northern end of the island. The ferry terminal basin and the small adjacent boat ramp basin are closed to shellfish harvesting.

There is a large network of ditches draining the roads and residential areas on Cedar Island. One area of particular concern is from Lola near the start of Cedar Island. A large canal was dug to drain several surrounding properties and has since shoaled over at the mouth. The canal receives runoff that lies stagnant much of the time. During heavy rains, the canal fills and flows into the bay and potentially releasing pulses of contaminated water.

There is also a large horseback riding facility next to the ferry terminal. Horses are rode and often allowed to roam free on the beach or in the marsh areas. There is also a large herd of cows that roams free along to beach on the north side of Cedar Island. These are both a potential source of bacterial contamination.

All of the homes within this area are served by individual on-site wastewater systems, those inspected during this survey were found to be functioning properly. Other pollution sources in this area include waterfowl and other wildlife.

Assessment of the shellfish harvesting area F-4 resulted in little change in bacterial water quality. One change in classifications was made at the boat basin at Quality Seafood in Cedar Island. It was reclassified from Approved to Prohibited due to potential pollution sources. Several changes in sampling stations will be made in order to more effectively monitor these areas.

14.3.3 Division of Environmental Health Growing Area F-7

Please see Chapter 13 section 13.3.4 for information on growing area F-7. Growing area F-7 encompasses part of subbasin 13 and 14.

14.4 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.

14.4.1 West Thorofare Bay [27-148-2b]

Current Status
West Thorofare Bay [27-148-2b; SA; HQW; NSW] from 0.3 miles downstream of source to West Bay (1,016.3 saltwater acres) is Supporting for aquatic life and recreational uses due to No Criteria Exceeded at ambient monitoring station JA126. The geometric mean of the 14 fecal coliform bacteria samples collected at this was 2 CFU/100 ml.

This station was discontinued in July 2002.

This segment is also Supporting shellfish harvesting due to a DEH rating of approved.

Recommendation
DWQ recommends the use of BMPs throughout this watershed to reduce stormwater runoff which carries bacteria which leads to shellfish harvesting and beach closures.

14.4.2 Thorofare [27-149-1-1]

Current Status
Thorofare [27-149-1-1; SA; HQW; NSW] from West Thorofare Bay to Thorofare Bay (34.9 saltwater acres) is Supporting for aquatic life and recreational uses due to No Criteria Exceeded at ambient monitoring station JA127. The geometric mean of the 17 fecal coliform bacteria samples collected at this was 4 CFU/100 ml.

This site was also discontinued in July 2002.

This segment is Impaired for shellfish harvesting due to a DEH rating of prohibited.

Recommendation
DWQ recommends the use of BMPs throughout this watershed to reduce stormwater runoff which carries bacteria which leads to shellfish harvesting and beach closures.

14.5 Additional Water Quality Issues within Subbasin 03-04-14

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.

14.5.1 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.

Chapter 15
North Carolina Water Quality Classifications and Standards

15.1 Description of Surface Water Classifications and Standards

North Carolina's Water Quality Standards Program adopted classifications and water quality standards for all the state's river basins by 1963. The program remains consistent with the Federal Clean Water Act and its amendments. Water quality classifications and standards have also been modified to promote protection of surface water supply watersheds, high quality waters (HQW), and unique and special pristine waters with outstanding resource values (ORW).

15.1.1 Statewide Classifications

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water. In addition to primary classifications, surface waters may be assigned a *supplemental* classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. Table 48 briefly describes the best uses of each classification. A full description is available in the document titled: *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (NCDENR-DWQ, 2004). Information on this subject is also available at DWQs website: http://h2o.enr.state.nc.us/csu/.

Table 48 Primary and Supplemental Surface Water Classifications

PRIMARY FRESHWATER AND SALTWATER CLASSIFICATIONS*	
Class	**Best Uses**
C and SC	Aquatic life propagation/protection and secondary recreation.
B and SB	Primary recreation and Class C uses.
SA	Waters classified for commercial shellfish harvesting.
WS	*Water Supply watershed*. There are five WS classes ranging from WS-I through WS-V. WS classifications are assigned to watersheds based on land use characteristics of the area. Each water supply classification has a set of management strategies to protect the surface water supply. WS-I provides the highest level of protection and WS-IV provides the least protection. A Critical Area (CA) designation is also listed for watershed areas within a half-mile and draining to the water supply intake or reservoir where an intake is located.
SUPPLEMENTAL CLASSIFICATIONS	
Class	**Best Uses**
Sw	*Swamp Waters*: Recognizes waters that will naturally be more acidic (have lower pH values) and have lower levels of dissolved oxygen.
Tr	*Trout Waters*: Provides protection to freshwaters for natural trout propagation and survival of stocked trout.
HQW	*High Quality Waters*: Waters possessing special qualities including excellent water quality, Native or Special Native Trout Waters, Critical Habitat areas, or WS-I and WS-II water supplies.
ORW	*Outstanding Resource Waters*: Unique and special surface waters which are unimpacted by pollution and have some outstanding resource values.
NSW	*Nutrient Sensitive Waters*: Areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment.

* Primary classifications beginning with "S" are assigned to saltwaters.

15.1.2 Statewide Water Quality Standards

Each primary and supplemental classification is assigned a set of water quality *standards* that establish the level of water quality that must be maintained in the waterbody to support the uses associated with each classification. Some of the standards, particularly for HQW and ORW waters, outline protective management strategies to control point and nonpoint source pollution. These strategies are discussed briefly below. The standards for C and SC waters establish the basic protection level for all surface waters. The other primary and supplemental classifications have more stringent standards than for C and SC, and therefore, require higher levels of protection.

Some of North Carolina's surface waters are relatively unaffected by pollution sources and have water quality higher than the standards that are applied to the majority of the waters of the state. In addition, some waters provide habitat for sensitive biota such as trout, juvenile fish, or rare, threatened or endangered aquatic species.

High Quality Waters (Class HQW)

There are 989 acres / 159 miles of freshwater and 270,320 acres / 16 miles of saltwater HQWs in the Neuse River basin (Figure 25). Special HQW protection management strategies are intended to prevent degradation of water quality below present levels from both point and nonpoint sources. HQW requirements for new or expanding wastewater discharge facilities address oxygen-consuming wastes, total suspended solids, disinfection, emergency requirements, volume, nutrients (in nutrient sensitive waters) and toxic substances.

Criteria for HQW Classification

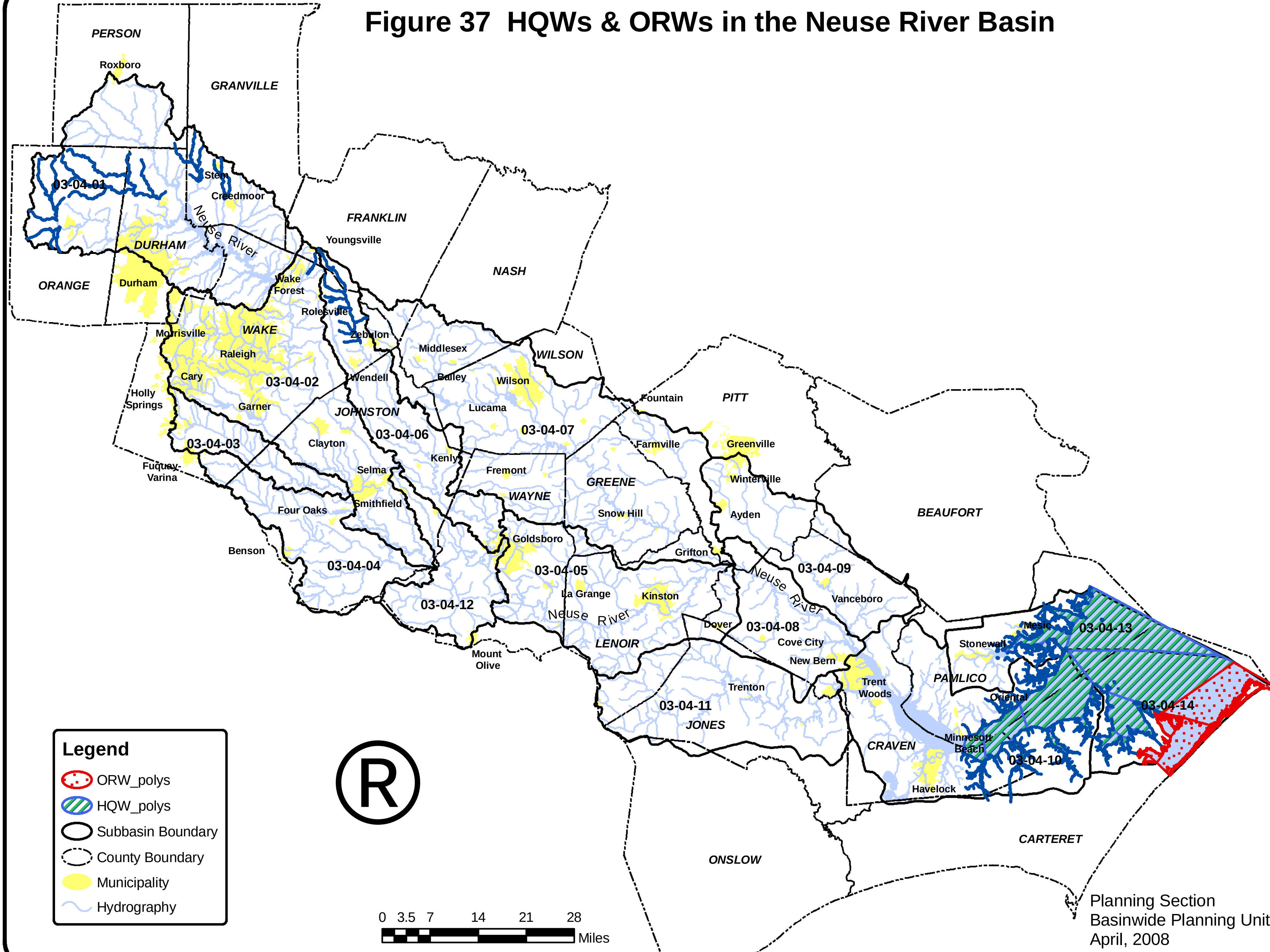
- Waters rated as Excellent based on DWQs chemical and biological sampling.
- Streams designated as native or special native trout waters by the Wildlife Resources Commission (WRC).
- Waters designated as primary nursery areas or other functional nursery areas by the Division of Marine Fisheries.
- Waters classified by DWQ as WS-I, WS-II or SA.

For nonpoint source pollution, development activities which require a Sedimentation and Erosion Control Plan in accordance with rules established by the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program, and which drain to and are within one mile of HQWs, are required to control runoff from the development using either a low density or high density option. The low-density option requires a 30-foot vegetated buffer between development activities and the stream; whereas, the high-density option requires structural stormwater controls. In addition, the Division of Land Resources (DLR) requires more stringent erosion controls for land-disturbing projects within one mile of and draining to HQWs.

Outstanding Resource Waters (Class ORW)

There are 63,513 saltwater acres of ORWs in the basin (Figure 37). These waters have excellent water quality (rated based on biological and chemical sampling as with HQWs) and an associated outstanding resource. Deep Creek in subbasin 03-04-01 was reclassified to ORW on November 1, 2007. This classification was after the completion of this assessment time period. It added an additional 22 freshwater stream miles. See section 1.5.7 for more details on this reclassification.

Figure 37 HQWs & ORWs in the Neuse River Basin



Planning Section
Basinwide Planning Unit
April, 2008

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to ORWs are set forth in 15A NCAC 2B .0225. At a minimum, no new discharges or expansions are permitted, and a 30-foot vegetated buffer or stormwater controls for new developments are required. In some circumstances, the unique characteristics of the waters and resources that are to be protected require that a specialized (or customized) ORW management strategy be developed.

The ORW rule defines outstanding resource values as including one or more of the following:

- an outstanding fisheries resource;
- a high level of water-based recreation;
- a special designation such as National Wild and Scenic River or a National Wildlife Refuge;
- within a state or national park or forest; or
- a special ecological or scientific significance.

Nutrient Sensitive Waters (NSW)

All waters in the Neuse River basin are classified as NSW. There are 17,901 acres/3,389 miles of freshwater and 370,779 acres/143 miles of saltwater NSWs in the basin (Figure *i*). Nutrient sensitive waters (NSW) is a supplemental classification that the Environmental Management Commission may apply to surface waters that are experiencing or are subject to growths of microscopic or macroscopic vegetation. Nutrient strategies are developed by the EMC to control these growths. For more information on NSW waters and nutrient strategies, refer to Chapter 24 and refer to 15A NCAC 2B .0223 for specifics on NSW rules.

Shellfish Harvesting Waters (Class SA)

There are 333,262 acres and 15 miles of SA waters in the basin. The best uses of Class SA waters are for shellfishing for market purposes and any other usage specified by the "SB" or "SC" classification. Fecal coliform bacteria in class SA waters shall meet the current sanitary and bacteriological standards as adapted by the Commission for Health Services. Domestic wastewater discharges are not allowed, and there are provisions for stormwater controls. Refer to 15A NCAC 2B .0221 for specifics on water quality standards in Class SA waters. All Class SA waters also carry a supplemental designation of HQW or ORW by rule (see above), depending on the resource value present at the time of classification.

Primary Recreation Waters (Class B and SB)

There are 10,968 acres / 78 miles of freshwater and 27,229 acres/ 19 miles of saltwater classified for primary recreation in the Neuse River basin. Class B and SB waters are protected for primary recreation activities (frequent and/or organized swimming) and must meet water quality standards for fecal coliform bacteria. Sewage and all discharged wastes into Class B waters must be treated to avoid potential impacts to existing water quality.

Chapter 16
Community Changes and Challenges
-Population Growth, Land Use, Development and Water Quality

16.1 Our Changing Waterfronts and Loss of Public Access

Waterfronts in North Carolina are changing. Historic landmarks for those that have been born and raised on the waterfronts are disappearing; as are fish houses and fishing fleets. These historic uses of waterfronts are being replaced with "urban waterfronts". Many waterfronts are redeveloping into waterfronts more like Wilmington's waterfront – the state's only designated "urban waterfront". Redevelopment projects on historically working waterfronts include activities such as restaurants, condominiums and mixed-use buildings. Fishing fleets are being replaced by yachts, charter boats or sport fishing boats. Even smaller coastal communities are feeling the brunt of coastal redevelopment for residences and businesses near the water. While land closest to the ocean has seen the first wave of development, the second and third waves of development on the sound and tidal creeks are already here.

Loss of Access to Public Use of Coastal Waters
North Carolina citizens and elected officials are concerned about the loss of working waterfronts, as fewer marinas and fishing piers are available for public access. The North Carolina Marine Fisheries Commission (MFC) passed a resolution asking that state leaders "recognize the vital importance of public access to State estuarine and marine fisheries and waters". As a result a Waterfront Access Study Committee was created to study the degree of loss and potential loss of the diversity of uses along the North Carolina coastal shoreline, and how these losses impact access to the public trust waters of the state. The Committee asks for the cooperation of municipalities, public agencies, resource and facility-development granting entities, coastal developers, businesses, and other coastal resource users to recognize and integrate enhanced waterfront-use diversity and increased public access as beneficial factors and/or criteria in their decision making. The Committee supports the use of limited public funds to achieve enhanced water quality, protection of natural and cultural/maritime heritage sites and resources, and maintaining or advancing waterfront-use diversity and public access. A final committee report is available online at: *www.ncseagrant.org/waterfronts*. The General Assembly created the Watershed Access and Marine Industry Fund to address some of the issues identified by the Waterfront Access Study Committee. There were 13 sites selected by Division of Marine Fisheries to receive the $20 million allocated to the fund in its first year.

16.2 Population Growth and Development

North Carolina's coastal counties are some of the fastest growing areas in the state and the associated development is impacting water quality. Four of the 18 counties in the basin are expected to experience growth rates in excess of thirty-five percent by 2020 (Table 49; Figure 38). As the counties in the Neuse River basin continue to grow there will likely be a loss of natural areas and an increase in the amount of impervious surface associated with new homes and businesses. Impacts are quickly felt with population increases resulting in an increase in runoff

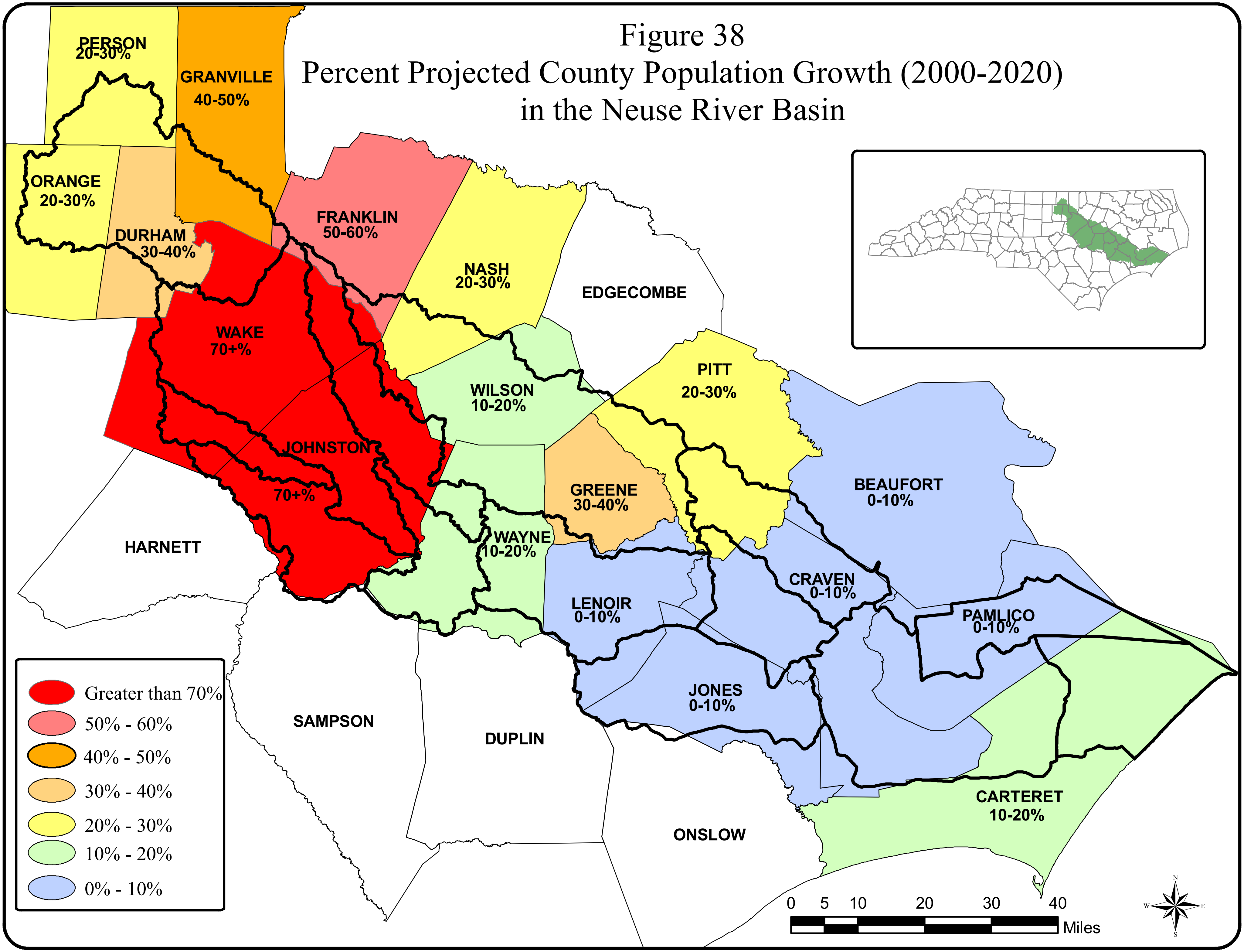


Figure 38
Percent Projected County Population Growth (2000-2020)
in the Neuse River Basin
PERSON
20-30%
GRANVILLE
40-50%
ORANGE
20-30%
DURHAM
30-40%
FRANKLIN
50-60%
NASH
20-30%
EDGECOMBE
WAKE
70+%
JOHNSTON
70+%
WILSON
10-20%
PITT
20-30%
GREENE
30-40%
WAYNE
10-20%
BEAUFORT
0-10%
CRAVEN
0-10%
LENOIR
0-10%
PAMLICO
0-10%
JONES
0-10%
HARNETT
SAMPSON
DUPLIN
ONSLOW
CARTERET
10-20%
Greater than 70%
50% - 60%
40% - 50%
30% - 40%
20% - 30%
10% - 20%
0% - 10%
0 5 10 20 30 40
Miles

from roads and new developments, increase in wastewater treatment options, a change in the shoreline fronts from fish houses to condominiums, reduced public access to waterfronts, beach closures and a decline in our freshwater, estuarine and marine resources. Between 2003-2006, DEH Recreational Water Quality Monitoring Program in the Neuse Basin reported 367 postings of beach closure days.

County population data present projected county growth estimates based on Office of State Planning information (June and September 2004) (Table 49). Counties with the highest expected growth are associated with the largest municipal areas and the most densely populated subbasins in the basin.

Table 49 County Population and Growth Estimates

County	% County in the Basin	County Population in 1990	County Population in 2000	% Growth 1990-2000	Estimated Population for 2020	Estimated % Growth 2000-2020
Beaufort	2	42,283	44,958	6.3	49,046	9.1
Carteret	50	52,407	59,383	13.3	69,000	16.2
Craven	95	81,812	91,523	11.9	96,449	5.4
Durham	73	181,844	223,318	28.3	297,461	27.5
Franklin	10	36,414	47,260	29.8	73,037	54.5
Granville	25	38,341	48,498	26.5	69,054	42.39
Greene	100	15,384	18,974	23.3	24,892	31.19
Johnston	98	81,306	121,900	49.9	217,764	78.64
Jones	81	9,361	10,419	11.3	10,499	0.8
Lenoir	99	57,274	59,598	4.1	57,437	-3.6
Nash	20	76,677	87,385	14.0	104,871	20.0
Orange	49	93,662	115,533	23.4	149,080	29.0
Pamlico	83	11,368	12,934	13.8	14,136	9.3
Person	32	30,180	35,623	18.0	43,901	23.2
Pitt	42	108,480	133,719	23.3	172,440	29.0
Wake	85	426,311	627,866	47.3	1,106,218	76.2
Wayne	91	104,666	113,329	8.3	125,614	10.8
Wilson	81	66,061	73,811	11.7	86,916	17.8
		1,513,831	**1,936,031**	**27.9**	**2,767,815**	**43.0**

♦ Source: http://www.osbm.state.nc.us/ncosbm/facts_and_figures/socioeconomic_data/census_home.shtm, 2007. Note: The numbers reported reflect county population; however, these counties may not entirely be within the basin. The intent is to demonstrate growth for counties located wholly or partially within the basin.

Urban growth poses one of the greatest threats to aquatic resources more than any other human activity. Greater numbers of homes, stores, and businesses require greater quantities of water. Growing populations not only require more water, but they also lead to the discharge and runoff of greater quantities of waste and pollutants into the state's streams and groundwater. Thus, just as demand and use increases, some of the potential water supply is lost (Orr and Stuart, 2000). The Neuse River basin municipal population and growth trends are reported in Table 50. Population fluctuations occur in developing coastal communities as seasonal changes bring time-share and rental property residents creating an increased demand on municipality resources and natural resources. County, city and town planners need to account for these fluctuations and recognize that temporary residents may have less incentive to invest in sustainable community development efforts. Table 50 below presents population data from Office of State Planning for municipalities located wholly or partly within the basin. Data presented by municipality summarize information on past growth of urban areas in the basin.

Table 50 Municipal Population and Growth Trends

Municipality	County	Apr-80	Apr-90	Apr-00	Percent Change (1980-1990)	Percent Change (1990-2000)
Apex *	Wake	2,847	4,789	20,212	68.2	322.1
Ayden	Pitt	4,361	4,883	4,622	12.0	-5.3
Benson *	Johnston	2,792	3,044	2,993	9.0	-1.7
Cary *	Chatham, Wake	21,763	44,397	94,536	104.0	112.9
Clayton	Johnston	4,091	4,756	8,126	16.3	70.9
Creedmoor	Granville	1,641	1,506	2,232	-8.2	48.2
Durham	Durham	101,149	136,612	187,035	35.1	36.9
Farmville	Pitt	4,707	4,446	4,421	-5.5	-0.6
Fuquay-Varina *	Wake	3,110	4,447	7,898	43.0	77.6
Garner	Wake	10,073	14,716	17,787	46.1	20.9
Goldsboro	Wayne	31,871	40,709	39,147	27.7	-3.8
Greenville *	Pitt	35,740	46,305	61,209	29.6	32.2
Grifton	Pitt	2,179	2,393	2,123	9.8	-11.3
Havelock	Craven	17,718	20,300	22,442	14.6	10.6
Hillsborough	Orange	3,019	4,263	5,446	41.2	27.8
Holly Springs *	Wake	688	1,024	9,192	48.8	797.7
Kinston	Lenoir	25,234	25,295	23,688	0.2	-6.4
Knightdale	Wake	985	1,884	5,658	91.3	200.3
La Grange	Lenoir	3,147	2,805	2,844	-10.9	1.4
Morrisville *	Durham, Wake	251	1,489	5,208	493.2	249.8
Mount Olive *	Duplin, Wayne	4,876	4,582	4,567	-6.0	-0.3
New Bern	Craven	14,557	17,363	23,111	19.3	33.1
Raleigh	Wake	150,255	212,092	276,093	41.2	30.2
River Bend	Craven	959	2,408	2,923	151.1	21.4
Roxboro *	Person	7,532	7,332	8,696	-2.7	18.6
Selma	Johnston	4,762	4,600	5,914	-3.4	28.6
Smithfield	Johnston	7,288	7,540	10,867	3.5	44.1
Trent Woods	Craven	1,177	2,366	4,224	101.0	78.5
Wake Forest	Wake	3,780	5,832	12,588	54.3	115.8
Wendell	Wake	2,222	2,921	4,247	31.5	45.4
Wilson	Wilson	34,424	36,930	44,405	7.3	20.2
Winterville	Pitt	2,052	3,069	4,791	49.6	56.1
Zebulon	Wake	2,055	3,173	4,046	54.4	27.5

* - The numbers reported reflect municipality populations; however, these municipalities are not entirely within the basin. The intent is to demonstrate growth for municipalities located wholly or partially within the basin.

As development in urbanizing areas consumes neighboring forests and fields, the impacts on rivers, lakes, and streams can be significant and permanent if stormwater runoff is not controlled (Orr and Stuart, 2000). As watershed vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and driveways, the ability of the environment to absorb and diffuse the effects of natural rainfall is diminished. Urbanization results in increased surface runoff and correspondingly earlier and higher peak stream flows after rainfall. Flooding frequency also increases. These effects are compounded when small streams are channelized (straightened) or piped, and storm sewer systems are installed to increase transport of stormwater downstream. Bank scour from these frequent high flow events tends to enlarge urban streams and increase suspended sediment. Scouring also destroys the variety of habitat in streams, leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999).

16.3 Changes in Land Cover

Land cover can be an important way to evaluate the effects of land use changes on water quality. Unfortunately, the tools and database to do this on a watershed scale are not yet available. Land cover information from the National Resources Inventory (NRI) published by the Natural Resource Conservation Service (NRCS) is presented only at an 8-digit hydrologic unit scale. This information is presented to provide a picture of the different land covers and developing land use trends in the Neuse River Basin, while noting that the data is outdated and does not reflect recent development along North Carolina's waterways.

Land cover information in this section is from the most current NRI, as developed by the NRCS (USDA-NRCS, June 2001). The NRI is a statistically based longitudinal survey that has been designed and implemented to assess conditions and trends of soil, water and related resources on the Nation's nonfederal rural lands. The NRI provides results that are nationally and temporally consistent for four points in time -- 1982, 1987, 1992 and 1997. The USDA is working to provide updates to land cover data in the near future.

In general, NRI protocols and definitions remain fixed for each inventory year. However, part of the inventory process is that the previously recorded data are carefully reviewed as determinations are made for the new inventory year. For those cases where a protocol or definition needs to be modified, all historical data must be edited and reviewed on a point-by-point basis to make sure that data for all years are consistent and properly calibrated. The following excerpt from the *Summary Report: 1997 National Resources Inventory* provides guidance for use and interpretation of current NRI data:

> *The 1997 NRI database has been designed for use in detecting significant changes in resource conditions relative to the years 1982, 1987, 1992 and 1997. All comparisons for two points in time should be made using the new 1997 NRI database. Comparisons made using data previously published for the 1982, 1987 or 1992 NRI may provide erroneous results because of changes in statistical estimation protocols, and because all data collected prior to 1997 were simultaneously reviewed (edited) as 1997 NRI data were collected.*

The following Table 51 summarizes acreage and percentage of land cover from the 1997 NRI for the major watersheds within the basin, as defined by the USGS 8-digit hydrologic units, and compares the coverages to 1982 land cover.

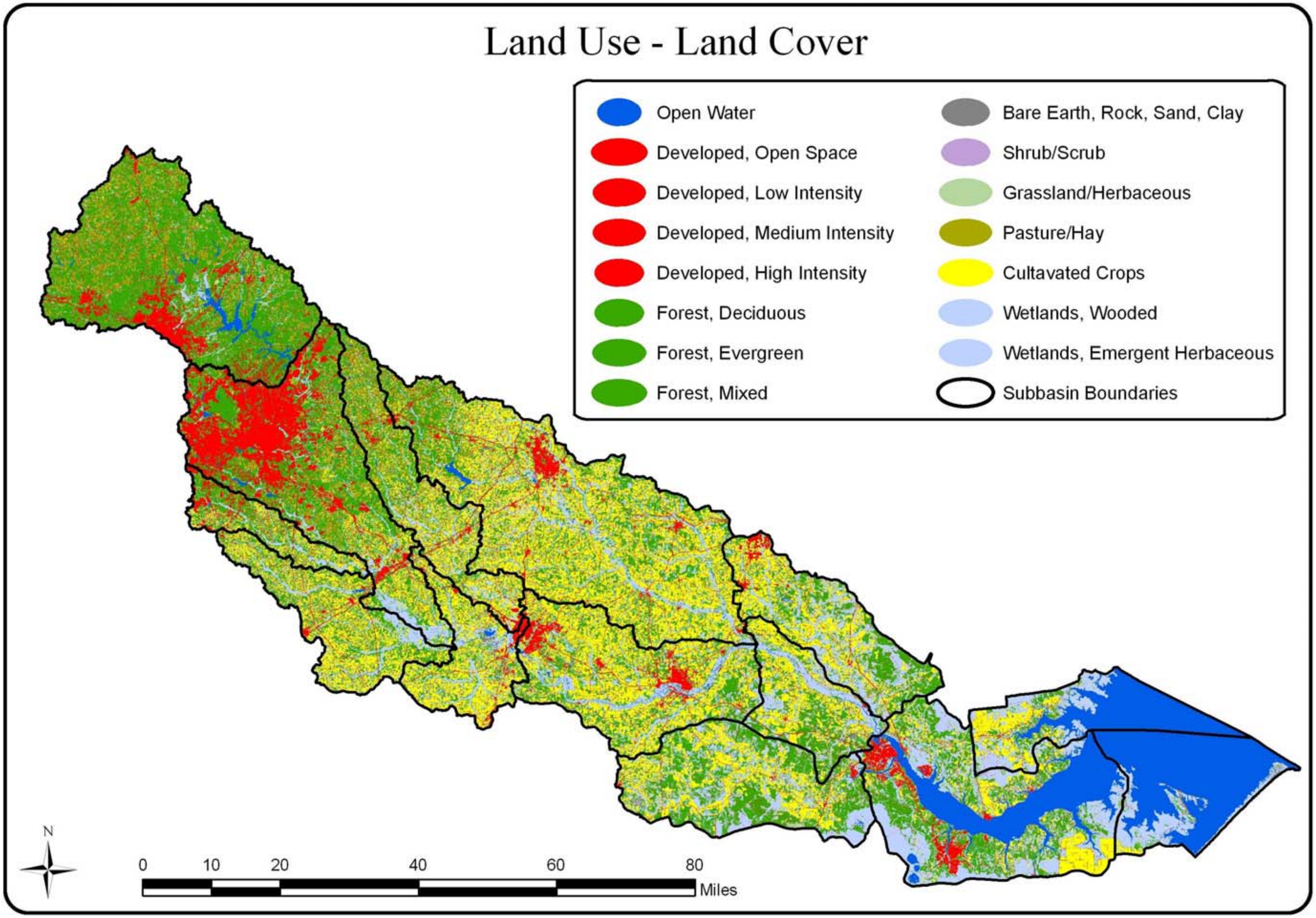
Table 51 Land Cover in the Neuse River Basin: 1982 vs. 1997

LAND COVER	MAJOR WATERSHED AREAS								1997 TOTALS		1982 TOTALS		% Change Since 1982
	Upper Neuse		Middle Neuse		Contentnea		Lower Neuse						
	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	
Cult. Crop	296.7	19.3	208.7	30.7	240.0	38.6	129.3	15.7	874.7	23.9	1054.4	28.8	-17.0
Uncult. Crop	25.4	1.7	16.3	2.4	8.8	1.4	3.4	0.4	53.9	1.5	13.1	0.4	311.5
Pasture	73.2	4.8	44.0	6.5	13.6	2.2	5.4	0.7	136.2	3.7	116.7	3.2	16.7
Forest	684.1	44.6	330.8	48.7	269.7	43.3	356.9	43.4	1641.5	44.9	1769.4	48.4	-7.2
Urban & Built-Up	349.7	22.8	47.7	7.0	48.1	7.7	35.5	4.3	481.0	13.1	254.1	6.9	89.3
Federal	5.8	0.4	2.9	0.4	0.0	0.0	75.1	9.1	83.8	2.3	75.1	2.1	11.6
Other	99.4	6.5	29.2	4.3	42.3	6.8	216.0	26.3	386.9	10.6	381	10.4	1.5
Totals	1534.3	100.0	679.6	100.0	622.5	100.0	821.6	100.0	3658.0	100.0	3663.8	100.0	
% of Total Basin		41.9		18.5		17.0		22.4		99.8		100.2	
Subbasins	03-04-01, 03-04-02, 03-04-03, 03-04-04, 03-04-06, 03-04-12		03-04-05, 03-04-08, 03-04-09		03-04-07		03-04-10, 03-04-11						
8-Digit Hydraulic Units	03020201		03020202		03020203		03020204						

Table 52 Land Use Percentages for the Neuse Basin based on the National Land Cover Database 2001

Type	Entire Basin	Upper Neuse	Middle Neuse	Contentnea	Lower Neuse	30201050401
Developed, Open Space	7.6	10.8	5.5	5.9	4.4	1.7
Developed, Low Intensity	2.7	4.2	1.8	1.8	1.2	0.3
Developed, Medium Intensity	1.0	1.6	0.6	0.5	0.4	0.2
Developed, High Intensity	0.3	0.4	0.2	0.1	0.1	0.0
Developed, Total	11.5	17.0	8.2	8.3	6.2	2.2
Bare Earth, Rock, Sand, Clay	0.1	0.2	0.1	0.1	0.1	5.7
Forest, Deciduous	12.8	22.6	6.1	10.2	1.6	0.0
Forest, Evergreen	15.2	12.1	16.9	11.7	23.3	7.1
Forest, Mixed	4.0	4.7	3.1	3.1	3.9	0.6
Forest, Total	32.0	39.4	26.2	24.9	28.8	7.7
Shrub/Scrub	1.9	1.6	2.3	1.0	2.7	3.3
Grassland/Herbaceous	8.1	7.3	9.5	7.9	8.6	2.9
Pasture/Hay	7.2	12.6	2.6	7.2	0.5	0.0
Cultivated Crops	22.3	14.2	31.8	36.9	18.1	0.0
Agriculture, Total	29.5	26.8	34.4	44.1	18.5	0.0
Wetlands, Wooded	14.9	7.2	18.7	13.3	28.5	18.6
Wetlands, Emergent Herbaceous	1.9	0.3	0.7	0.4	6.5	59.6
Wetlands, Total	16.8	7.5	19.4	13.7	35.1	78.2

Figure 39 Land Cover/Land Use Map 2001.



16.3.1 National Land Cover Database (NLCD) 2001 Description and Definitions

The national land cover database (2001) is a geographic information systems raster file that was developed by the Multi-Resolution Land Characterization Consortium which is made up of several federal government agencies. These agencies include the US Geological Survey, the Environmental Protection Agency, National Oceanic and Atmospheric Administration, US Forest Service, Bureau of Land Management, National Aeronautics and Space Administration, National Park Service, and Natural Resources Conservation Service. It was developed using multiple datasets including, three sets of infrared landsat imagery that were collected during the spring, summer, and fall seasons. This data was then improved upon using ancillary data files such as a 30 meter digital elevation model, population density, buffered roads, and city lights. The percent impervious cover and the percent tree canopy were created to show the intensity at which land was either developed or forested. Due to differences in methodology of how the data was created and how land cover types were defined this data can not be compared directly to the 1982-1997 NRI data. The definition for the NLCD 2001 can be found below.

Open Water - All areas of open water, generally with less than 25 percent cover of vegetation or soil

Developed, Open Space - Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.

Developed, Low Intensity -Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.

Developed, Medium Intensity - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.

Developed, High Intensity - Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to100 percent of the total cover.

Barren Land (Rock/Sand/Clay) - Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15 percent of total cover.

Deciduous Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20 percent of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.

Evergreen Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20 percent of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.

Mixed Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20 percent of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.

Shrub/Scrub - Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20 percent of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.

Grassland/Herbaceous - Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80 percent of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.

Pasture/Hay - Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.

Cultivated Crops - Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.

Woody Wetlands - Areas where forest or shrub land vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

Chapter 17
Water Quality Stressors and Sources

17.1 Stressor Identification

17.1.1 Introduction and Overview

Human activities can negatively impact surface water quality, even when the activity is far removed from surface waters. The many types of pollution generated by human activities may seem insignificant when viewed separately, but when taken as a whole can result in significant cumulative impacts on the aquatic ecosystem. Water quality stressors are identified when impacts have been noted to biological (fish and benthic) communities or water quality standards have been violated. Stressors apply to one or more use support categories and may be identified for Impaired waters, as well as Supporting waters with noted impacts.

Identifying stressors is challenging because direct measurements of the stressor may be difficult or prohibitively expensive. DWQ staff use field observations from sample sites, special studies and data from ambient monitoring stations, as well as information from other agencies and the public to identify stressors and their potential sources. The Division of Environmental Health Shellfish Sanitation Section collects data and information regarding potential sources of water quality stressors in shellfish growing areas. It is important to identify stressors and potential sources of stressors so that water quality programs can target limited resources to address the stressor.

Stressors to recreational use include pathogenic indicators, such as fecal coliform bacteria *escheria coli* (*E. coli*) and *enterrococci*. In the fish consumption category, mercury is typically the noted stressor. Other substances may also result in the issuance of a fish consumption advisory or advice by the NC Division of Health and Human Services (NCDHHS).

Most stressors to the biological community are a complex grouping of many different stressors that individually may not degrade water quality or aquatic habitat, but together can severely impact aquatic life. Sources of stressors are most often associated with land use in a watershed, as well as the quality and quantity of any treated wastewater that may be entering a stream. During naturally severe conditions such as droughts or floods, any individual stressor, or group of stressors, may have more severe impacts to aquatic life than during normal climatic conditions. The most common source of stressors is from altered hydrology.

17.1.2 Stressor Sources

Pollutants that enter waters fall into two general categories: *point sources* and *nonpoint sources*. Point sources are typically piped discharges and are controlled through regulatory programs administered by the state. All regulated point source discharges in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the state.

Point Sources

Piped discharges from:
- Municipal wastewater treatment plants
- Industrial facilities
- Small package treatment plants
- Large urban and industrial stormwater systems

> ***Nonpoint Sources***
>
> - Construction activities
> - Roads, parking lots and rooftops
> - Agriculture
> - Failing septic systems and straight pipes
> - Timber harvesting
> - Hydrologic modifications

Nonpoint sources are from a broad range of land use activities. Nonpoint source pollutants are typically carried to waters by rainfall, runoff, and snowmelt. Sediment and nutrients are most often associated with nonpoint source pollution. Other pollutants associated with nonpoint source pollution include fecal coliform bacteria, nutrients, heavy metals, oil and grease, and any other substance that may be washed off the ground or deposited from the atmosphere into surface waters. Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur intermittently, depending on rainfall events and land disturbance. Given these characteristics, it is difficult and resource intensive to quantify nonpoint contributions to water quality degradation in a given watershed.

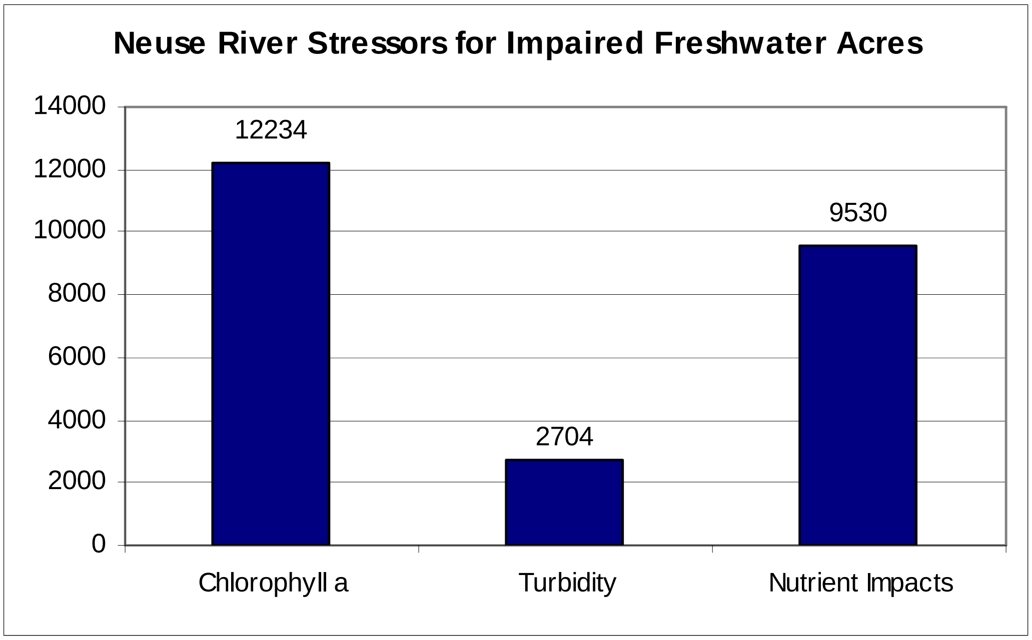
DWQ identifies the source of a stressor, point or nonpoint, as specifically as possible depending on the amount of information available in a watershed. Most often the source is based on the predominant land use in a watershed. Stressors sources identified in the Neuse River Basin during this assessment period include stormwater runoff, development, row crop agriculture, concentrated animal operations and land application of municipal, industrial and animal waste. Point source discharges are also considered a water quality stressor source. In addition to these sources, many impacts originate from unknown sources.

17.1.3 Overview of Stressors Identified in the Neuse River Basin

The stressors noted below are summarized for all waters and for all use support categories. Figures 40-43 identifies stressors noted for Impaired waters and those with noted impacts in both miles and acres. Estuarine stressors are represented separately from the freshwater segments of the Neuse River basin. The Neuse River Estuary is affected by the large assortment of stressors contributed to the system in the area of the estuary and from the entire upstream watershed. These stressors come from existing and new development contributions, industrial, municipal and agricultural waste contributions and from the array of agricultural and forestry practices in the entire Neuse River watershed. The accumulative affect of all these contributions can be seen in the estuary resulting in Impairment due to excessive nutrient contributes throughout the watershed.

The stressors noted in the figure may not be the sole reason for the impairment or noted impacts. For specific discussion of stressors to the impaired or noted waters, refer to the subbasin chapters. Stressor definitions and potential impacts are discussed in the remainder of this chapter. The figures show the primary stressors in the Neuse River Basin are habitat degradation, nutrient impact, chlorophyll *a*, turbidity and fecal coliform bacteria.

Figure 40 Stressors Identified in Impaired Water, in Acres and Miles



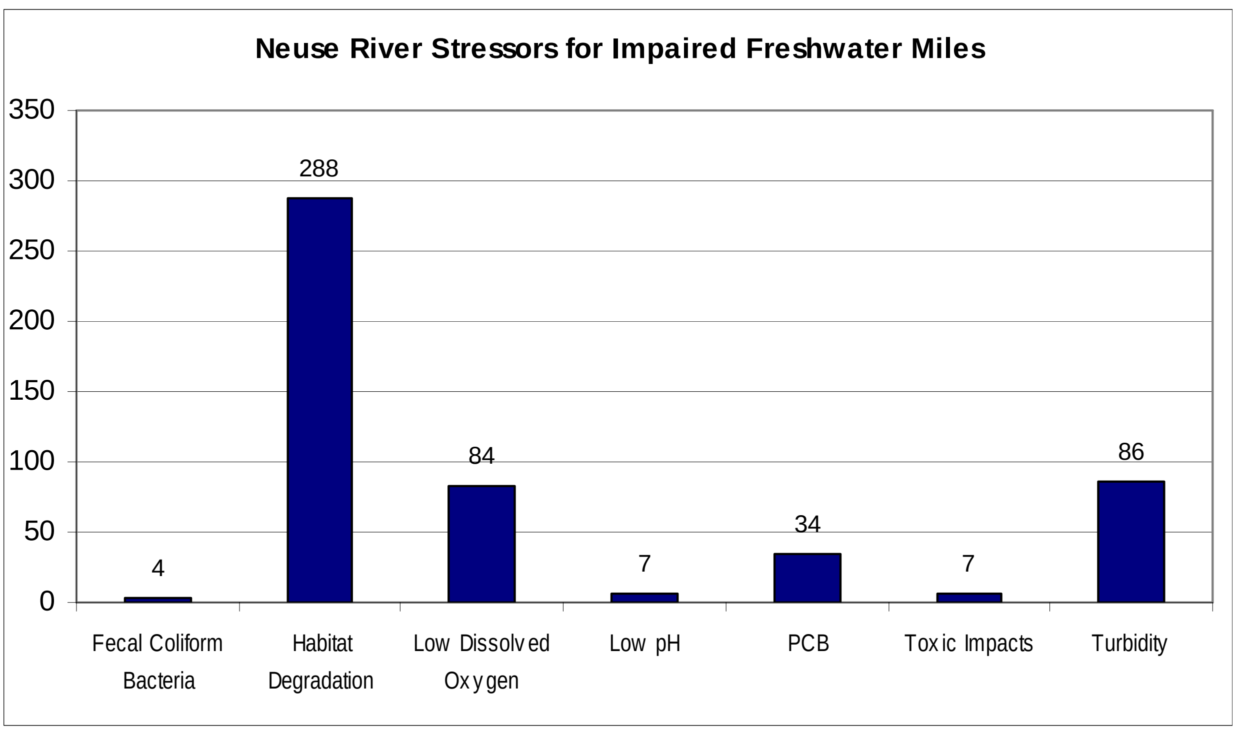


Figure 41 Stressors Identified in Impaired Estuarine Waters, in Acres

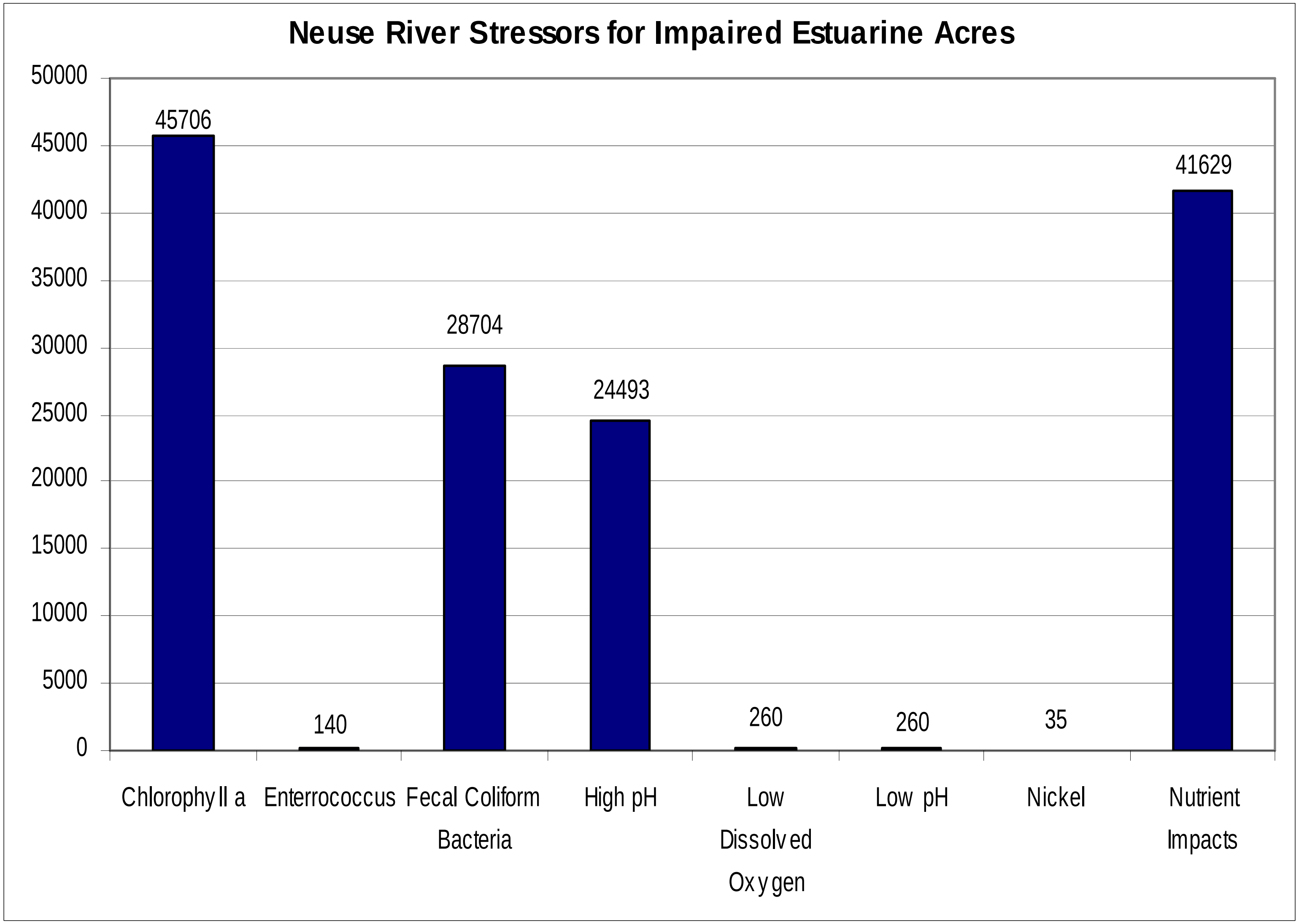
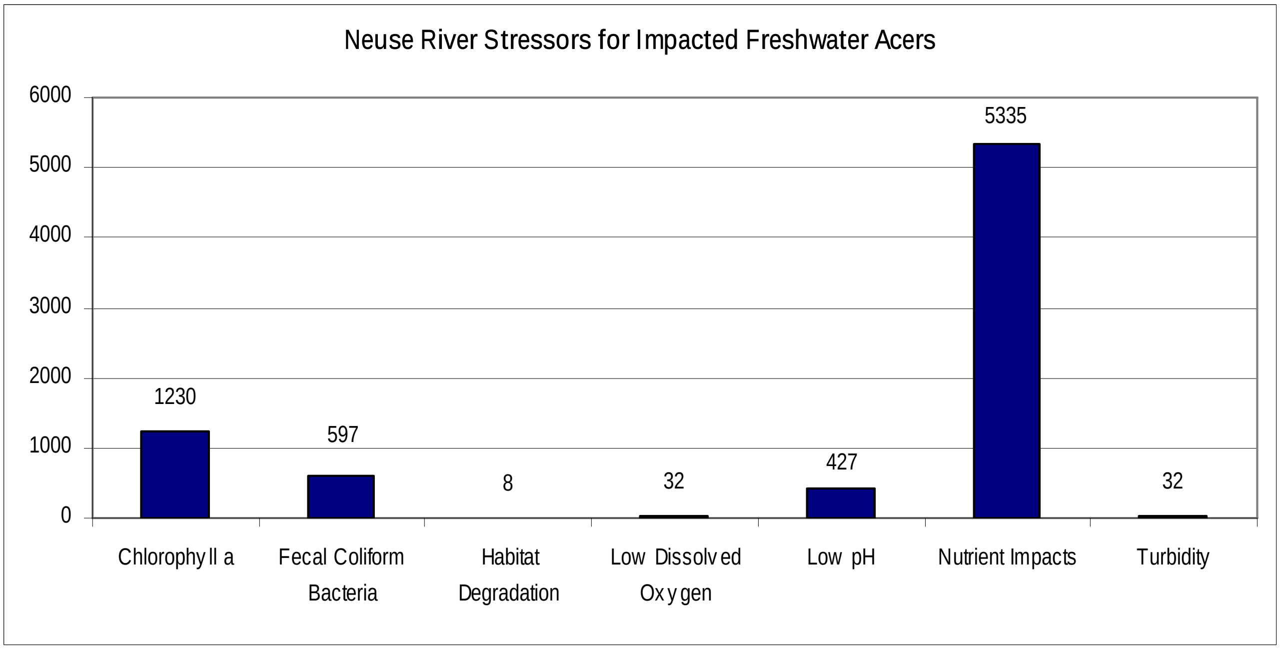


Figure 42 Stressors Identified in Impacted Waters, in Acres and Miles



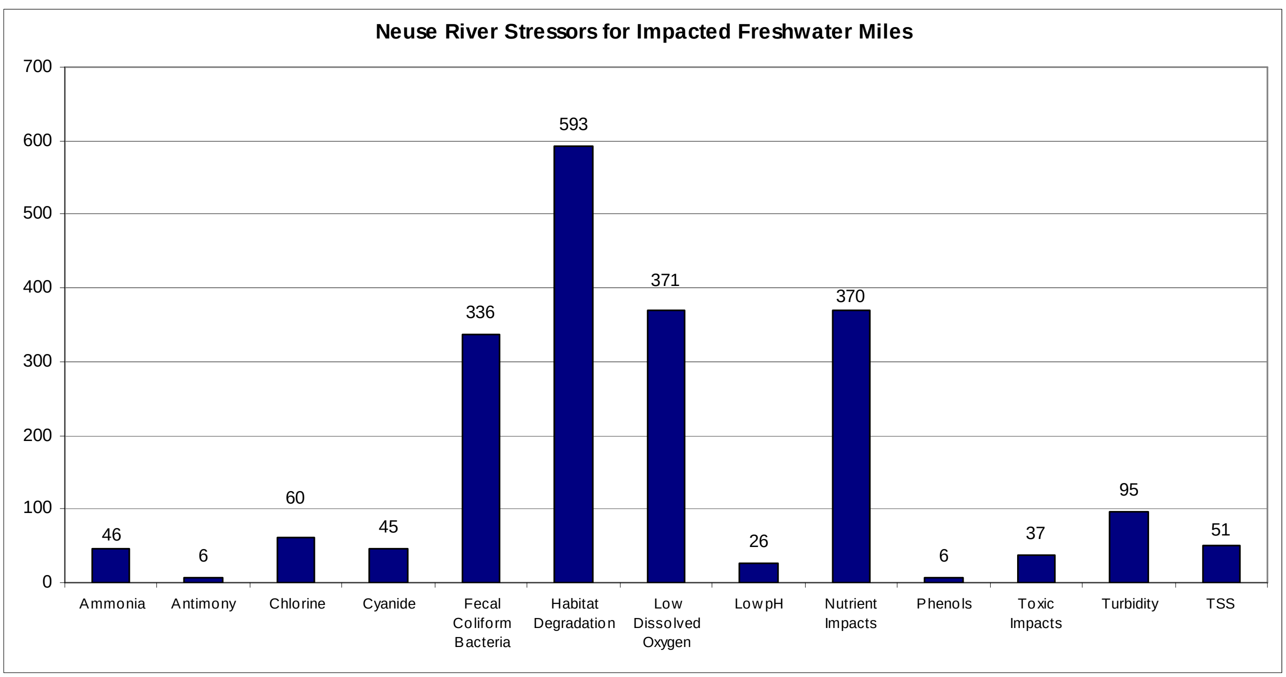
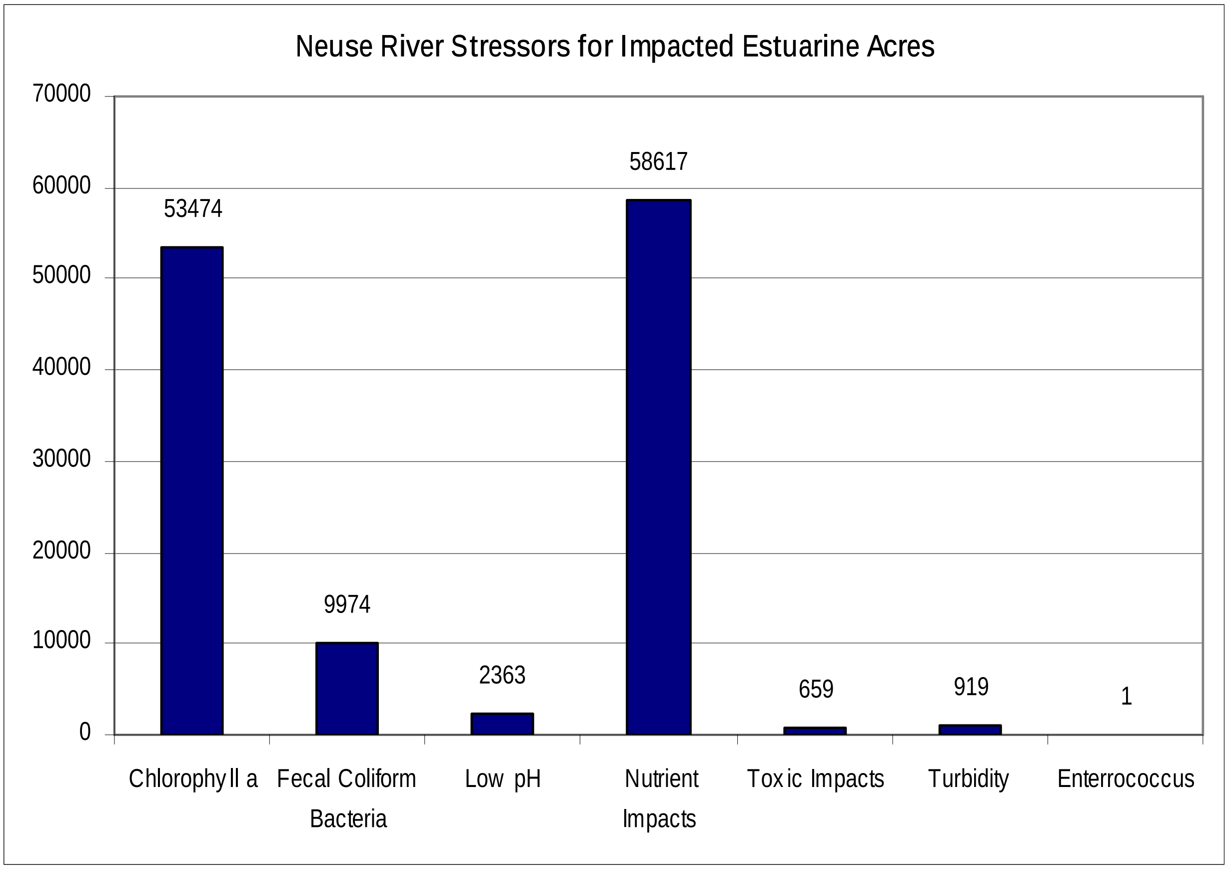


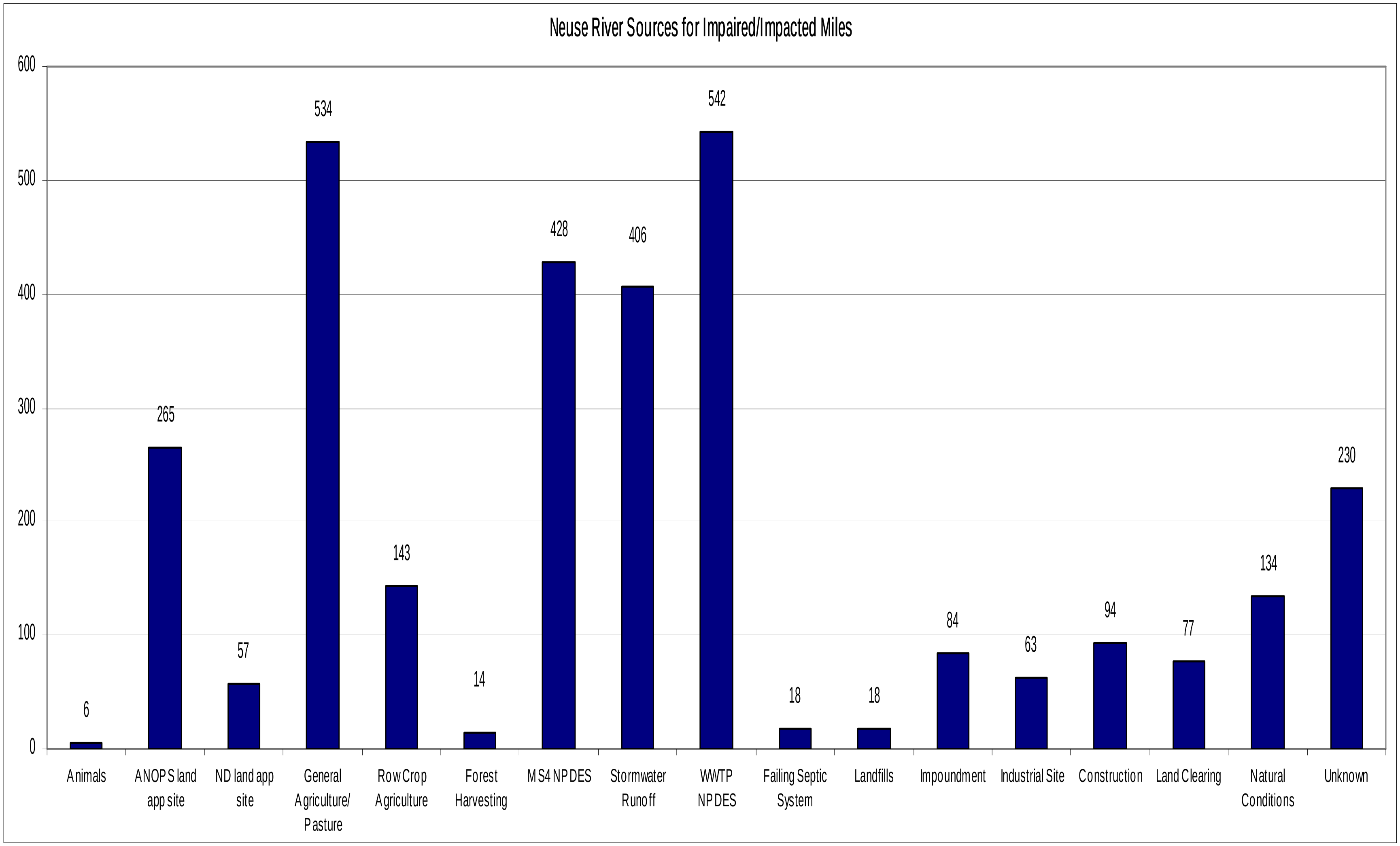
Figure 43 Stressors Identified in Impacted Estuary Waters, in Acres



17.1.4 Overview of Stressor Sources Identified in the Neuse River Basin

The sources noted below are summarized for all waters and for all use support categories. Figures 44, 46; 47 identify sources of stressors noted for waters in the Neuse River Basin during the most recent assessment period. Refer to the subbasin chapters (Chapters 1 – 14) for a complete listing and discussion of sources by stream. The Neuse River Estuary is affected by the accumulation of all the stressors contributed to the system in the area of the estuary and from the entire upstream watershed. The sources of these stressors come from existing and new development, on-site, municipal, industrial and agricultural waste and from the assortment of agricultural and forestry practices in the entire Neuse River watershed. The accumulative affect of all these contributions can be seen in the estuary resulting in Impairment due to excessive nutrient contributes throughout the watershed. Figure 44 shows sources identified for both freshwater and saltwater.

Figure 44 Sources Suspected in Impaired/Impacted Waters, in Miles



Wastewater treatment plants

Wastewater treatment plants (WWTPs) were noted as a potential source to many of the freshwater and saltwater stream miles and acres in the Neuse River basin. WWTPs are just one of many sources that can contribute excess nutrients that may increase the potential for algal blooms and cause exceedances of the chlorophyll *a* standard. This includes all discharges upstream of the Impairment or impacted area. Point source dischargers have substantially reduced their nitrogen contribution over the last several years. The Neuse River NSW Management Strategy which required a 30 percent reduction in nitrogen contribution was fully implemented in 2003. The majority of the point source dischargers have exceeded the required 30 percent reduction. During this assessment period, Falls Lake in the upper portion of the Neuse River basin is newly impaired due to elevated chlorophyll *a* levels. A TMDL is currently being developed for the Falls Lake watershed. The results from this process may require dischargers contributing to this impairment to reduce their nitrogen and phosphorus contribution further. Rules will be developed after the completion of the TMDL to address the required reductions needed in order for Falls Lake to support its designated uses. More information can be found in Chapter 1 (subbasin 03-04-01) and 24.

Land application of sludge from industrial and municipal WWTPs as well as from concentrated animal operations is also becoming a concern. Contribution of groundwater with high levels of nitrogen is a potential source of nutrients not originally recognized in the management strategy. Research is finding that groundwater below these fields have exceedingly high levels of nitrogen concentrations (personal communication – DWQ Aquifer Protection Section; Harden and Spruill, 2004; Harden and Spruill, 2008). Research has also found that if this groundwater flows through a well establish buffer zone, nutrient removal can often occur, reduce the load and impact to the receiving stream (Harden and Spruill, 2008). When the buffer zone is breached due to ditches or tile drains then the nutrient load can be considerable and needs to be addressed with an appropriate BMP to reduce this contribution.

Stormwater/Nonpoint Source Runoff

Stormwater runoff from a variety of land use practices is identified as the primary source of impairment to the surface waters in the Neuse River Basin (Table 53), based on data for the 2008 Integrated Report). Runoff is recognized as contributing to water quality decline in at least 1,600 freshwater stream miles in the Neuse River Basin (Table 53). This accounts for 50 percent of the Freshwater stream miles in the Neuse River Basin. These numbers likely underestimate the true stream miles affected by the many different types of nonpoint source runoff.

Runoff from rain events carry sediment and nutrients that affect the aquatic habitat and fecal coliform bacteria that result in impairment of the recreation and shellfish harvesting use support categories. Excessive nutrient loading is ultimately the primary stressor in the Neuse River basin resulting in the impairment of Falls Lake and the Neuse River Estuary due to the elevated chlorophyll *a* concentrations. While great strides have been made in the reduction of nitrogen contribution from both point and nonpoint sources to the Neuse River Basin, more needs to be done to reduce the nutrient load.

Sediment transported into the steams via runoff accounted for a large increase in the number of stream miles and acres impaired as result of instream turbidity standard violations. There were also many stream miles that have elevated turbidity levels (greater than 7 percent exceedance of the state standard) and were classified as impacting water quality due these elevated levels. Many more stream miles are likely to become impaired during the next assessment period if this trend continues. The biologist often identified sedimentation as a possible cause of stress to the biotic communities being assessed (see section17.2.2 and 17.3.3). Stormwater contributions from all the land use practices in this watershed need to be reduced further in order for the Neuse River to support a healthy aquatic resource. Better stormwater controls are needed throughout the watershed on both existing and new development as well as from forestry harvesting and the many different agricultural practices.

Table 53 Number of Freshwater Stream Miles Impaired or Impacted by Nonpoint Source Runoff.

Nonpoint Sources of Runoff/Stormwater	Impaired or Impacted Freshwater Miles	Total Miles
Urban Nonpoint Source Stormwater/Runoff		
MS4 NPDES	428 miles	
Non-MS4 Stormwater	406	
Construction	94	
Land Clearing	77	
		1005 miles
Other Nonpoint Source Runoff		
General Agriculture	534 miles	
Row Crop Agriculture	143 miles	
Forest Harvesting	14 miles	
		691 miles

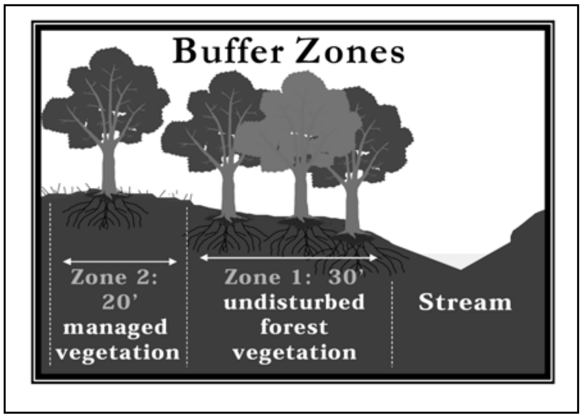
Note: Total miles affected by urban and other nonpoint source runoff is 1,696 miles.
Total number of freshwater stream miles in the Neuse River Basin is 3,389 miles.
Data is from the NC 2008 Integrated Report.

Recommendations on how to protect and reduce water quality impacts from agricultural practices in the watershed can be found in Chapter 6 and 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).

As part of the Neuse River Basin NSW Nutrient Management Strategy, stormwater rules were passed which required several local governments to adapt rules that were specifically designed to reduce nitrogen contribution from new development. Details can be found in Chapter 24 and at http://h2o.enr.state.nc.us/nps/Neuse_NSW_Rules.htm. It is apparent that these rules need to be strengthened and extended beyond the original local governments covered in the stormwater rule.

A riparian buffer protection rule was also passed as part of the nutrient management strategy which requires that up to 50 feet of the riparian area be protected and maintained on the banks of waterways throughout the basin. This rule does not require establishment of new buffers unless the existing use of the buffer changes. A fact sheet on the Neuse riparian buffer rules can be found at http://h2o.enr.state.nc.us/nps/BufRulFakSheet-NeuseTP2-00.pdf or at the link above.

Figure 45 Diagram of a Buffer Zone



Riparian buffers reduce the quantity and velocity of stormwater as well as aids in nutrient removal as it flows through the buffer zones. Buffers also reduce the nutrient contribution from groundwater which flow through these buffer zones. It is important to protect the existing buffers and to establish new and possibly wider buffers where at all possible (Wenger, 1999). Preserving riparian buffers on ephemeral streams would also help to reduce nutrient loading to the watershed.

Agriculture

Agriculture was noted as a potential source of water quality stressors when field observations and watershed studies noted agriculture as the predominant land cover. In the Neuse River basin, the majority of agricultural land is cultivated crop. Impacts to streams from agricultural activities can include excessive nutrient loading, pesticide and herbicide contamination, bacterial contamination, and sedimentation. Pasture and row crop agriculture was noted as a source of stressors in 677 freshwater stream miles. Agriculture impacts and programs are discussed in more detail in Chapter 19.

Concentrated animal feed operations (CAFOs) also have an impact on the water quality in the Neuse River basin. The number of CAFOs grew tremendously throughout the 1990's. The land application of waste (wet and dry) is contributing to runoff of nutrients to the nutrient sensitive waters of the Neuse as well as from contaminated groundwater. Many of the facilities and land application fields are in an area of the coastal plain where the groundwater table is high which requires ditching or tile drain in order to allow for crop harvesting and waste application. These are direct conveyances for the highly nutrient laden water to reach surface waters. These operations are having a significant negative impact on the Neuse River water quality. There is a great need for these facilities to incorporate appropriate BMPs to reduce this contribution.

CAFOs (hog and poultry) throughout the coastal plain of NC are contributing to a substantial increase in atmospheric nitrogen concentration and deposition in the Neuse River watershed. Research to date indicates that atmospheric contribution accounts for 15 to 55 percent of the total nitrogen to the Neuse River Estuary and that these contributions have risen over the last two decades with the increase in concentrated animal operation in the coastal region of our state (Whitall et al., 2003). A full report on the atmospheric contribution to the Neuse River can be found in Appendix VI.

Development

Land clearing activities for residential and commercial development, for road/highway construction as well as for timber harvest was noted as potential sources of water quality stressors. Streams where land clearing is a noted source are likely to be more heavily impacted in the future by increased development and impervious surfaces. Studies have demonstrated that water quality begins to decline when only 5 to 12 percent of a watershed is covered by impervious surfaces such as roads, rooftops and parking lots (Center for Watershed Protection, 2003).

Due to the chronic introduction of pollutants found in urban stormwater, along with an increase in both the velocity and flow of stormwater into streams, attention to stormwater control in urban areas is critical. Without proper BMPs, urban development can alter the hydrology of a watershed often resulting in downstream flooding, streambank erosion and severely degraded habitats.

The Division of Water Quality recommends the use of riparian buffers as well as better site design and development planning techniques to minimize the negative impacts of new development on water quality. Many local government ordinances would have to be modified in order to allow for this type of development. For more information on "better site design" techniques and model ordinances, go to the Center for Watershed Protections website http://www.cwp.org/Resource_Library/Better_Site_Design/index.htm#pwp.

Refer to Chapter 16 for more information related to population growth and land cover changes and its potential impacts on water quality.

Boats and Marinas

Currently, there are more than 360,000 boaters using North Carolina waterways each year (DCM website http://dcm2.enr.state.nc.us/Marinas/marinas.htm). The number of marinas in the Neuse River Estuary is projected to increase over the next several decades. There are development plans for several instream and upland marina in the area. Marinas can pose a great risk to water quality. In the Neuse River basin, the Division of Environmental Health reports that 45 acres of shellfish harvesting waters (in growing areas F-1 to F-7) are closed because of marina.

A large source of pollution from commercial and recreational boaters is sewage, along with litter and gasoline spills. Each can cause any number of problems, with wastewater carrying many different bacteria or viruses that impact human health. Bacteria also impact shellfish harvesting areas and recreational beaches.

Many boat owners add chlorine and formaldehyde to their wastewater holding tanks to control odor or to disinfect, which if released, can be toxic to aquatic life. Most of these chemical additives are now biodegradable; however, if the wrong amount or the wrong type is added, it can be toxic to aquatic life.

Sewage is also high in nutrients (i.e., nitrogen and phosphorus), which is the main reason the estuary is impaired. Sewage can also result in a decrease in dissolved oxygen levels which is required for the survival of aquatic organisms. These problems can become magnified in enclosed marinas and harbors where water circulation is poor.

The Clean Marina Program was initiated in 2000 by the Division of Coastal Management. This is a voluntary program designed to show that marina operators can help safeguard the environment by using management and operations techniques that go above and beyond regulatory requirements (for more information on the Clean Marina Program see section 22.2.8 or go to http://dcm2.enr.state.nc.us/Marinas/marinas.htm). DWQ encourages all marinas within the Neuse River basin to participate in the Clean Marina Program.

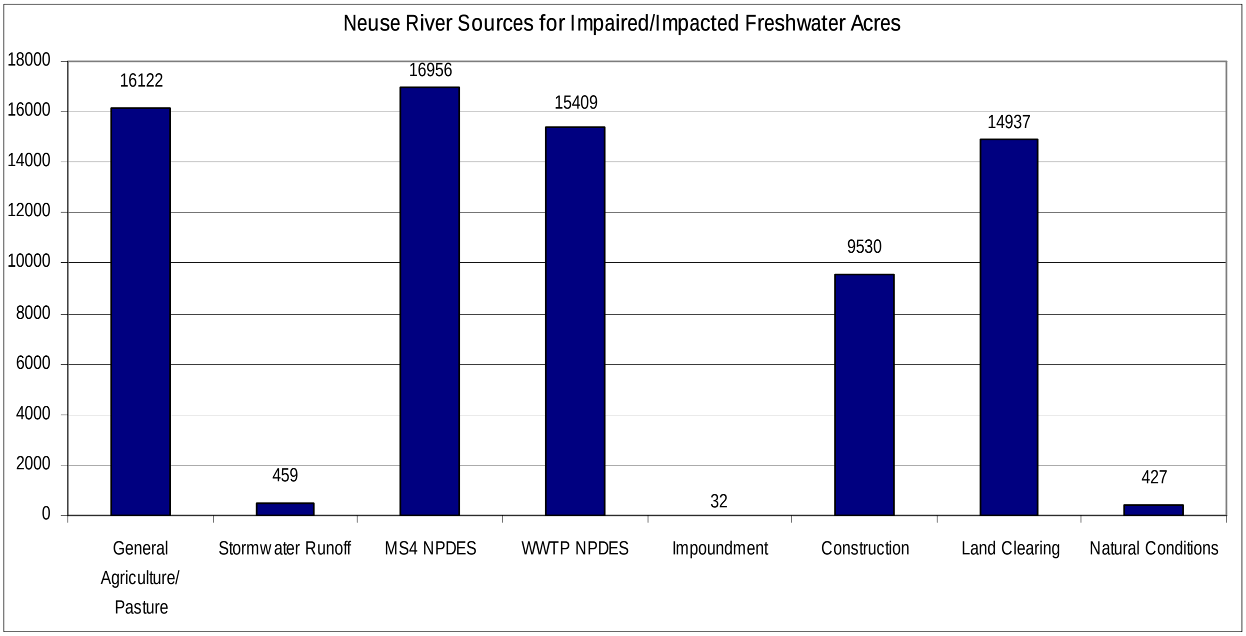


Figure 46 Sources Identified in Impaired/Impacted Freshwaters, in Acres

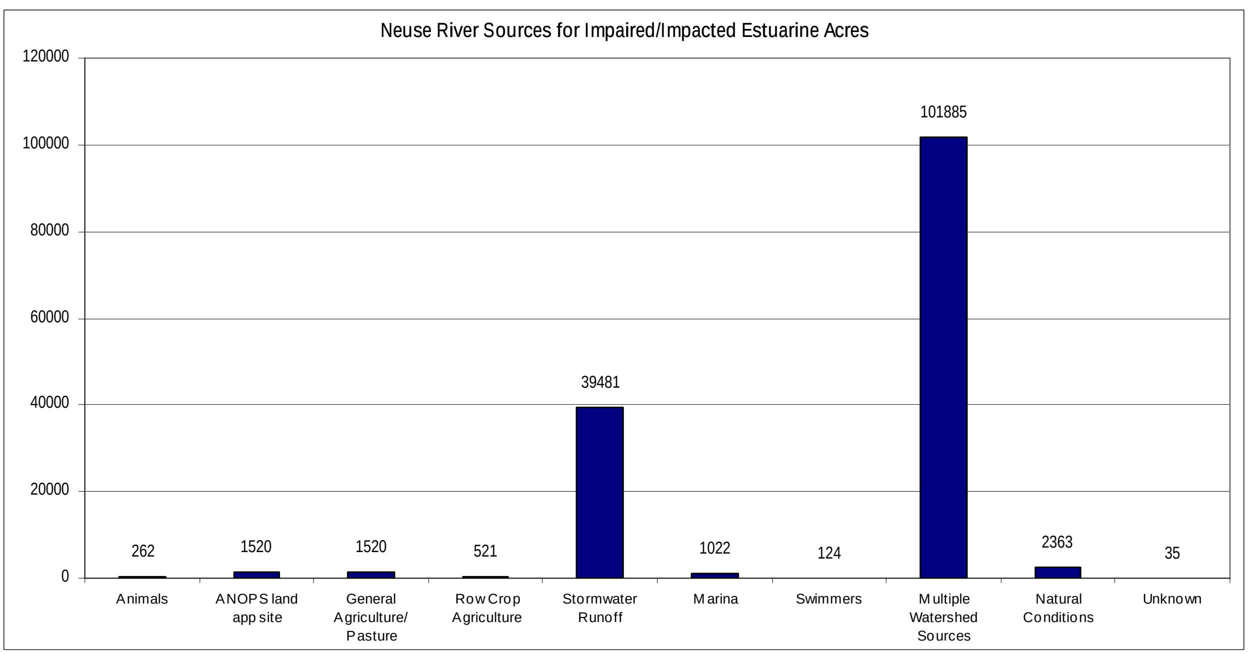


Figure 47 Sources Identified in Impaired/Impacted Estuarine Waters, in Acres

17.2 Aquatic Life Stressors - Habitat Degradation

17.2.1 Introduction and Overview

Instream habitat degradation is identified as a notable reduction in habitat diversity or a negative change in habitat. This term may include sedimentation, lack of organic (woody and leaf) habitats and channelization. These stressors to aquatic insect and fish communities can be caused by many different land use activities and less often by discharges of treated wastewater. In the Neuse River basin, 288 stream miles are Impaired where at least one form of habitat degradation has been identified as the stressor. There is an additional 593 stream miles where habitat degradation is a noted impact to water quality. Many of the stressors discussed below are either directly caused by or are a symptom of altered watershed hydrology. The altered hydrology increases both sources of stressors and delivery of stressors to receiving waters. Refer to the subbasin chapters (Chapters 1-14) for more information on the types of habitat degradation noted at sample locations and in watershed studies.

Some Best Management Practices

Agriculture

- No till or conservation tillage practices
- Strip cropping and contour farming
- Leaving natural buffer areas around small streams and rivers

Construction

- Using phased grading/seeding plans
- Limiting time of exposure
- Planting temporary ground cover
- Using sediment basins and traps

Forestry

- Controlling runoff from logging roads
- Replanting vegetation on disturbed areas
- Leaving natural buffer areas around small streams and rivers
- Avoid stream crossings during forest operations

Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (construction, mining, timber harvest and agricultural activities) or a large percentage of impervious surface area (Center for Watershed Protection, 2003).
A watershed in which most of the riparian vegetation has been removed from streams or channelization has occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well. All of these activities result in altered watershed hydrology.

Quantifying amounts of habitat degradation is difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and even more resources to restore the stream. Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been Impaired by activities that cause habitat degradation. As point sources become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation need to be addressed to further improve water quality in North Carolina's streams and rivers.

17.2.2 Sedimentation as a Stressor Related to Turbidity and Total Suspended Solids

Sedimentation is a natural process important to the maintenance of diverse aquatic habitats. Overloading of sediment in the form of sand, silt and clay particles fills pools and covers or embeds riffles that are vital aquatic insect and fish habitats. A diversity of these habitats is important for maintenance of biological integrity. Suspended sediment can decrease primary productivity (i.e. photosynthesis) by shading sunlight from aquatic plants, affecting the overall productivity of a stream system. Suspended sediment also has several effects on various fish species including avoidance and redistribution, reduced feeding efficiency, and therefore, reduced growth by some species, respiratory problems, reduced tolerance to diseases and toxicants, and increased physiological stress (Roell, 1999). Sediment filling rivers, streams and reservoirs also decreases their storage volume and increases the frequency of floods (NCDENR-DLR, 1998). Across the state, sediment overloading too many streams has reduced biological diversity to the point of the stream being Impaired for aquatic life.

Sediment comes from land-disturbing activities in a watershed. The cause of this form of sedimentation is erosion of land in the watershed. Land-disturbing activities such as the construction of roads and buildings, crop production, livestock grazing and timber harvesting can accelerate erosion rates by causing more soil than usual to be detached and moved by water.

Streambank erosion, caused by very high stormwater flows after rain events, is another source of sediment overloading. Watersheds with large amounts of impervious surfaces transport water to streams very rapidly and at higher volumes than occurs in watersheds with less impervious surfaces. In many urban areas, stormwater is delivered directly by storm sewers. This high volume and velocity of water after rain events undercuts streambanks causing bank failure and large amounts of sediment to be deposited directly into the stream. Many urban streams are adversely impacted by sediment overloading from the watershed as well as from the streambanks.

Sedimentation can be controlled during most land-disturbing activities by using appropriate BMPs. Substantial amounts of erosion can be prevented by planning to minimize the amount and time that land is exposed during land-disturbing activities and by minimizing impervious surface area and direct stormwater outlets to streams. Erosion can be controlled during most land-disturbing activities by using appropriate BMPs. In fact, erosion can substantially be prevented by minimizing the amount and time the land is exposed. DWQs role in sediment control is to work cooperatively with those agencies that administer sediment control programs to maximize the effectiveness of these programs and to protect water quality. Where programs are not effective, as evidenced by a violation of instream water quality standards, and where DWQ can identify a source, appropriate enforcement action can be taken. Generally, this entails requiring the landowner or responsible party to install acceptable BMPs.

As a result of new stormwater rules enacted by EPA in 1999, construction or land development activities that disturb one acre or more are required to obtain a NPDES stormwater permit. An erosion and sediment control plan must also be developed and approved for these sites under the state's Sedimentation Pollution Control Act (SPCA) administered by the NC Division of Land Resources. Site disturbances of less than one acre are required to use BMPs, but an approved plan is not required. Many local governments located in the Neuse basin are covered by a specific Neuse River Basin NSW Management Strategy stormwater rules. Details can be found in Chapter 24 and at http://h2o.enr.state.nc.us/nps/Neuse_NSW_Rules.htm. These rules were specifically designed to reduce nitrogen contribution from new development in these designated areas. It is apparent that these rules need to be extended beyond the original local governments covered in the initial stormwater rule.

Establishing, conserving and managing streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife (NCDENR-DWQ, 2004). To obtain a free copy of DWQs *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

A riparian buffer protection rule was also passed as part of the nutrient management strategy which requires that up to 50 feet of the riparian area be protected and maintained on the banks of waterways throughout the basin. This rule does not require establishment of new buffers unless the existing use of the buffer changes. A fact sheet on the Neuse riparian buffer rules can be found at http://h2o.enr.state.nc.us/nps/BufRulFakSheet-NeuseTP2-00.pdf or at the link above.

Channelization refers to the physical alteration of naturally occurring stream and riverbeds. Although increased flooding, bank erosion and channel instability often occur in downstream areas after channelization has occurred, flood control, reduced erosion, increased usable land area, greater navigability and more efficient drainage are frequently cited as the objectives of channelization projects (McGarvey, 1996). Direct or immediate biological effects of channelization include injury and mortality of benthic macroinvertebrates, fish, shellfish/mussels and other wildlife populations, as well as habitat loss. Indirect biological effects include changes in benthic macroinvertebrate, fish and wildlife community structures, favoring species that are more tolerant of or better adapted to the altered habitat (McGarvey, 1996). Channelization has occurred historically in parts of the Neuse River Basin and continues to occur in some watersheds, especially in small headwater streams.

17.2.3 Loss of Riparian Vegetation and Organic Aquatic Microhabitats

During the 2005 basinwide sampling, DWQ biologists reported degradation of aquatic communities at numerous sites throughout the Neuse River basin in association with narrow or nonexistent zones of native riparian vegetation. Riparian vegetation loss was common in rural and residential areas as well as in urban areas. The loss of riparian vegetation and subsequent reduction of organic aquatic habitats is caused by removal of riparian areas most commonly by land clearing for development, field agriculture, and pastureland as well as forestry and by grazing animals. Instream organic habitat removal has also been caused by de-snagging activities.

Removing trees, shrubs and other vegetation to plant grass or place rock (also known as riprap) along the bank of a river or stream degrades water quality. Removing riparian vegetation eliminates habitat for aquatic macroinvertebrates that are food for trout and other fish. Rocks or concrete lining a bank absorb the sun’s heat and warm the water. Some fish require cooler water temperatures as well as the higher levels of dissolved oxygen cooler water provides. Trees, shrubs and other native vegetation cool the water by shading it. Straightening a stream, clearing streambank vegetation, and lining the banks with grass or rock severely impact the habitat that aquatic insects and fish need to survive.

Establishing, conserving and managing streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife. To obtain a free copy of DWQs *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

Organic microhabitat (leafpacks, sticks and large wood) and edge habitat (root banks and undercut banks) play very important roles in a stream ecosystem. Organic matter in the form of leaves, sticks and other materials serve as the base of the food web for small streams. Additionally, these microhabitats serve as special niches for different species of benthic macroinvertebrates, providing food and/or habitat. For example, many stoneflies are found almost exclusively in leafpacks and on small sticks. Some beetle species prefer edge habitat, such as undercut banks. If these microhabitat types are not present, there is no place for these specialized macroinvertebrates to live and feed. The absence of these microhabitats in some streams in the Neuse River basin is directly related to the absence of riparian vegetation and increased flashiness of the streams. Organic microhabitats are critical to headwater streams, the health of which is linked to the health of the entire downstream watershed.

17.2.4 Channelization

Channelization refers to the physical alteration of naturally occurring stream and riverbeds. Channelization is caused by mechanical straightening of channels or by hydraulic overloading during rain events. Often streams in urban areas become channelized as part of the development process in essence using the stream channels as stormwater conveyances. Although increased flooding, bank erosion and channel instability often occur in downstream areas after channelization has occurred, flood control, reduced erosion, increased usable land area, greater navigability and more efficient drainage are frequently cited as the objectives of channelization projects (McGarvey, 1996).

Typical Channel Modifications

- Removal of any obstructions, natural or artificial, that inhibit a stream's capacity to convey water (clearing and snagging).
- Widening, deepening or straightening of the channel to maximize conveyance of water.
- Lining the bed or banks with rock or other resistant materials.

Channelization reduces the sinuosity of streams greatly increasing the velocity of water flowing down these streams. Direct or immediate biological effects of channelization include injury and mortality of benthic macroinvertebrates, fish, shellfish/mussels and other wildlife populations, as well as habitat loss. Indirect biological effects include changes in benthic macroinvertebrate, fish and wildlife community structures, favoring species that are more tolerant of or better adapted to the altered habitat (McGarvey, 1996).

Restoration or recovery of channelized streams may occur through processes, both naturally and artificially induced. In general, streams that have not been excessively stressed by the channelization process can be expected to return to their original forms. However, streams that have been extensively altered may establish a new, artificial equilibrium (especially when the channelized streambed has been hardened). In such cases, the stream may enter a vicious cycle of erosion and continuous entrenchment. Once the benefits of a channelization project become outweighed by the costs, both in money and environmental integrity, channel restoration efforts are likely to be taken (McGarvey, 1996).

Channelization of streams within the continental United States is extensive and promises to become even more so as urban development continues. Overall estimates of lost or altered riparian habitats within US streams are as high as 70 percent (U.S. Fish and Wildlife). Unfortunately, the dynamic nature of stream ecosystems makes it difficult (if not impossible) to quantitatively predict the effects of channelization (McGarvey, 1996). Channelization has occurred historically in parts of the Neuse River basin and continues to occur in some watersheds, especially in small headwater and coastal streams.

17.2.5 Recommendations for Reducing Habitat Degradation

In March 2002, the Environmental Management Commission (EMC) sent a letter to the Sedimentation Control Commission (SCC) outlining seven recommendations for improving erosion and sedimentation control, based on a comprehensive performance review of the turbidity standard conducted in 2001 by DWQ staff. Specifically, the recommendations are that the EMC and SCC:

1. Evaluate, in consultation with the Attorney General's Office, whether statutory authority is adequate to mandate temporary ground cover over a percentage of the uncovered area at a construction site within a specific time after the initial disturbance of the area. If it is found that statutory authority does not exist, then the EMC and SCC should prepare resolutions for the General Assembly supporting new legislation to this effect;

2. Prepare resolutions supporting new legislation to increase the maximum penalty allowed in the Sedimentation Pollution Control Act from $5,000 to $25,000 for the initial response to a noncompliant site;

3. Jointly support a review of the existing Erosion and Sediment Control Planning and Design Manual by DLR. This review should include, but not be limited to, a redesign of the minimum specifications for sedimentation basins;

4. Evaluate, in consultation with the Attorney General's Office, whether the statutory authority is adequate for effective use of the "Stop Work Order" tool and, if found not to be adequate, to prepare resolutions for the General Assembly supporting new legislation that will enable staff to more effectively use the "Stop Work Order" tool;

5. Support increased research into and experimentation with the use of polyacrylamides (PAMs) and other innovative soil stabilization and turbidity reduction techniques;

6. Jointly support and encourage the awarding of significant monetary penalties for all activities found to be in violation of their Stormwater Construction General Permit, their Erosion and Sediment Control Plan, or the turbidity standard; and

7. Hold those individuals who cause serious degradation of the environment through excessive turbidity and sedimentation ultimately responsible for restoration of the area.

DWQ will continue to work cooperatively with DLR and local programs that administer sediment control in order to maximize the effectiveness of the programs and to take appropriate enforcement action when necessary to protect or restore water quality. However, more voluntary implementation of BMPs is needed for activities that are not subject to these rules in order to substantially reduce the amount of widespread sedimentation present in the Neuse River basin. Additionally, more public education is needed basinwide to educate landowners about the value of riparian vegetation along small tributaries and the impacts of sedimentation to aquatic life.

Funding is available through numerous federal and state programs for landowners to restore and/or protect riparian buffer zones along fields or pastures, develop alternative watering sources for livestock, and fence animals out of streams (refer to Chapters 19 and Chapter 6 of the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm). EPA's *Catalog of Federal Funding Sources for Watershed Protection* (Document 841-B-99-003) outlines some of these and other programs aimed at protecting water quality. A copy may be obtained by calling the National Center for Environmental Publications and Information at (800) 490-9198 or by visiting the website at http://www.epa.gov/OWOW/watershed/wacademy/fund.html. Local contacts for various state and local agencies are listed in Appendix IV.

17.3 Aquatic Life Stressors – Water Quality Standard Violations

17.3.1 Introduction and Overview

In addition to the habitat stressors discussed in the previous section, the stressors discussed below are identified by water quality standards. These are usually direct measures of water quality parameters from ambient water quality monitoring stations. The water quality standards are designed to protect aquatic life. As with habitat degradation, altered watershed hydrology greatly increases the sources of these stressors as well as delivery of the stressors to the receiving waters. The following are water quality standards that were identified for waters with noted impacts. Refer to the subbasin chapters (Chapter 1 – 14) for more information on the affected waters.

17.3.2 Low Dissolved Oxygen

Maintaining an adequate amount of dissolved oxygen (DO) is critical to the survival of aquatic life and to the general health of surface waters. A number of factors influence DO concentrations including water temperature, depth, biological activity and turbulence. Oxygen-consuming wastes such as decomposing organic matter and some chemicals can reduce DO levels in surface water through biological activity and chemical reactions. NPDES permits for wastewater discharges set limits on certain parameters in order to control the effects that oxygen depletion can have in receiving waters.

Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state DO standard and at least 10 samples were collected. The DO water quality standard for Class C waters is not less than a daily average of 5 mg/l with a minimum instantaneous value of not less than 4 mg/l. Swamp waters (supplemental Class Sw) may have lower values if caused by natural conditions. In the Neuse River basin during this assessment period, there were 83 stream miles and 260 estuarine acres that are Impaired where low DO is a stressor. There were also over 370 freshwater stream miles where low DO is a stressor for waters with noted impacts, although many of these streams are in swampy areas where low DO levels are likely from natural sources.

17.3.3 Turbidity

The major sources of elevated turbidity are from agriculture and land clearing activities as well as from urban stormwater. These sources also add other pollutants beside suspended particulates. Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state turbidity standard and at least 10 samples were collected. The turbidity water quality standard for Class C waters is not to exceed 50 Nephelometric Turbidity Units (NTU). However, salt waters (SC, SB and SA) as well as lakes and reservoirs are not to exceed 25 NTUs. In the Neuse River basin during this assessment period, there were 86 stream miles and 2,700 freshwater acres of Falls Lake Impaired where turbidity is a stressor. There were also 95 freshwater stream miles, 32 freshwater acres and 918 estuarine/saltwater acres that are impacted where turbidity is a stressor. This is likely a more wide spread problem than the data indicates. Most storm events are not sampled which is when most of the sediment runoff occurs and when the streams in the Neuse River Basin are most likely violating water quality standards.

17.3.4 Chlorophyll *a* Algal Blooms

Algae are aquatic, microscopic plants, which respond to nutrients, temperature and light, and are an important food source for fish and other aquatic animals. Algae also contain pigments, including chlorophyll, which enable them to photosynthesize and produce oxygen. During summer, algae respond to warm temperatures, high light and nutrients washed into waterways after rain events and from treated wastewater. When temperatures and nutrient concentrations are elevated, algae reproduce to high concentrations ("bloom"). When this occurs at a particular site, chlorophyll *a*, dissolved oxygen (DO) and pH increase. When a site experiences dissolved oxygen concentrations >9 mg/l, DO percent saturation >110 percent, pH >8, or chlorophyll *a* concentrations exceed the state standard of 40 µg/l, the site is likely experiencing an algal bloom. When these algae die off or respire at night, dissolved oxygen can become very low; often resulting in fish kills. Algal blooms have been a problem in lakes, reservoirs and estuaries that are overloaded with nutrients (Wetzel, 2001).

Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state chlorophyll *a* standard of 40 µg/l and at least 10 samples were collected. In the Neuse River basin during this assessment period, there were 12,200 freshwater acres and 45,700 estuarine acres that are Impaired where chlorophyll *a* is a stressor. There were also 1,230 freshwater acres and 53,470 estuarine acres that are impacted where chlorophyll *a* is a stressor.

17.3.5 pH

Waters are Impaired for aquatic life when greater than 10 percent of samples collected either do not meet the state minimum pH standard or exceed the state maximum standard where at least 10 samples were collected. The pH water quality standard for Class C waters is between 6.0 and 9.0. For Class SC waters the standard is between 6.8 and 8.5. Swamp waters (supplemental Class Sw) may have lower values if caused by natural conditions. In the Neuse River basin during this assessment period, there were 7 stream miles and 260 estuarine acres that are Impaired where low pH is a stressor. There were 24,493 estuarine acres that are Impaired where high pH is a stressor. There were also 427 freshwater acres, 2,363 estuarine acres and 26 stream miles that are impacted where low pH is a stressor, although many of these streams are in swampy areas where low pH levels are likely from natural sources. An additional 426 estuarine acres were impacted where high pH is a stressor.

17.3.6 Nutrients

In Nutrient Sensitive Waters (NSW) like those of the Neuse River basin, nitrogen and phosphorus are the nutrients of most concern. Nutrients in surface waters come from both point and nonpoint sources including agriculture and urban runoff, wastewater treatment plants, forestry activities and atmospheric deposition. While nutrients are beneficial to aquatic life in small amounts, excessive levels can stimulate algal blooms and plant growth, depleting dissolved oxygen in the water column, resulting in fish kills.

In the Neuse River Basin, over 12,000 freshwater acres and 45,000 saltwater acres are impaired due to excessive nutrients resulting in chlorophyll *a* standard violations. The accumulative affect of these nutrients from upstream sources are seen in Falls Lake and the Neuse River Estuary.

17.4 Water Quality Stressors Impairing Surface Waters Recreational Uses

Bacteria live in the digestive tract of warm-blooded animals (humans as well as other mammals) and are excreted in their waste. Fecal coliform bacteria do not actually pose a danger to people or animals. However, where fecal coliform are present, disease-causing bacteria may also be present and water that is polluted by human or animal waste can harbor other pathogens that may threaten human health.

> ***Sources of Fecal Coliform in Surface Waters***
>
> - Urban stormwater
> - Wild animals and domestic pets
> - Improperly designed or managed animal waste facilities
> - Livestock with direct access to streams
> - Improperly treated discharges of domestic wastewater, including leaking or failing septic systems, straight pipes and WWTP overflows.

The presence of disease-causing bacteria tends to affect humans more than aquatic creatures. High levels of bacteria can indicate high levels of sewage or animal wastes that could make water unsafe for human contact (swimming). Fecal coliform bacteria and other potential pathogens associated with waste from warm-blooded animals are not harmful to fish and aquatic insects. However, high levels of bacteria may indicate contamination that increases the risk of contact with harmful pathogens in surface waters. Pathogens associated with fecal coliform bacteria can cause diarrhea, dysentery, cholera and typhoid fever in humans. Some pathogens can also cause infection in open wounds.

A number of factors beyond the control of any state regulatory agency contribute to elevated levels of disease-causing bacteria. Therefore, the state does not encourage swimming in surface waters. To assure that waters are safe for swimming indicates a need to test waters for pathogenic bacteria. Although bacteria standards have been used to indicate the microbiological quality of surface waters for swimming for more than 50 years, the value of this indicator is often questioned. Evidence collected during the past several decades suggests that the coliform group may not adequately indicate the presence of pathogenic viruses or parasites in water. The detection and identification of specific pathogenic bacteria, viruses and parasites such as *Giardia*, *Cryptosporidium* and *Shigella* are expensive, and results are generally difficult to reproduce quantitatively. Also, to ensure the water is safe for swimming would require a whole suite of tests for many organisms, as the presence/absence of one organism would not document the presence/absence of another. This type of testing program is not possible due to resource constraints.

17.4.1 DWQ Assesses the Recreation Use Support Category Based on Ambient Monitoring Data and DEH Program Recommendations

The recreation category is a human health related category intended to evaluate waters for the support of primary recreation activities such as swimming, water-skiing, skin diving, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis. Waters of the state designated for these uses are classified as Class B, SB and SA.

The use support ratings applied to this category are currently based on the state's fecal coliform bacteria water quality standard where ambient monitoring data are available, on the Division of Environmental Health (DEH) enterococci standard or on the duration of local or state health agencies posted swimming advisories. The advisories are based on the state's enterococcus bacteria standards.

DWQ and the LNBA conducts monthly ambient water quality monitoring that includes fecal coliform bacteria testing. The DEH tests coastal recreation waters (beaches) for bacteria levels to assess the relative safety of these waters for swimming. The Recreational Beach Monitoring Program determines the quality of coastal waters and beaches for suitability for bodily contact activities. Shoreline surveys of potential sources of pollution that could affect the area are also conducted. Swimming advisories are posted when bacteriological standards are exceeded or point source discharges are found. If an area has elevated bacteria levels, health officials will advise that people not swim in the area by posting a swimming advisory and by notifying the local media and county health department. Water samples are collected and analyzed for fecal coliform bacteria from numerous sampling stations located throughout the coastal area for both the shellfish and recreational programs.

Water quality standards for fecal coliform bacteria are intended to ensure safe use of waters for recreation (refer to Administrative Code Section 15A NCAC 2B .0200). The North Carolina fecal coliform standard for freshwater is (1) 200 colonies/100ml based on the geometric mean of at least five consecutive samples taken during a 30-day period or (2) not to exceed 400 colonies/100ml in more than 20 percent of the samples during the same period (5-in-30). In the Neuse River Basin, there are 597 Freshwater acres and 339 stream miles of where this standard was exceeded, causing these waters to be Impacted or Impaired. These waters are discussed in the subbasin chapters.

The AU being assessed for the five-year data window is Supporting in the recreation category if neither number (1) nor (2) of the standard are exceeded. The AU being assessed is Impaired in the recreation category if either number (1) or (2) is exceeded. Waters without sufficient fecal coliform bacteria data (five samples within 30 days) are Not Rated, and waters with no data are noted as having No Data.

DWQ uses DEH Recreational Water Quality Monitoring Program data to assign use support ratings. Waters are Impaired when swimming advisories are posted for more than 61 days during the five-year assessment period or the geometric mean is greater than 35 enterococci per 100 ml in at least 5 samples taken over a 30 day period. Waters with beach monitoring sites with advisories posted less than 61 days are Supporting. Other information can be used to Not Rate unmonitored waters.

Assessing the water quality standard requires significant sampling efforts beyond the monthly ambient monitoring sampling and must include at least five samples over a 30-day period. Decades of monitoring have demonstrated that bacteria concentrations may fluctuate widely in surface waters over a period of time. Thus, multiple samples over a 30-day period are needed to evaluate waters against the North Carolina water quality standard for recreational use support. Waters classified as Class SA, SB and B are targeted for this intensive sampling effort due to the greater potential for human body contact.

DWQ attempts to determine if there are any swimming areas monitored by state, county, or local health departments or by DEH. Each January, DEH, county, or local health departments are asked to list those waters which were posted with swimming advisories in the previous year.

17.5 Shellfish Harvesting Issues

17.5.1 DEH Classifications and Protocols

DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. Estuarine waters are delineated according to DEH shellfish management areas (e.g., Outer Banks, Area H-5), which include Class SA, SB and SC waters. DEH samples growing areas regularly and reevaluates the areas by conducting shellfish sanitation shoreline surveys every three years to determine if their classification is still applicable. DEH classifications may change after the most recent sanitary survey. Classifications are based on DEH bacteria sampling, locations of pollution sources, and the availability of the shellfish resource. Growing waters are classified as shown in Table 54.

Table 54 DEH Classification and Criteria

DEH Classification	DEH Criteria
Approved (APP)	**Fecal Coliform Standard for Systematic Random Sampling:** The median fecal coliform Most Probable Number (MPN) or the geometric mean MPN of the water shall not exceed 14 per 100 milliliters (ml), and the estimated 90th percentile shall not exceed an MPN of 43 MPN per 100 ml for a 5-tube decimal dilution test. **Fecal Coliform Standard for Adverse Pollution Conditions Sampling:** The median fecal coliform or geometric mean MPN of the water shall not exceed 14 per 100 ml, and not more than 10 percent of the samples shall exceed 43 MPN per 100 ml for a 5-tube decimal dilution test.
Conditionally Approved-Open (CAO)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be open more frequently than closed.
Conditionally Approved-Closed (CAC)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be closed more frequently than open.
Restricted (RES)	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited (PRO)	No Sanitary Survey; point source discharges; marinas; data do not meet criteria for Approved, Conditionally Approved or Restricted Classification.

17.5.2 Shellfish Sanitary Surveys and Program Protocols

The Shellfish Sanitation (SS) and Recreational Water Quality Section of the Division of Environmental Health is responsible for monitoring and classifying coastal waters as to their suitability for shellfish harvesting for human consumption, and inspection and certification of shellfish and crustacea processing plants.

The Shellfish Sanitation Program is conducted in accordance with the guidelines set by the Interstate Shellfish Sanitation Conference (ISSC) contained in the *National Shellfish Sanitation Program (NSSP) Guide for the Control of Molluscan Shellfish Model Ordinance*. The NSSP is administered by the US Food and Drug Administration (FDA). Classifications of coastal waters for shellfish harvesting are done by means of a Sanitary Survey, which includes: a shoreline survey of sources of pollution, a hydrographic and meteorological survey, and a bacteriological survey of growing waters. Sanitary Surveys are conducted for all potential shellfish growing areas in coastal North Carolina and recommendations are made to the Division of Marine Fisheries of which areas should be closed for shellfish harvesting.

17.5.3 How DWQ Assesses the Shellfish Harvesting Category Based on DEH Program Recommendations

Use support assessment is conducted such that the DEH classification is used to assign a use support rating for the shellfish harvesting category. By definition, Conditionally Approved-Open areas are areas that DEH has determined do not, or likely do not, meet water quality standards and these areas are rated Impaired, along with Conditionally Approved-Closed and Prohibited or Restricted areas. Only Approved areas are rated Supporting. DWQ also used DEH fecal coliform bacteria data, if the geometric mean is greater than 14 FCU/100 ml or more than 10 percent of the samples collected are greater than 43 CFU per 100 ml than the area is also considered impaired, even if DEH has classified the waters as approved. In the Neuse River Estuary, there is over 28,000 acres Impaired bases on one of these assessment methods.

17.6 Fish Consumption

17.6.1 Advice Related to Mercury

All waters in NC are Impaired based on a fish consumption advisory for mercury in large mouth bass by the NC Department of Health and Human Services (DHHS). See list below for other fish included in the NC fish consumption advisory.

The presence and accumulation of mercury in North Carolina's aquatic environment are similar to contamination observed throughout the country. Mercury has a complex life in the environment, moving from the atmosphere to soil, to surface water, and eventually, to biological organisms. Mercury circulates in the environment as a result of natural and human (anthropogenic) activities. A dominant pathway for mercury in the environment is through the atmosphere. Mercury emitted from industrial and municipal stacks into the ambient air can circulate around the globe. At any point, mercury may then be deposited onto land and water. Once in the water, mercury can accumulate in fish tissue and humans. Mercury is also commonly found in wastewater; however, mercury in wastewater is typically not at levels that could be solely responsible for elevated fish levels.

Fish is part of a healthy diet and an excellent source of protein and other essential nutrients. However, nearly all fish and shellfish contain trace levels of mercury. The risks from mercury in fish depend on the amount of fish eaten and the levels of mercury in the fish. In March 2003, the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) issued a joint consumer advisory for mercury in fish and shellfish. The advice is for women who might become pregnant, women who are pregnant, nursing mothers, and young children. Aside from being issued jointly by two federal agencies, this advisory is important because it emphasizes positive benefits of eating fish and gives examples of commonly eaten fish that are low in mercury. In the past, the FDA issued an advisory on consumption of commercially caught fish, while the EPA issued advice on recreationally caught fish.

By following these three recommendations for selecting and eating fish, women and young children will receive the benefits of eating fish and shellfish and be confident that they have reduced their exposure to the harmful effects of mercury. These recommendations are:

- **Do not eat shark, swordfish, king mackerel, or tilefish**. They contain high levels of mercury.
- Eat up to 12 ounces (two average meals) a week of a variety of fish and shellfish that are lower in mercury. Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish. Another commonly eaten fish, albacore ("white") tuna, has more mercury than canned light tuna. So, when choosing your two meals of fish, you may eat up to 6 ounces (one average meal) of albacore per week.
- Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas. If no advice is available, eat up to 6 ounces (one average meal) per week of fish you catch from local waters. Don't consume any other fish during that week.

For more detailed information, visit EPA's website at http://www.epa.gov/waterscience/fish/ or the FDA's website at http://www.cfsan.fda.gov/seafood1.html The FDA's food information toll-free phone number is 1-888-SAFEFOOD.

The NC Department of Health and Human Services (DHHS) also issues fish consumption advisories and advice for those fish species and areas at risk for contaminants. DHHS notifies people to either limit consumption or avoid eating certain kinds of fish. While most freshwater fish in North Carolina contain very low levels of mercury and are safe to eat, several species have been found to have higher levels. More information regarding use support assessment methodology related to fish consumption advisories and advice can be found at http://h2o.enr.state.nc.us/tmdl/General_303d.htm. Due to high levels of mercury in seventeen saltwater and five freshwater fish species, the DHHS offers the following health advice (updated March 31, 2006).

Women of childbearing age (15 to 44 years), pregnant women, nursing women, and children under 15:

- **Do not eat** the following ocean fish: almaco jack, banded rudderfish, canned white tuna (albacore tuna), cobia, crevalle jack, greater amberjack, south Atlantic grouper (gag, scamp, red, and snowy), king mackerel, ladyfish, little tunny, marlin, orange roughy, shark, Spanish mackerel, swordfish, tilefish, or tuna (fresh or frozen).

- **Do not eat** the following freshwater fish: bowfin (blackfish), catfish (caught wild), chain pickerel (jack fish), or warmouth caught in North Carolina waters south and east of Interstate 85.
- **Do not eat** largemouth bass caught in North Carolina waters (statewide).
- Eat up to two meals per week of other fish. A meal is 6 ounces of cooked fish for adults or 2 ounces of cooked fish for children under 15.

All other people:

- Eat no more than one meal (6 ounces) per week of ocean and/or freshwater fish listed above. These fish are often high in mercury.
- Eat up to four meals per week of other fish. A meal is 6 ounces of cooked fish for adults or 2 ounces of cooked fish for children under 15.

17.6.2 Neuse River Basin Site Specific Advisories

<u>Neuse River, Wake County, just below Crabtree Creek to Auburn-Knightdale Road</u>
Pollutant - Polychlorinated biphenyls (PCBs) **Date Issued** - 4/2/08
Limit consumption of carp and catfish to no more than one meal per month. High levels of chemicals called PCBs may be found in carp and catfish from these waters.

<u>Walnut Creek and Rocky Branch, Wake County, just upstream of the Neuse River</u>
Pollutant - Polychlorinated biphenyls (PCBs) **Date Issued** - 4/2/08
Limit consumption of carp and catfish to no more than one meal per month and limit consumption of all other fish to no more than one meal per week from these waters. High levels of chemicals called PCBs may be found in these fish.

<u>Crabtree Creek, Wake County, above Lake Crabtree and below Lake Crabtree to where it enters the Neuse River</u>
Pollutant - Polychlorinated biphenyls (PCBs) **Date Issued** - 3/31/06
Limit consumption of carp, catfish, and largemouth bass from Crabtree Creek to no more than one meal per month. High levels of chemicals called PCBs have been found in carp, catfish, and largemouth bass from these waters.

<u>Brier Creek, Wake County (downstream of Brier Creek Reservoir), Lake Crabtree, Wake County</u>
Pollutant - Polychlorinated biphenyls (PCBs) **Date Issued** - 5/7/04
Brier Creek - Do not eat any fish from Brier Creek. High levels of chemicals called PCBs have been found in the fish. Swimming, boating, and other recreational activities present no known significant health risks from PCBs and are not affected by this advisory. PCB-related risks, if any, from these activities have been shown to be negligible. If future testing reveals new information, then new advice will be given and new signs will be issued.
Lake Crabtree - Do not eat carp or catfish from Lake Crabtree. High levels of chemicals called PCBs have been found in these fish. Limit consumption of all other fish from Lake Crabtree to no more than one meal per month. When in doubt about the fish species, do not eat any of the fish. Swimming, boating, and other recreational activities present no known significant health risks from PCBs and are not affected by this advisory. PCB-related risks, if any, from these

activities have been shown to be negligible. If future testing reveals new information, then new advice will be given and new signs will be issued.
Note: These advisories are an extension of the fish advisories that were issued upstream along Little Brier Creek and Brier Creek Reservoir in December 2003 (see below).

Little Brier Creek, Wake County (downstream of Brier Creek Parkway), tributaries to Little Brier Creek, and Brier Creek Reservoir
Pollutant - Polychlorinated Biphenyls **Date Issued** - 12/8/03
Do not eat fish from Little Brier Creek (downstream of Brier Creek Parkway), its tributaries, and Brier Creek Reservoir. Fish from these waters are not safe to eat. High levels of chemicals (PCBs) have been found in the fish.

For more information and detailed listing of site-specific advisories, visit the NCDHHS website at http://www.epi.state.nc.us/epi/fish/index.html or call (919) 733-3816.

Chapter 18
Stormwater and Wastewater Management for Improved Water Quality

18.1 Introduction to Stormwater Runoff

Stormwater runoff is rainfall or snowmelt that runs off the ground or impervious surfaces (e.g., buildings, roads, parking lots, etc.). In some cases, it drains directly into streams, rivers, lakes, and oceans. In other cases, particularly in urbanized areas, stormwater drains into streets and manmade drainage systems consisting of inlets and underground pipes, commonly referred to as a storm sewer system. Storm sewer systems are designed simply to capture the stormwater and convey it to the nearest surface water without treatment. These sewers should not be confused with sanitary sewers, which transport human and industrial wastewaters to a treatment plant before discharging into surface waters.

Common stormwater pollutants include sediment, nutrients, organic matter, bacteria, oil and grease, and toxic substances (e.g., metals, pesticides, herbicides, hydrocarbons). Stormwater can also impact the temperature of a surface waterbody, which can affect the water's ability to support certain fish and aquatic communities.

Uncontrolled stormwater runoff has many impacts on both humans and the environment. Cumulative effects include flooding, undercut and eroding streambanks, widened stream channels, threats to public health and safety, impaired recreational use, and increased costs for drinking and wastewater treatment. For more information on stormwater runoff, visit the DWQ Stormwater Permitting Unit at http://h2o.enr.state.nc.us/su/stormwater.html or Chapter 5 of the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm.

18.2 Stormwater Programs

There are many different stormwater programs administered by DWQ. One or more of these programs affects many communities in the Neuse River basin. The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. Those programs try to accomplish this goal by controlling the source(s) of pollutants. These programs include National Pollutant Discharge Elimination System (NPDES) Phase I and II, coastal county stormwater requirements, HQW/ORW stormwater requirements, Neuse River basin NSW stormwater requirements, Universal Stormwater Management Program (USMP) and requirements associated with the Water Supply Watershed Program. Local governments that are or may be affected by these programs are presented in Table 55.

Table 55 Communities in the Neuse River with Stormwater Requirements

Local Government	NPDES Phase I	NPDES Phase II*	NPDES Phase II Post Construction Only	Neuse NSW Stormwater Rules	Coastal Stormwater Rules	Water Supply Watershed Stormwater Requirements
Apex		X				X
Ayden		X				
Bailey			X			
Benson		*				
Cary		X		X		X
Clayton						X
Creedmoor						X
Durham	X	X		X		X
Eureka			X			
Farmville		*	X			
Fountain			X			
Fremont			X			
Fuquay-Varina		X				
Garner		X		X		X
Goldsboro		X		X		X
Grifton			X			
Havelock		*		X	X	
Hillsborough		X				X
Holly Springs		X				
Kinston		*		X		
Kenly		*				
Knightdale		X				
Middlesex			X			
Morrisville		X				X
Mount Olive			X			
New Bern				X	X	
Pikeville			X			
Princeton			X			X
Raleigh	X	X		X		X
Rolesville		X				X
Roxboro		*				X
Selma						X
Seven Springs			X			
Smithfield		*		X		X
Stem						X
Wake Forest		X				X
Walnut Creek			X			
Trent Woods		*				

	NPDES			Neuse NSW Stormwater Rules	Coastal Stormwater Rules	Water Supply Watershed Stormwater Requirements
Local Government	Phase I	Phase II*	Phase II Post Construction Only			
Wendell		*	X			
Wilson		*		X		X
Winterville		X				
Zebulon		*	X			
Counties						
Beaufort					X	
Carteret					X	
Craven					X	
Durham		X		X		X
Franklin		X				X
Granville						X
Green						
Johnston				X		X
Lenoir						
Nash		X				X
Onslow		X			X	
Orange		X		X		X
Pamlico					X	
Person						X
Pitt		X				
Wake		X		X		X
Wayne		X		X		X
Wilson						X

* Session Law 2006-246 provides for the expansion of Phase II requirements, designation criteria include proximity to impaired waters, TMDL designations, more than 4,000 housing units or population greater than 10,000. Neuse municipalities will be reviewed for additional designations in 2009.

DWQs Stormwater Permitting Unit webpage: http://h2o.enr.state.nc.us/su/index.htm provides links to the stormwater BMP manual, a map tool to identify where to file a permit and guidance on North Carolina's evolving stormwater programs. A description of Federal and State stormwater regulations and programs are also described in detail in Chapter 5 of the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm. The Neuse River basin NSW stormwater requirements are described in Chapter 24. On August 9, 2008, Governor Easley signed the revised Coastal Stormwater Rules (SB 1967) into law. This final bill was the result of a stakeholder meeting process that included representatives of the regulated community, environmental advocacy groups, state and local governments and many other organizations. They go into effect October 1, 2008. For more information on the Coastal Stormwater Rules go to http://h2o.enr.state.nc.us/su/coastal.htm.

Stormwater Regulation Challenges

One challenge in meeting the goal of enhancing and protecting water quality is the state's inaccurate or lack of location data to identify permitted stormwater discharges. This permit data is important to DWQ for both tracking and renewing permits, assessing the program, and determining potential cumulative impacts. Discharge outfall locations are also important to compliment protection and restoration efforts by other organizations. In particular, the Division of Environmental Health needs to include the data in their extensive surveys of pollution sources for shellfish growing areas.

To correct this problem, updating discharge locations began in 2005 to include GPS coordinates of outfalls and digital photographs. DWQ is working with regional offices to ensure data entry is consistent and a protocol exists for collecting GPS coordinates in a consistent manner at permitted sites. As a result of the 2005-2006 municipal outfalls updates the number of untreated stormwater outfalls detected are listed in Table 56 below:

Table 56 Stormwater Outfalls (2005-06)

Municipality	Number of Outfalls Identified
Bridgeton	8
New Bern	18
Oriental	5
River Bend	8

18.3 Wastewater Management Programs

18.3.1 NPDES Wastewater Discharge Permit Summary

Discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge are broadly referred to as 'point sources'. Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater collection systems for municipalities and stormwater discharges associated with certain industrial activities. Point source dischargers in North Carolina must apply for and obtain a NPDES permit. Discharge permits are issued under the NPDES program, which is delegated to DWQ by the Environmental Protection Agency (EPA).

Currently, there are 136 permitted wastewater dischargers in the Neuse River basin. Table 57 provides summary information (by type and subbasin) about the discharges. The types of dischargers listed in the table are described in the inset box. Facilities are mapped in each subbasin chapter, and a complete listing of permitted facilities is included in Appendix III.

Table 57 Summary of NPDES Dischargers and Permitted Flows for the Neuse River Basin.

	Subbasins														
Facility Categories	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	*TOTAL*
Total Facilities	**16**	**53**	**14**	**1**	**6**	**4**	**15**	**2**	**3**	**13**	**3**	**3**	**3**	**0**	**136**
Total Permitted Flow (MGD)	29.4388	133.384625	25.97335	1.9	35.8	0.657	23.7474	32.2	0.316	11.5599	0.427	0.308	0.0	0.0	296.1737
Facilities Grouped by Size															
Major Discharges	**3**	**6**	**3**	**1**	**3**	**0**	**4**	**1**	**0**	**3**	**0**	**1**	**0**	**0**	**25**
Permitted Flow (MGD)	25.8	114.0	25.6	1.9	33.05	0.0	22.55	32.0	0.0	10.6	0.0	0.0	0.0	0.0	268.2
Minor Discharges	**13**	**47**	**11**	**0**	**3**	**4**	**11**	**1**	**3**	**10**	**3**	**2**	**3**	**0**	**111**
Permitted Flow (MGD)	3.6388	19.384625	0.37335	0.0	2.75	0.657	1.1974	.2	0.316	0.9599	0.4	.308	0.0	0	27.9737
Facilities Grouped by Type															
100% Domestic Waste	**5**	**20**	**4**	**0**	**0**	**2**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**34**
Permitted Flow (MGD)	0.3788	2.5334	0.36	0.0	0.0	0.024	0.033	0.0	0.0	0.5	0.0	0.0	0.0	0.0	3.8292
Municipal Facilities	**3**	**5**	**3**	**1**	**3**	**1**	**8**	**0**	**1**	**2**	**2**	**1**	**0**	**0**	**30**
Permitted Flow (MGD)	25.8	109.0	25.6	1.9	30.2	0.63	23.71	0.0	0.3	7.075	0.4	.275	0.0	0.0	227.59
Nonmunicipal Facilities	**8**	**28**	**7**	**0**	**3**	**1**	**5**	**2**	**2**	**10**	**1**	**2**	**3**	**0**	**72**
Permitted Flow (MGD)	3.26	21.851225	0.01335	0.0	5.6	0.009	0.0044	32.2	0.016	3.9849	0.027	0.033	0.0	0.0	64.7545

Note: 1) Data pull - October 17, 2008
2) Some flow totals equal zero due to no limit on flow.
3) Major Discharger defined as – Wastewater treatment plants with flows ≥ 1 MGD
(million gallons per day); and some industrial facilities(depending on flow and potential impacts to public health and water quality).

18.3.2 NPDES Wastewater Non-Discharge Permit Summary

The Land Application Unit (LAU) in the Aquifer Protection Section of DWQ oversees non-discharge wastewater treatment and recycling systems including land application of wastewater and residuals. The program has operational and monitoring requirements similar to those of the NPDES wastewater program; however, the primary difference is that the treated effluent is not discharged to surface waters. Instead, it is usually discharged to a spray irrigation system for land application. Some other options for the land application of effluent include rapid infiltration basins and drip irrigation systems.

Systems that are reviewed and permitted by LAU include spray irrigation systems, animal waste management systems, rapid infiltration basins, drip irrigation systems, land application of residuals, wastewater collection systems, and beneficial reuse of wastewater systems. The non-discharge program and all associated permits, is regulated by North Carolina General Statutes 143.215.1 and Administrative Code Section 15A NCAC 2T .0100 - Waste Not Discharged to Surface Waters. These sections not only give DWQ the authority to issue permits, but they also provide details on the permitting process and information that must be submitted with a permit application.

Every wastewater treatment facility in the State of North Carolina, including large NPDES facilities, pretreatment systems and non-discharge systems, produce some form and amount of wastewater residuals. DWQ requires a permit for the land application of these residuals. The program was developed around the EPA rules 40 CFR Part 257 and 40 CFR Part 503.

Within the coastal portion of the Neuse River Basin, it is important to note that there is a direct connection between groundwater and surface water in many places. Drainage ditches and canals are widespread in eastern NC and function as a direct pathway for groundwater that may be impacted from nutrients and coliform bacteria, especially in rural areas where agriculture is widespread, to enter into the surface water system. In other cases, surface water bodies, themselves, directly border areas where groundwater quality may be impaired. In many areas, the time it takes for groundwater to move into the surface water system is brief (Harden and Spruill, 2008). Although groundwater quality at non-discharge facilities may be compliant with 2L groundwater quality standards, groundwater flux moving into the surface water system has the ability to transport contaminants into surface water bodies and add to total mass loadings. It is recommended that research be conducted to better establish and understand the relationship between groundwater and surface water in eastern North Carolina. Such understanding would provide for more accurate assessment of surface water impairments resulting from groundwater discharges and enable the state to make sound permitting judgments and recommendations to better protect water quality in general.

Many non-discharge systems are constructed by the developer and turned over to a homeowners association (HOA) after completion. If there is a major problem, the HOA is responsible for the repair bill and funding the repair can be an issue. For systems that will be or are owned by a HOA, the statutes and rules require special accounts be set up by the HOA for the operation of the treatment system. In addition, the HOA must set up a reserve fund for major repairs.

Non-discharge systems create some challenges for the DWQ regional offices in terms of inspections and assuring permit and compliance conditions are met. DWQ may seek additional staffing resources to meet these challenges. One of DWQs goals is to better review covenants and bylaws upon permit review to make sure that HOAs are adhering to the financial assuredness requirements under the permit.

In the Neuse River basin, 268 non-discharge permits have been issued. More information about non-discharge permits can be found on the DWQ LAU Web site (http://h2o.enr.state.nc.us/lau/main.html) and in the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm).

18.3.2.1 Coastal Wastewater Management Strategies

New development activities in coastal areas frequently rely on non-discharge systems for wastewater treatment and disposal. These treatment systems are designed to satisfy at least the minimum permitting requirements for protection of the surface and ground waters that they could potentially impact. Permitted non-discharge facilities can be a good alternative to permitted surface water discharges when appropriately permitted based on site conditions for disposal and treatment. The new rules for waste not discharged to surface waters can be found at: http://h2o.enr.state.nc.us/admin/rules/documents/2Tbook.pdf as 15A NCAC 02T. Numerous non-discharge systems and necessary treatment requirements are described at this website. These rules replaced the earlier 15A NCAC 02H .0200 rule version and are used in concert with 15A NCAC 02H .0400 rules (Coastal Waste Treatment Disposal Rules).

Reuse quality treatment may use infiltration ponds, but many systems use a sprayfield area with known soil types and crop designations along with hydraulic limits for disposal. Older, smaller package plants often have rotary distributor disposal systems, although these are becoming outdated and are being replaced by drip irrigation or small spray systems.

Setbacks are required for surface waters, drainage ditches and waterways for all irrigation sites. The land surface provides a final "treatment" phase in the disposal process, allowing for uptake and often vegetative removal of nutrients and/or fecal coliform bacteria that may be present in plant effluent depending on the level of treatment permitted for a given facility. However, the effectiveness of this treatment depends upon the ability of the cover crops to take up the nutrients. In addition, the coarse grain sands do not always provide adequate adsorption and retention time before it enters groundwater. With the promulgation of the Subchapter 02T rules, high-rate systems must meet more stringent effluent limitations and/or increased setbacks.

If the water table is high in a disposal area, water level meters are installed to prevent irrigation until there is a certain vertical separation between the land surface and the water table. Runoff is a real concern at any irrigation site, but it can be prevented with proper hydraulic loading (water balance), buffering, and storage.

Another issue that can be associated with non-discharge systems is the installation of high rate infiltration systems in very densely developed areas. The high rate systems, combined with low-pressure systems and individual septic tank systems, can overload the upper groundwater aquifer in coastal areas. These conditions make it very difficult to conduct meaningful groundwater compliance monitoring because of the large number of neighboring influences from septic systems. Some solutions include effluent monitoring limits combined with more effective bacteriological treatment, increased denitrification, centralized waste treatment or limiting growth.

Non-discharge systems work well when the site is conducive to infiltration. However, problems can arise when the site is a low-lying area with a high groundwater table (thereby inhibiting infiltration), or with nearby wetlands or ditches that can act as a conduit for runoff. Most non-discharge spray irrigation sites have storage ponds that would allow the wastewater to be held until appropriate to spray.

Many non-discharge systems are constructed by developers and turned over to a homeowners association (HOA) after completion. If there is a major problem, the HOA is responsible for the repair bill and funding the repair can be an issue. For systems that will be or are owned by a HOA, the statutes and rules require special accounts be set up by the HOA for the operation of the treatment system. In addition, the HOA must set up a reserve fund for major repairs.

There are also "space" issues to consider. Although a designated green space area (in essence a repair area) is required for a coastal project, the repair solution can still be difficult to implement due to limited space to work in.

Non-discharge systems create some challenges for the DWQ regional offices in terms of inspections and assuring permit and compliance conditions are met. DWQ may seek additional staffing resources to meet these challenges. One of DWQs goals is to better review covenants and bylaws upon permit review to make sure that HOAs are adhering to the financial assuredness requirements under the permit.

18.4 On-Site Waste Management

North Carolina has enacted laws and adopted rules that mandate significant requirements for inspection and review of On-site Waste System (OSWS) performance. Siting, sizing, inspections, approvals, and permitting are the responsibilities of County Health Departments through their local authorized agents, but engineers and regional soil specialists are called upon for training, authorization, informal appeals, and consultation with environmental health specialists. Enforcement of onsite wastewater rules and laws is the responsibility of the local environmental health specialists. For more information on NC state rules pertaining to site evaluations and soil suitability for septic systems see http://www.deh.enr.state.nc.us/osww_new/images/Rules/1900RulesJune2006.pdf.

Septic Systems and Straight Piping

With increase in development there is an increase in demand for individual wastewater treatment systems requiring higher flows on smaller tracks of land. Wastewater from many households is not treated at wastewater treatment plants associated with NPDES discharge permits. Instead, it is treated on-site through the use of permitted septic systems. Poorly planned and/or maintained systems can fail and contribute to nonpoint source pollution. Wastewater from some of these homes illegally discharges directly to streams through what is known as a "straight pipe". In other cases, wastewater from failing septic systems makes its way to streams or contaminates groundwater. Straight piping and failing septic systems are illegal discharges of wastewater into waters of the State.

With on-site septic systems, the septic tank unit treats some wastes and the drainfield provides further treatment and filtration of the pollutants and pathogens found in wastewater. A septic system that is operating properly does not discharge untreated wastewater to streams and lakes or to the ground’s surface where it can run into nearby surface waters. Septic systems are a safe and effective long-term method for treating wastewater if they are sited, sized and maintained properly. If the tank or drainfield are improperly located or constructed, or the systems are not maintained, nearby wells and surface waters may become contaminated, causing potential risks to human health. Septic tanks must be properly installed and maintained to ensure they function properly over the life of the system. Information about the proper installation and maintenance of septic tanks can be obtained by calling the environmental health sections of the local county health departments. See Appendix IV for contact information.

Discharge of untreated or partially treated sewage can be extremely harmful to humans and the aquatic environment. Pollutants from illegally discharged household wastewater contain chemicals, nutrients, disease pathogens and endocrine disrupting chemicals. Although DWQs ambient monitoring of the waters in the Pasquotank River basin show a relatively small percentage of fecal coliform bacteria samples exceeding state standards for primary recreation, smaller streams may contain a higher concentration of bacteria and other pollutants. The economies of the counties in this basin are highly dependent upon river recreation, especially for tourists and seasonal residents.

2008 Recommendations
In order to protect human health and maintain water quality failing septic systems should be repaired, older systems must be updated, and straight pipes must be eliminated. Additional monitoring of fecal coliform throughout tributary watersheds will aid in identifying where straight pipes and failing septic systems are problems. Furthermore, precautions should be taken by local septic system permitting authorities to ensure that new systems are sited and constructed properly and an adequate repair area is also available. County, town and city planners need to understand the economic and human health ramifications caused by unsatisfactory septic systems and plan for long-term septic system sustainability. In areas where soils prevent individual septic systems a collective community septic system in appropriate soils may allow for sustainable development where a centralized sewer system is not available. Educational information should also be provided to new septic system owners regarding the maintenance of these systems over time. For more information please see Chapter 9 in the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans*. http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm.

DENR On-Site Wastewater System Management
DENR has several initiatives related to on-site wastewater education, including current literature and scientific evaluation of potential pollutants from On-site Wastewater Systems. The Division of Environmental Health (DEH) On-Site Wastewater Section has an active grant-seeking program. Current successful grants include those to the Wastewater Discharge Elimination (WaDE) program for eliminating straight pipes and failing systems, nonpoint source coordinator grants for fate and transport of microbes in the shellfish areas, endocrine disrupting chemicals and pharmaceuticals, and an on-site management grant. The DEH Shellfish Sanitation and Recreational Water Quality Section also have significant involvement with on-site wastewater inspections and protection of water quality in the CAMA counties. Sanitary Surveys are conducted for the shellfishing harvesting areas, which include inspecting on-site wastewater discharges. On-site wastewater systems are inspected once every year as a drive-by or shoreline observation, and every three years door-to-door inspections. The Division of Waste Management oversees the septage management firms and septage disposal in NC.

Chapter 19
Agriculture and Water Quality

19.1 Animal Operations

Over the years, key legislative bills were introduced and approved to regulate concentrated animal feeding operations (CAFOs) in the State of North Carolina. In May 2006, the Environmental Management Commission (EMC) adopted Title 15A Subchapter 02T. The rules reflect current policy and provide routine consideration of an applicant's compliance status. Section .1300 of Subchapter 02T applies to all persons proposing to construct, modify, expand or operate an animal waste management system. Animal waste is defined as livestock or poultry excreta or mixture of excreta with feed, litter, bedding or other material generated at a feedlot. Animal waste management systems are defined as a combination of structural and nonstructural practices that collect, treat, store or apply animal waste to the land. An animal waste management plan is defined as a plan to properly collect, store, treat or apply animal waste to the land in an environmentally safe manner developed in accordance with the General Statute §143-215.10C (www.ncleg.net/EnactedLegislation/Statutes/HTML/BySection/Chapter_143/GS_143-215.10C.html).

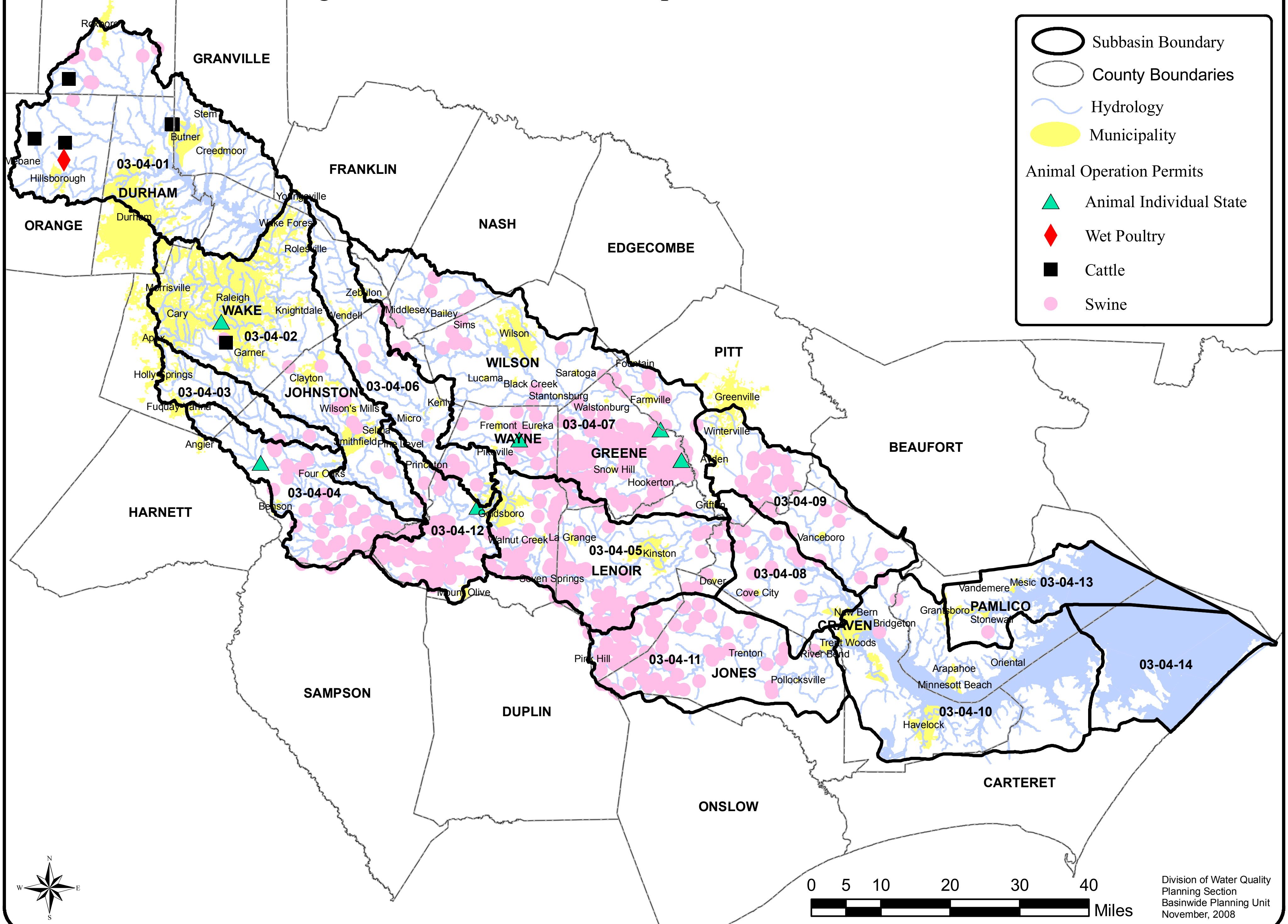
Table 58 summarizes the number of permitted livestock operations/facilities by animal type and the total number of animals permitted for each subbasin. These numbers reflect only operations required by law to be permitted, and therefore, do not represent the total number of animals in each subbasin. The Neuse River basin contains approximately 507 permitted animal operations, including cattle, poultry and hog farms, as shown in Figure 34. Data is from DWQ BIMS database (November 2008).

Table 58 Permitted Animal Operations

	Cattle		Swine		Poultry	
Subbasin	**No. of Facilities**	**No. of Animals**	**No. of Facilities**	**No. of Animals**	**No. of Facilities**	**No. of Animals**
03-04-01	5	1,080	8	7,980	1	60,000
03-04-02	1	192	10	24,378	--	--
03-04-03	--	--	2	1,180	--	--
03-04-04	--	--	47	165,560	--	--
03-04-05	--	--	92	308,525	--	--
03-04-06	--	--	12	26,472	--	--
03-04-07	--	--	152	584,072	--	--
03-04-08	--	--	13	37,718	--	--
03-04-09	--	--	30	107,501	--	--
03-04-10	--	--	3	8,409	--	--
03-04-11	--	--	68	304,520	--	--
03-04-12	--	--	63	238,511	--	--
03-04-13	--	--	1	1,119	--	--
03-04-14	--	--	--	--	--	--
Totals	**6**	**1,272**	**500**	**1,815,945**	**1**	**60,000**

Data from DWQ BIMS database - November 2008.

Figure 34 Permitted Animal Operations in the Neuse Basin



Division of Water Quality
Planning Section
Basinwide Planning Unit
November, 2008

19.2 Agricultural Best Management Practices and Funding Opportunities

19.2.1 NC Agriculture Cost Share Program

The NC Agricultural Cost Share Program (NCACSP) was established in 1984 to help reduce agricultural nonpoint runoff into the state's waters. The program helps owners and renters of established agricultural operations improve their on-farm management by using best management practices (BMPs). These BMPs include vegetative, structural or management systems that can improve the efficiency of farming operations while reducing the potential for surface and groundwater pollution. The NCACSP is implemented by the Division of Soil and Water (DSWC), which divide the approved BMPs into five main purposes or categories.

- *Sediment/Nutrient Delivery Reduction from Fields*
  Sediment/nutrient management measures include planned systems that prevent sediment and nutrient runoff from fields into streams. Practices include: field borders, filter strips, grassed waterways, nutrient management strategies, riparian buffers, water control structures, streambank stabilization, and road repair/stabilization.

- *Erosion Reduction/Nutrient Loss Reduction in Fields*
  Erosion/nutrient management measures include planned systems for reducing soil erosion and nutrient runoff from cropland into streams. Practices include: critical area planting, cropland conversion, water diversion, long-term no-till, pastureland conversion, sod-based rotation, stripcropping, terraces, and Christmas tree conservation cover.

- *Stream Protection from Animals*
  Stream protection management measures are planned systems for protecting streams and streambanks. Such measures eliminate livestock access to streams by providing an alternate watering source away from the stream itself. Other benefits include reduced soil erosion, sedimentation, pathogen contamination and pollution from dissolved, particulate, and sediment-attached substances. Practices include: heavy use area protection, livestock exclusion (i.e., fencing), spring development, stream crossings, trough or watering tanks, wells, and livestock feeding areas.

- *Proper Animal Waste Management*
  A waste management system is a planned system in which all necessary components are installed for managed liquid and solid waste to prevent or minimize degradation of soil and water resources. Practices include: animal waste lagoon closures, constructed wetlands, controlled livestock lounging area, dry manure stacks, heavy use area protection, insect and odor control, stormwater management, waste storage ponds/lagoons, compost, and waste application system.

- *Agricultural Chemical (agrichemical) Pollution Prevention*
  Agrichemical pollution prevention measures involve a planned system to prevent chemical runoff to streams for water quality improvement. Practices include: agrichemical handling facilities and fertigation/chemigation back flow prevention systems.

The NCACSP is a voluntary program that reimburses farmers up to 75 percent of the cost of installing an approved BMP. The cost share funds are paid to the farmer once the planned BMP is completed, inspected and certified to be installed according to NRCS standards and specifications and SWCC policies. The annual statewide budget for BMP cost sharing is approximately $8 million. [Note: the annual statewide budget for ACSP cost sharing is $5.6 million; the additional $2.4 million is the annual statewide budget for technical assistance.] During the period from 2002 to 2006, $5,562,064 was provided for projects in the Neuse River basin. Table 59 summaries the cost and total BMPs implemented (i.e., acres, units, linear feet) throughout the Neuse River basin.

Table 59 Summary of NCACSP Projects in the Neuse River Basin (2002-2006).

	Purpose of BMP								
	Erosion Reduction[1]		**Sediment Reduction[2]**		**Stream Protection[3]**		**Animal Waste[4]**		**Total Cost ($)**
	Total	**Cost ($)**	**Total**	**Cost ($)**	**Total**	**Cost ($)**	**Total**	**Cost ($)**	
Subbasin 03-04-01	2,953.37 ac 11,756.5 ft	418,497 12,824	1,397.31 ac --	140,327 --	10 units 10,628 ft	39,034 12,078	8 units --	114,963 --	**737,723**
Subbasin 03-04-02	2,455.48 ac 2,566 ft	198,949 2,171	159.96 ac --	30,567 --	-- 3,357 ft	-- 2,960	12 units --	89,143 --	**323,790**
Subbasin 03-04-03	111.57 ac --	22,181 --	24.1 ac --	8,242 --	-- --	-- --	-- --	-- --	**30,423**
Subbasin 03-04-04	687.87 ac 2,430 ft	108,738 6,234	45.73 ac --	10,953 --	4 units 9,150 ft	29,108 10,517	10 units 1 ton	68,658 6,000	**240,208**
Subbasin 03-04-05	6,422.92 ac 1.40 ft	410,405 4,898	1,895.4 ac --	90,929 --	-- --	-- --	32 units 2 tons	201,901 12,000	**720,133**
Subbasin 03-04-06	3,704.91 ac 1,124 ft	292,897 1,216	115.36 ac 2 units	28,006 3,404	5 units 3,368 ft	5,990 4,044	2 units --	4,017 --	**339,574**
Subbasin 03-04-07	12,270.69 ac 6,726 ft	595,601 3,489	2,967.06 ac 6 units	241,978 5,799	3 units --	4,071 --	21 units --	192,846 --	**1,044,274**
Subbasin 03-04-08	1,675.27 ac --	113,917 --	597.66 ac 2 units	64,743 3,586	-- --	-- --	5 units --	32,431 --	**214,677**
Subbasin 03-04-09	12,625.05 ac --	198,665 --	723.5 ac 31 units	82,454 27,452	-- --	-- --	8 units --	60,391 --	**368,962**
Subbasin 03-04-10	1,776.9 ac --	199,305 --	114.8 ac 39 units	8,330 33,687	-- --	-- --	1 unit --	3,912 --	**245,234**
Subbasin 03-04-11	1,839.23 ac 450 ft	206,973 470	3,850.2 ac 1 units	103,346 797	-- 16,025 ft	-- 22,832	41 units 1 ton	175,611 6,000	**516,029**
Subbasin 03-04-12	3,951.98 ac --	268,924 --	99.7 ac --	8,150 --	-- --	-- --	21 units --	140,322 --	**417,396**
Subbasin 03-04-13	2,832.84 ac --	252,890 --	530.95 ac 73 units	55,301 55,450	-- --	-- --	-- --	-- --	**363,641**
Subbasin 03-04-14	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	**0**

[1] Erosion Reduction/Nutrient Loss Reduction in Field
[2] Sediment/Nutrient Delivery Reduction from Field
[3] Stream Protection from Animals
[4] Proper Animal Waste Management

Total Benefits						
	Acres Affected	**Soil Saved (tons)**	**(N)itrogen Saved (lb.)**	**(P)hosphorous Saved (lb.)**	**Waste-N Saved (lb.)**	**Waste-P Saved (lb.)**
Subbasin 03-04-01	6,750.94	38,736.93	130,489.86	5,285.59	34,502.40	19,459.30
Subbasin 03-04-02	3,203.80	16,571.40	42,968.00	6,505.80	271,699.00	271,641.00
Subbasin 03-04-03	248.53	1,402.00	5,416.00	383.00	0	0
Subbasin 03-04-04	1,470.83	7,773.53	38,486.00	12,580.20	88,400.00	108,785.00
Subbasin 03-04-05	14,046.63	53,512.50	338,148.55	114,826.70	213,253.00	246,833.70
Subbasin 03-04-06	4,829.76	26,352.80	67,204.20	9,186.58	5,630.00	3,182.00
Subbasin 03-04-07	23,613.64	102,929.02	305,118.95	68,619.02	268,235.00	263,867.00
Subbasin 03-04-08	2,819.17	5,325.21	65,940.09	956.20	12,351.60	4,841.20
Subbasin 03-04-09	7,939.20	17,219.39	62,801.99	5,101.94	31,218.00	22,356.80
Subbasin 03-04-10	2,301.17	3,123.10	29,885.25	1,341.93	0	0
Subbasin 03-04-11	10,168.92	11,544.20	88,126.54	14,363.04	379,970.00	261,572.00
Subbasin 03-04-12	6,151.59	29,616.60	280,967.10	83,328.80	417,565.00	498,172.00
Subbasin 03-04-13	4,257.13	,3680.00	634,039.45	1,332.93	0	0

* The North Carolina Agricultural Nutrient Assessment Tool (NCANAT) contains two field-scale assessment tools: the Nitrogen Loss Estimation Worksheet (NLEW) and the Phosphorus Loss Assessment Tool (PLAT). NCANAT is a product of the cooperative effort between the NC State University, NC Department of Agriculture & Consumer Services, USDA-NRCS and the DENR. The tool consists of a function that allows comparisons to be made before and after BMPs are installed. Gains and losses of nitrogen, phosphorus and sediment due to BMP implementation can be computed. The DSWC has adopted this program to calculate these losses for the NCACSP reporting requirements.

19.2.2 Conservation Reserve Enhancement Program (CREP)

The Conservation Reserve Enhancement Program (CREP) is a joint effort of the North Carolina Division of Soil and Water Conservation, the NC Clean Water Management Trust Fund, the Farm Service Agency, the Natural Resource Conservation Service - United States Department of Agriculture (USDA) and the NC Division of Forest Resources to address water quality problems of the Lumber, Roanoke, Yadkin-PeeDee, Neuse, Tar-Pamlico, Chowan, Pasquotank, Cape Fear and White Oak River basins. CREP is a voluntary program that seeks to protect land along watercourses that is currently in agricultural production. The objectives of the program include: installing 100,000 acres of forested riparian buffers, grassed filter strips and wetlands; reducing the impacts of sediment and nutrients within the targeted area; and providing substantial ecological benefits for many wildlife species that are declining in part as a result of habitat loss. Under CREP, landowners can voluntarily enroll eligible land in 10 to 15-year contracts or 30-year and permanent conservation easements. The state will provide additional incentives to landowners that enroll land in 30-year and permanent agreements. Cost sharing will be available for installation of forested riparian buffers, grassed filter strips, wetlands restoration practices, water control structures, livestock exclusion, and remote livestock watering in order to increase the efficiency of enrolled practices. Interested landowners should contact their local Soil and Water Conservation District or Farm Service Agency office.

County Soil and Water Conservation District (SWCD) contacts for the Neuse River basin are included in Appendix IV. BMP definitions and SWCD contact information can be found online at http://www.enr.state.nc.us/dswc/index.html.

19.2.3 USDA – NRCS Environmental Quality Improvement Program (EQIP)

The USDA – Environmental Quality Improvement Program (EQIP) provides technical, educational and financial assistance to eligible farmers to address soil, water and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. NRCS district contacts for the Neuse River basin are provided in Appendix IV, or information can also be found on NRCS website at http://www.nc.nrcs.usda.gov/programs/EQIP/index.html.

Chapter 20
Natural Resources in the Neuse River Basin

20.1 Forestry Management

Approximately 77 percent of forestland in the Neuse basin is privately-owned, 11 percent is owned by forest industry and the rest is publicly-owned. These ownership estimates comes from the most recent Forestry Inventory and Analysis data published by the USDA Forest Service (*Forest Statistics for North Carolina, 2002.* Brown, Mark J. Southern Research Station Resource Bulletin SRS-88. January 2004).

At least 67,659 acres of land were planted or regenerated with forest trees across the basin from September 1, 2000 through August 31, 2005. During this same time period, the DFR provided individual forest plans for landowners that encompassed over 210,000 acres in the basin. This includes 435 plans, such as pre-harvest, rehabilitation and forest stewardship that provide site specific guidance for water quality protection.

The DFR also operates a 700 + acre tree nursery in Goldsboro, NC. The nursery grows 9 species of conifers and 51 species of hardwoods that are available for forest management and stream / wetland restoration projects. Call 1-888-NC TREES (628-7337) for more information.

Through the Urban and Community Forestry program, DFR provides technical assistance to landowners and municipalities in the form of yard tree inspections, urban forest management plans, and training/workshop opportunities. DFR also offers support to municipalities by assisting with the development of community forestry programs including street tree inventories, establishing a tree board, developing/revising tree ordinances, and developing strategic management plans. During the period September 1, 2000 through August 31, 2005 the DFR performed 950 urban forest activities for landowners and municipalities in the Neuse River Basin.

20.2 Forest Practices Guidelines Related to Water Quality

The DFR is delegated the authority to monitor and evaluate forestry operations for compliance with laws and/or rules. Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act (SPCA) of 1973. However, forestry operations are exempt from the permit and plan requirements of the SPCA, if the operations meet the compliance standards outlined in the Forest Practices Guidelines Related to Water Quality (FPG) and General Statutes regarding stream obstruction. For more information regarding forest practices guidelines related to water quality please visit Chapter 7 in the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm.

The DFR has personnel in all 100 counties who perform FPG inspections and handle other basic water quality related tasks on a daily basis. Three of the four DFR districts located in the Neuse River Basin currently have Water Quality Foresters. Water Quality Foresters conduct FPG inspections, survey BMP implementation, check for compliance with forest harvest requirements of state buffer rules, develop preharvest plans, provide training opportunities for landowners, loggers, and the public regarding water quality issues related to forestry, and assist other DFR staff with more technical water quality issues.

During the period September 1, 2000 through August 31, 2005 the Division of Forest Resources inspected 2,922 forestry sites for FPG compliance the basin; 95.8 percent of the sites inspected were in compliance. In addition, 1,125 re-inspections were performed to ensure that sites continued to be or were brought into compliance with the performance standard.

20.2.1 Neuse River Basin Buffer Rule

On August 1, 2000 a mandatory buffer rule (15A NCAC 2B .0233) became effective for intermittent and perennial streams and waterbodies in the Neuse River basin. These riparian buffer rules ensure that timber harvesting and other forestry related activities maintain the integrity of the riparian areas and protect water quality. The DFR provides assistance to loggers, landowners, and land managers to ensure the correct site determinations and rule interpretations are made for any forestry activities in the Neuse River Basin. When DFR staff locates an operation that is not in compliance with the buffer rules, a referral is made to the North Carolina Division of Water Quality (DWQ) for final determination and possible regulatory action. Twenty-six referrals for Neuse Buffer Rule violations were made by DFR to DWQ during the period of September 1, 2000 through August 31, 2005.

20.2.2 Other Water Quality Regulations

In addition to the State regulations noted above, DFR monitors the implementation of the following Federal rules relating to water quality and forestry operations:

- The Section 404 silviculture exemption under the Clean Water Act
- The federally-mandated 15 Best Management Practices (BMPs) related to road construction in wetlands
- The federally mandated BMPs for mechanical site preparation activities for the establishment of pine plantations in wetlands of the southeastern U.S.

20.2.3 Forestry Best Management Practices

Implementing Forestry Best Management Practices is strongly encouraged by the Division of Forest Resources in order to efficiently and effectively protect the water resources of North Carolina and maintain compliance with the FPGs. During this reporting period, DFR provided 2,265 written or verbal BMP recommendations on tracts totaling 102,522 acres in the Neuse River Basin. The Forestry Best Management Practices Manual describes recommended techniques that should be used to help comply with the State's forestry laws and help protect water quality. The N.C. Forestry BMP Manual was revised and produced in 2006 after nearly four years of work by an interagency and multi-stakeholder Technical Advisory Committee. The new manual contains detailed BMP descriptions, and citations of the numerous regulations that govern forestry operations, related to water quality and wetlands. A copy is available from the NCDFR and online at www.dfr.state.nc.us.

To further assess BMPs, the DFR conducted a detailed, statewide BMP Implementation Survey from March 2000 through March 2003 to evaluate Forestry BMPs on *active* harvest operations. During that time period, 83 of those surveys were performed in the Neuse River Basin. On those sites, implementation of North Carolina's recommended BMPs was 95 percent. Two percent of the conditions on those sites had potential to be a risk to water quality. Forestry BMP implementation and FPG compliance in the Neuse River Basin were among the highest in the state. The problems most often cited in this survey relate to stream crossings, skid trails, and site rehabilitation. This survey, and additional surveys to be conducted, will serve as a basis for focused efforts in the forestry community to address water quality concerns through better and more effective BMP implementation and training.

20.2.4 Bridgemats

To help prevent water quality problems associated with stream crossings, the DFR has been loaning bridgemats to loggers for establishing temporary stream crossings during harvest activities. Temporary bridges are usually the best solution for stream crossings, instead of culverts or hard-surfaced 'ford' crossings. Bridgemats are available upon request from any District Office. More information about using bridgemats, and the above noted BMP survey, is available on the 'Water Quality' section of the DFRs Web site http://www.dfr.state.nc.us/.

20.2.5 Forest Products Industry

The forest industry is a vital economic driver throughout the Neuse River basin, with significant forest industry operations located in the upper, middle, and lower sectors of the basin. Statewide, forest industry contributes nearly $18 billion annually to North Carolina's economy. In the Neuse basin, 18 different businesses are considered "Primary Processors" of forest products raw material, which represents 7 percent of the total number of primary processors in the state, including one of the state's five pulp & paper mills, located at New Bern. Other examples of primary processors in this basin include a large multi-product complex near Goldsboro that manufactures plywood, lumber, and oriented-strand-board (OSB), and a high-volume lumber mill located in southern Granville County. All primary processors pay an assessment to the state, which is then combined with annual legislative appropriations, to fund the "Forest Development Program - FDP", which provides cost-shared reforestation assistance for forest landowners.

20.2.6 Forest Legacy Program

The USDA-Forest Service's Forest Legacy Program partners with participating states to support efforts that protect environmentally sensitive forestlands. The program is specifically designed to encourage the protection of privately owned forestlands and is entirely voluntary. It encourages and supports acquisition of conservation easements that most often are used to place restrictions on development, while requiring sustainable forestry practices, and protecting other values. The program's Web site has more information: http://www.fs.fed.us/spf/coop/programs/loa/flp.shtml.

In 2004, the Forest Legacy Program provided funding for the acquisition of a conservation easement along the Neuse River near New Bern that encompasses nearly 927 acres, and is located within subbasin 03-04-08 and 03-04-09. The North Carolina Clean Water Management Trust Fund provided match funding in the form of a conservation easement purchase on 729 additional acres.

20.2.7 Protection from Wildfires

Uncontrolled high intensity fires can combust excessive amounts of ground cover and vegetation and have potential to negatively impact water quality. The DFR performs hazard reduction burns to reduce fuel load and therefore wild fire hazard. During the period from September 1, 2000 to August 31, 2005, 9,756 acres of land were prepared for or burned for reduction of hazardous fuels.

20.3 Special Projects in the Neuse Basin

20.3.1 Urban Forest Watershed Protection & Education Initiative (UFWPE)

Initiated in 2004, the objective of the Urban Forest Watershed Protection and Education Initiative (UFWPE) is to provide technical guidance, education, and recognition to communities that implement forestry projects and programs that protect their local watershed. The UFWPE practices prepared for development and implementation will serve as additional tools to complement ongoing efforts to improve water quality via Low Impact Development. The overall concept is to pursue how traditional forest management practices may be used as a stormwater device 'tool' within a watershed where urbanization and development is replacing or adjoining forest and agricultural lands. A UFWPE pilot program is underway at the Clemmons Educational State Forest (Clemmons ESF) near Clayton, North Carolina. The efforts of the surrounding communities, combined with water quality protection programs at Clemmons ESF, will improve the opportunity to protect and restore water quality in the Beddingfield Creek, which flows through Clemmons ESF and surrounding communities.

Program highlights include:

- Protected 304 acres and 12,400 feet of stream in the Beddingfield Creek Watershed, which drains directly to the Neuse River and adds to Clemmons Educational State Forest.
- Developed and rolled out two educational module workbooks, focused on nonpoint source pollution, water quality, and river basins/watersheds. These workbooks are used for school classes hosted at Clemmons state forest.
- Constructed an open-air Outdoor Water Quality Classroom, and a River Basin Observation Deck at the state forest, for use in administering the educational module workbooks. Partners included 319-Grant Program, APNEP, and Lowe's Home Improvement.
- Obtained sampling and monitoring equipment to be installed at the state forest to begin baseline data collection and monitoring of conditions in Beddingfield Creek.

20.3.2 Upper Neuse Watershed Management Plan

Since mid-2005, the DFR has been an active stakeholder in the ongoing development of the Implementation Plan for the Upper Neuse Watershed Management Plan, as coordinated through the Upper Neuse River Basin Association and Triangle-J Council of Governments. Forestry is an important land use within the upper Neuse basin, with two wood-products manufacturing facilities located in or very near this region. These facilities depend upon the sustainable availability of resources from the privately-owned forestlands in the basin. Likewise, forest owners rely upon the market-based financial incentive for the continued ownership and management of their lands in forestry. The Implementation Plan will recognize and promote the inherent financial and environment benefits of continued forestland management across the Upper Neuse basin in a manner that dissuades efforts to install additional regulatory burdens by local governments on forestry-related activities.

20.4 Ecological Significance of the Neuse River Basin

The Neuse River Basin contains many rare plants and animals. Nine animals of aquatic or wetland habitats are federally listed. Of these, the manatee, loggerhead, Atlantic ridley, piping plover, and bald eagle are found primarily in estuarine habitats, whereas the dwarf wedgemussel and the Tar River spinymussel occur in freshwater streams of the Piedmont and upper Coastal Plain. Especially noteworthy are the number of State-listed mollusk species, nearly all of which are freshwater mussels.

Table 60 List of Rare Species Associated with Aquatic Habitats in the Neuse River Basin (June 2006).

Scientific Name	Common Name	State	Federal
	RARE AQUATIC ANIMALS		
Mammal			
Trichechus manatus	Manatee	E	LE
Reptile			
Alligator mississippiensis	American alligator	T	T(S/A)
Caretta caretta	Loggerhead	T	LT
Lepidochelys kempii	Atlantic ridley	E	LE
Malaclemys terrapin centrata	Carolina diamondback terrapin	SC	
Amphibian			
Necturus lewisi	Neuse River waterdog	SC	
Fish			
Acipenser brevirostrum	Shortnose sturgeon	E	LE
Ambloplites cavifrons	Roanoke bass	SR	
Etheostoma collis pop 2	Carolina darter - eastern piedmont population	SC	FSC
Lampetra aepyptera	Least brook lamprey	SC	
Lythrurus matutinus	Pinewoods shiner	SR	FSC
Notropis bifrenatus	Bridle shiner	SC	
Noturus furiosus pop 1	Carolina madtom - Neuse River population	SC	
Mollusk			
Alasmidonta heterodon	Dwarf wedgemussel	E	LE
Alasmidonta undulata	Triangle floater	T	
Alasmidonta varicosa	Brook floater	E	FSC
Anodonta implicata	Alewife floater	T	

Scientific Name	Common Name	State	Federal
Elliptio lanceolata	Yellow lance	E	FSC
Elliptio marsupiobesa	Cape Fear spike	T	
Elliptio roanokensis	Roanoke slabshell	T	
Elliptio steinstansana	Tar River spinymussel	E	LE
Fusconaia masoni	Atlantic pigtoe	E	FSC
Lampsilis cariosa	Yellow lampmussel	E	FSC
Lampsilis radiata conspicua	Carolina fatmucket	T	
Lampsilis radiata radiata	Eastern lampmussel	T	
Lampsilis sp.2	Chameleon lampmussel	SR	
Lasmigona subviridis	Green floater	E	FSC
Ligumia nasuta	Eastern pondmussel	T	
Somatogyrus virginicus	Panhandle pebblesnail	SR	FSC
Strophitus undulatus	Creeper	T	
Villosa constricta	Notched rainbow	SC	
Villosa delumbis	Eastern creekshell	SR	
<u>Crustacean</u>			
Cambarus davidi	Carolina ladle crayfish	SR	
Orconectes carolinensis	North Carolina spiny crayfish	SR	
Procambarus plumimanus	Croatan crayfish	SR	
<u>Insect</u>			
Baetisca laurentina	A mayfly	SR	
Ceraclea tarsipunctata	A caddisfly	SR	
Dibusa angata	A caddisfly	SR	
Ephemerella berneri	A mayfly	SR	
Gomphus septima	Septima's clubtail	SR	FSC
Leptohyphes robacki	A mayfly	SR	
Matrioptila jeanae	A caddisfly	SR	
Psilotreta frontalis	A caddisfly	SR	
Shipsa rotunda	A stonefly	SR	
Tachopteryx thoreyi	Gray petaltail	SR	
RARE WETLAND OR BOTTOMLAND ANIMALS			
<u>Mammal</u>			
Corynorhinus rafinesquii	Rafinesque's big-eared bat	SC	FSC
Myotis austroriparius	Southeastern bat	SC	FSC
<u>Bird</u>			
Anhinga anhinga	Anhinga	SR	
Botaurus lentiginosus	American bittern	SR	
Charadrius melodus	Piping plover	T	LT

Scientific Name	Common Name	State	Federal
Circus cyaneus	Northern harrier	SR	
Dendroica virens waynei	Black-throated green warbler (coastal population)	SR	
Egretta caerulea	Little blue heron	SC	
Egretta thula	Snowy egret	SC	
Egretta tricolor	Tricolored heron	SC	
Haliaeetus leucocephalus	Bald eagle	E	LT
Ictinia mississippiensis	Mississippi kite	SR	
Pelecanus occidentalis	Brown pelican	SC	
Phalacrocorax auritus	Double-crested cormorant	SR	
Plegadis falcinellus	Glossy ibis	SC	
Sterna antillarum	Least tern	SR	
Sterna nilotica	Gull-billed tern	T	
Reptile			
Deirochelys reticularia	Chicken turtle	SR	
Nerodia sipedon	Carolina salt marsh snake	SC	
Seminatrix pygaea	Black swamp snake	SR	
Amphibian			
Ambystoma talpoideum	Mole salamander	SC	
Ambystoma tigrinum	Tiger salamander	T	
Hemidactylium scutatum	Four-toed salamander	SC	
Crustacean			
Lynceus gracilicornis	Graceful clam shrimp	SR	

Status Abbreviations: SR = Significantly Rare; T and LT = Threatened; T(S/A) = Threatened due to Similarity of Appearance; SC = Special Concern; FSC = Federal Species of Concern; E and LE = Endangered; C = Candidate

An endangered taxon is in danger of extinction throughout all or a significant portion of its range. A threatened taxon is likely to become an endangered species within the foreseeable future. Special concern species require monitoring, but may be taken or collected under specific regulations. A significantly rare species is rare in North Carolina, but has no official state status. Federal species of concern refers to a taxon under consideration for listing, but at present there is insufficient information to support listing. A candidate taxon is very rare in North Carolina. If present land use trends continue, candidate species are likely to merit listing as Endangered or Threatened.

For more information on rare plant and animal species, visit the NC Natural Heritage Program (NHP) website at www.ncnhp.org.

20.4.1 Rare Aquatic Animals – Vertebrates

The manatee (*Trichechus manatus*) is a sporadic visitor to estuarine waters in the basin. The species does not breed in the state but individuals are sighted every few years, even as far inland as New Bern. The American alligator (*Alligator mississippiensis*) is present in the lower Neuse

Basin, primarily in Croatan National Forest and Cherry Point Marine Corps Air Station. The American alligator is considered Threatened due to its similarity of appearance to other rare crocodilians. Loggerhead turtles (*Caretta caretta*) nest along coastal beaches and forage in the ocean and in most of the sounds. Estuaries and tidal marshes are the preferred habitat for the other rare aquatic reptiles in the basin -- Carolina diamondback terrapin (*Malaclemys terrapin centrata*) and Carolina salt marsh snake (*Nerodia sipedon williamengelsi*). An especially significant aquatic amphibian is the Neuse River waterdog (*Necturus lewisi*), which is endemic to the Neuse and Tar systems in the upper Coastal Plain and lower Piedmont.

Another aquatic vertebrate species endemic to North Carolina is the Carolina madtom (*Noturus furiosus*). Like the Neuse River waterdog, this small fish lives only in the Neuse and Tar basins. Among the other rare fishes in the Neuse Basin, the Roanoke bass (*Ambloplites cavifrons*) and Carolina darter (*Etheostoma collis*) have restricted ranges, being limited mainly to the Piedmont and upper Coastal Plain of southern Virginia and North Carolina. The shortnose sturgeon (*Acipenser brevirostrum*) moves from the ocean and estuaries into freshwater rivers to spawn between February and May. Juveniles may remain upriver for up to five years after birth before migrating to the ocean. Historically, shortnose sturgeon were widely reported from North Carolina rivers, but their numbers have declined greatly. Current distribution is not well known. Shortnose sturgeon can grow to over three feet in length, and may live for up to 30 years.

20.4.2 Rare Aquatic Animals – Mollusks

Good water quality in the Neuse River Basin is critical to the survival of a large number of rare freshwater mussels. Eighteen species of rare freshwater mussels, plus one rare snail [panhandle pebblesnail (*Somatogyrus virginicus*)] are known from the Neuse Basin, and two species, the dwarf wedgemussel (*Alasmidonta heterodon*) and Tar River spinymussel (*Elliptio steinstansana*), are federally-listed as Endangered. The majority of the Neuse Basin mollusks inhabit small streams. Many of the larger rivers in the state, such as the main stem of the Neuse, no longer support populations of rare mussels because of high amounts of sedimentation and pollution. Most populations of the rare mollusk species occur in the Piedmont and upper Coastal Plain, in rapidly developing areas such as the Research Triangle. The future of these populations is uncertain.

20.4.3 Rare Wetland and Bottomland Animals and Plants

The Neuse River Basin contains many dozens of other rare animals, and rare plants, dependent on wetlands or open water for their existence. The bald eagle (*Haliaeetus leucocephalus*) is a Federally Threatened species that nests mainly in estuarine habitats, but it also nests in the Piedmont at large reservoirs such as Falls Lake. It forages for fishes on both fresh and brackish waters of lakes, large rivers, and sounds. The Federally Threatened piping plover (*Charadrius melodus*) nest on barrier islands and sand flats and forage on tidal flats and shores. Many other State-listed bird species nest in coastal regions and feed in tidal marshes or in estuaries; these include herons, egrets, ibises, pelicans, terns, and skimmers.

Among the fifty-two rare wetland plants in the Neuse Basin, three are federally-listed as Threatened or Endangered. The rough-leaf loosestrife (*Lysimachia asperulifolia*), which is found in savannas and pocosin ecotones, is restricted to southeastern North Carolina and adjacent South Carolina. In Virginia and other states north of North Carolina, the Federally Threatened Virginia jointvetch (*Aeschynomene virginica*) grows in tidal freshwater marshes; in this state, however, the species is found mostly in ditches and other moist disturbed soil. The seabeach amaranth (*Amaranthus pumilus*) grows on sand flats, near the ends of barrier islands. Its seeds are carried in ocean water to other beaches and flats. Because the species is an annual and occurs in the ever-changing environment of sand flats, populations of seabeach amaranth fluctuate tremendously from year to year. Probably the most imperiled rare plant in the basin is the Godfrey's sandwort (*Minuartia godfreyi*), which is State Endangered. The only extant population in North Carolina is in a tidal marsh near New Bern, and within its range in the southeastern states it is known from only a few locations. Most of the other rare plants in the Neuse Basin grow in wet soils of savannas, pocosins, and flatwoods and are only indirectly affected by water quality and quantity.

20.4.4 Wetland Communities

Because the Neuse River spans two physiographic provinces -- the coast and the lower Piedmont -- the river basin contains a wide array of natural communities, both upland and wetland. The basin contains the full array of estuarine wetland communities, such as Salt Marsh, Brackish Marsh, and Estuarine Fringe Loblolly Pine Forest. The basin also contains a few good examples of Tidal Freshwater Marsh, notably at the junction of the Trent and Neuse rivers near New Bern. In addition, the northernmost Pine Savanna natural communities remaining in good condition are here; these are located in Croatan National Forest.

Nonriverine forested wetlands are prominent in the lower part of the basin. Pamlico County, in particular, contains high-quality remnant stands of Nonriverine Swamp Forest and Nonriverine Wet Hardwood Forest. Often mixed with these nonriverine hardwood forests are communities of pocosin vegetation, such as Pond Pine Woodland, High Pocosin, Bay Forest, and Low Pocosin. This association is especially notable in the Croatan National Forest.

A variety of riverine communities are represented in the basin, although they are not as mature and high-quality as those in the Roanoke River Basin. Examples of Cypress--Gum Swamp and Bottomland Hardwood communities are located on the Neuse floodplain upstream of New Bern in northwestern Craven County, and below Smithfield in Johnston County. In the Piedmont, some of the best examples of Piedmont/Mountain Swamp Forest were destroyed by the creation of Falls Lake, but remnants of this rare natural community still exist in streams above the flooded portion of the lake.

20.4.5 Significant Natural Heritage Areas

The North Carolina Natural Heritage Program (NHP) compiles the N.C. Department of Environment and Natural Resources' (DENR) list of Significant Natural Heritage Areas as required by the Nature Preserve Act (NCGS Chapter 113-A-164 of Article 9A). The list is based on the program's inventory of natural diversity in the State. Natural areas are evaluated on the basis of the occurrences of rare plant and animal species, rare or high-quality natural communities, and geologic features. The global and statewide rarity of these elements and the quality of their occurrence at a site relative to other occurrences determines a site's significance rating. The sites included on this list are the best representatives of the natural diversity of North Carolina, and therefore have priority for protection. Inclusion on the list does not imply that any protection or public access exists.

Figure 49 shows the Significant Natural Heritage Areas in the Neuse Basin. Highlighted below are certain Aquatic Significant Natural Heritage Areas, which are stream segments or other bodies of water that contain significant natural resources, such as a high diversity of rare aquatic animal species. Also described in groups below are several natural areas that contribute to the maintenance of water quality in the Neuse Basin. More complete information on Significant Natural Heritage Areas (both terrestrial and aquatic) may be obtained from the NHP.

20.2.6 Significant Aquatic Natural Heritage Areas in the Neuse River Basin

The reaches of stream identified by the NHP as Aquatic Significant Natural Heritage Areas only show the location of areas known for natural diversity. The impact from lands adjacent and upstream of these stream reaches will determine water quality and the viability of aquatic species.

1. Eno River: This nationally significant river in Orange and Durham counties supports fourteen rare animals: two fishes, one amphibian, eight mussels, one snail, and two dragonflies. It contains the only currently known North Carolina population of the panhandle pebblesnail (*Somatogyrus virginicus*). Eno River State Park protects much of the land along the river, but protection is still needed for the land bordering the river's headwaters.

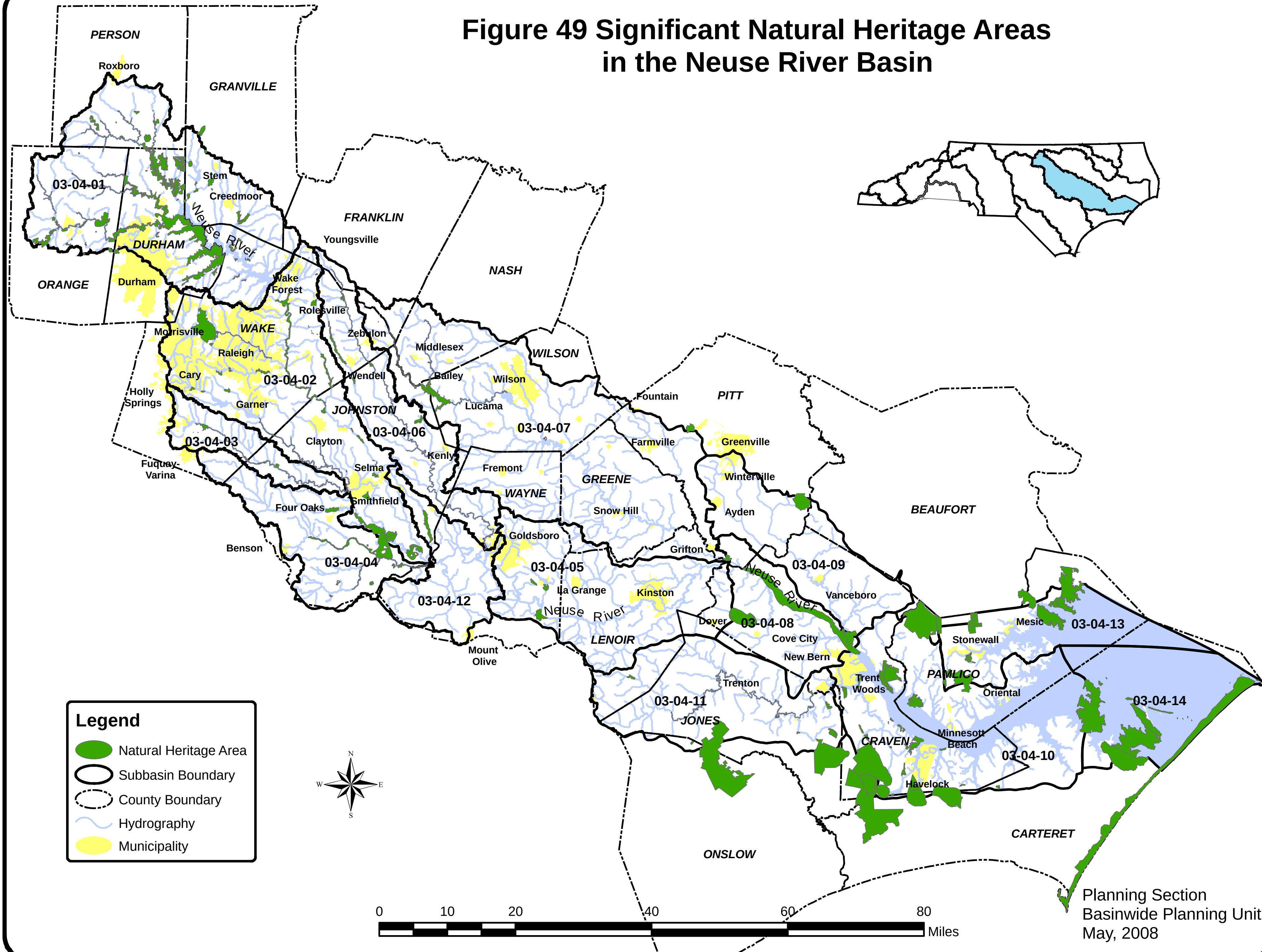
2. Flat River: Eleven rare animal species -- one fish, one amphibian, and nine mussels -- make their home in this state significant river in Person and Durham counties. While the lower portions of the river are protected by N.C. State University's Hill Forest, protection is lacking for the lands along the upper portions of the river.

3. Swift Creek: This nationally significant stream in southern Wake and Johnston counties contains eleven rare animals: one rare fish and ten rare mussels, including the Federally Endangered dwarf wedgemussel. Although there are several protected areas along the stream above Lake Wheeler, all of the rare animals live in the creek below Lake Benson, where there are no lands protected along the banks of the stream. Thus, protection efforts are greatly needed downstream of Lake Benson.

4. Turkey Creek: This state significant stream in Nash and northwestern Wilson counties contains one rare amphibian and six rare mussel species, including the Federally Endangered dwarf wedgemussel. Though there is a protected site in its floodplain, there are no protected areas along the banks of the creek; thus, protection efforts are greatly needed.

5. Little River (Franklin/Wake/Johnston/Wayne counties): The Neuse basin contains two Little Rivers that contain rare species or communities. Beginning in Franklin County, the nationally significant Little River that flows through Wake, Johnston, and Wayne counties contains fifteen rare animals: three fishes, one amphibian, and eleven mussels, including several populations of the Federally Endangered dwarf wedgemussel and the only population of the Tar River spinymussel in the Neuse basin. The only protected site along the river is Mitchells Mill State Natural Area in Wake County. A reservoir, which will impact several of these rare species, may be constructed on the river downstream from Mitchells Mill State Natural Area. Aquatic species would benefit from protection efforts along the Little River.

Figure 49 Significant Natural Heritage Areas in the Neuse River Basin



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Basinwide Planning Unit
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6. Middle Creek: This state significant tributary to Swift Creek in southern Wake and Johnston counties contains eleven rare animals: two fishes, one amphibian, and eight mussels, including the Federally Endangered dwarf wedgemussel. Most of the creek flows through private, unprotected lands.

7. Moccasin Creek: This state significant stream runs along the boundaries of Wake, Franklin, Nash, and Johnston counties and contains one rare amphibian and four rare mussel species, one of which is the Federally Endangered dwarf wedgemussel. Except for a very small nature preserve in Johnston County, there are no protected lands along this creek; thus, protection efforts are greatly needed.

8. Little River (Orange/Durham counties): The state significant Little River, of Durham and Orange counties, is located in the headwaters of the Neuse River Basin. The significant portion of the aquatic habitat originates as two separate forks in western Orange County which join just after crossing the Orange/Durham county line. Rare species present include one amphibian, one fish and five mussels. Except for the Little River Park on the North Fork Little River, there are no protected lands along this creek; thus, protection efforts are greatly needed.

9. Contentnea Creek: The section of Contentnea Creek that is most significant is located between Buckhorn Dam and Wiggin's Mill Reservoir. Known to occur in this high-quality aquatic system are populations of three rare mussels, one amphibian and two rare fish. Most of the creek flows through private, unprotected lands.

10. Mill Creek: This creek is a small tributary of the Neuse River located in Johnston County, on the state's upper Coastal Plain and contains one rare fish, one rare amphibian, and large, reproducing populations of several non-listed mussel species. Except for Howell Woods, there are no protected lands along this creek; thus, protection efforts are greatly needed.

11. Trent River: This state significant river is located in Jones County and includes seven rare animals: three mussels, two fish, one amphibian and one crayfish. Except for a very small easement, there are no protected lands along this creek; thus, protection efforts are greatly needed.

In addition to the reservoir to be constructed on the Little River, a number of reservoirs are being planned for other streams in the Neuse River Basin. Some impacts to mussel populations on Turkey Creek and Moccasin Creek are expected with the proposed expansion of Buckhorn Reservoir.

20.2.7 Terrestrial and Wetland Natural Areas Contributing to Neuse River Water Quality

1. Cedar Island Marshes; Cherry Point Piney Island; Jones Island; and Pamlico Point Marshes and Impoundments: These four sites collectively consist of thousands of acres of primarily brackish marsh where the Neuse River merges with Pamlico Sound. Large numbers of the rare and secretive black rail (*Laterallus jamaicensis*) nest in these marshes, as do large numbers of other marsh birds. The first two sites, in Carteret County, are in federal ownership, whereas most of the latter two sites, which are in Pamlico County, are in private ownership except for a portion of Pamlico Point owned by the N.C. Wildlife Resources Commission.

2. Sweetwater Creek Natural Area and Trent River/Brice Creek Marshes: These two natural areas lie in close proximity near the mouth of the Trent River, near New Bern. Extensive examples of the uncommon wetland community Tidal Freshwater Marsh are present at the sites, and the former site contains the only known location of the globally rare Godfrey's sandwort (*Minuartia godfreyi*) in the state. Both sites are in private ownership and are in need of protection.

3. Neuse River Floodplain and Bluffs: This floodplain corridor, extending for approximately twenty air miles from New Bern upstream to Pitt County, consists mostly of swamp forests with a few marl outcrops present on vertical riverbanks. Progress has been made in protecting this natural area and the water quality of the Neuse. A few sections of the floodplain are owned by the N.C. Wildlife Resources Commission, and the North Carolina Coastal Land Trust has protected over 1000 acres within the floodplain. There is one privately-owned Registered Natural Heritage Area as well. Nonetheless, protection is needed for almost 90 percent of this floodplain/buffer natural area.

4. Cliffs of the Neuse State Park: This relatively small State Park protects about two miles of shoreline along the Neuse River in southeastern Wayne County. The park is best known for the natural communities of its high bluffs and wetlands, including bottomland hardwoods and cypress-gum swamp forests.

5. Neuse River/Brogden Bottomlands; Cowbone Oxbows; and Sage Pond/Neuse River Floodplain: These are the three most important sites in the floodplain of the Neuse in southeastern Johnston County. The floodplain is remarkably wide (up to 4 miles) in this part of the basin; even though much of the floodplain forests have been cut over, considerable acreage still remains in swamp and bottomland forest. This portion of the river contains several oxbow lakes, which are rare in North Carolina. No parts of this natural area are in public or otherwise protected ownership; thus, protection effort is greatly needed.

6. William B. Umstead State Park: This State Park protects nearly 5400 acres of forest land in the upper part of the Neuse River Basin. Crabtree Creek flows for several miles through the park, which features bottomland hardwoods as well as several rhododendron bluffs along the creekbank.

7. Eno River State Park and Occoneechee Mountain: The State Park protects more than eight miles of frontage on the Eno River, mostly in various upland communities. Occoneechee Mountain is located upstream of the park, opposite the town of Hillsborough. A portion of this monadnock, one of the highest hills in the eastern Piedmont, is managed by the Division of Parks and Recreation as a State Natural Area.

20.5 Public Lands

The Neuse River basin contains ecologically significant public lands in Eno River State Park, Cedar Island and other areas. In addition to Eno River State Park, Division of Parks and Recreation managed areas in the Neuse River basin include: William B. Umstead State Park, Waynesborough State Park, Cliffs of the Neuse State Park, Mitchell Mill State Natural Area, and Occoneechee Mountain State Natural Area. The Wildlife Resources Commission manages Butner-Falls of Neuse Game Land, Caswell Farm Game Land, Cherry Farm Game Land, Goose

Creek Game Land, and Neuse River Game Land. State educational institution-owned land includes North Carolina State University's 1700-acre Hill Demonstration Forest, and Johnston Community College's 2900-acre Howell Woods Environmental Learning Center. Camp Butner Training Site, owned by North Carolina National Guard, is a 4000-acre training facility composed primarily of pine plantations and some quality natural areas, including Knap of Reeds Creek. The training facility is a large contiguous block of habitat relatively free of fragmentation – something increasingly rare in the North Carolina Piedmont; therefore, the Camp Butner (CBTS) is considered a significant natural resource.

Federally-owned land in the Neuse basin includes both military and natural resource reservations. National Park Service owns Cape Lookout National Seashore, which includes Core Banks and Portsmouth Island. The U.S. Fish and Wildlife Service manages Cedar Island National Wildlife Refuge, while the U.S. Army Corps of Engineers owns Falls Lake and land around the reservoir. State agencies, specifically Wildlife Resources Commission and Division of Parks and Recreation, manage the land around Falls Lake for the Corps. The U.S. Department of Defense owns Cherry Point, a Marine Corps Air Station with a number of large significant natural areas. A portion of the Croatan National Forest lies in the Neuse River basin, including most of the 9000-acre Sheep Ridge Wilderness, and a large part of the 8000-acre Catfish Lake Wilderness. See accompanying map for the location of these state and federal public lands.

20.6 Fisheries

20.6.1 Fisheries Management Plans

The Division of Marine Fisheries develops Fisheries Management Plans for all commercially and recreationally significant species or fisheries that comprise state marine or estuarine resources. More information on fish habitat requirements, water quality needs and recommendations can be found for specific species on DMFs website: http://www.ncfisheries.net/fmps/index.html.

20.6.2 Fish Kill Summary

DWQ has systematically monitored and reported fish kill events across the state since 1996. From 2002 to 2006, field investigators reported ~57 fish kill events in the Neuse River basin. Low dissolved oxygen, algal blooms, high water temperatures, increased salinity and possible chemical contamination may have contributed to these fish kill events. Annual fish kill reports are found at DWQs Environmental Sciences website: http://h2o.enr.state.nc.us/esb/Fishkill/fishkillmain.htm. An estuarine fish kill log can also be found in Appendix II.

20.7 Submerged Aquatic Vegetation

Submerged Aquatic Vegetation (SAV) is a fish habitat dominated by one or more species of underwater vascular plant. These vegetation beds occur in both subtidal and intertidal zones and may occur in isolated patches or cover extensive areas. Fresh water vegetation may also grow in SAV beds. In North Carolina, SAV usually occurs in water less than 6 ft deep because of light limitations (DMF website http://www.ncfisheries.net/habitat/chppSAV.html). SAV is valued as a Critical Habitat Area under Marine Fisheries Commission rules. Over 150 fish and invertebrate species are known to use SAV as adults or juveniles, of which about 30 are important commercial fishery species. SAV beds provide an excellent nursery area for many species, including blue crabs, red drum, pink shrimp, spotted seatrout, and gag. SAV blades provide a surface for post-larval shellfish attachment, especially bay scallops, and refuge for small fish like mummichogs, pipefish, and grass shrimp. Large predators like flounders, rays, and red drum forage around SAV. SAV produces oxygen and detritus that is exported to other habitats, and reduces moderate turbidity and turbulence.

SAV coverage has declined and currently there are about 200,000 acres of SAV in coastal North Carolina (DMF website http://www.ncfisheries.net/habitat/chppSAV.html). SAV is an environmental indicator and responds to water quality conditions. SAV is extremely dependent on clarity of the water column for its existence. Reduced light availability from nutrient and sediment loading is thought to be the primary cause of losses. Efforts need to continue to support SAV research to promote restoration and to identify water quality conditions that are limiting growth.

20.8 Water Resources

20.8.1 River Basin Hydrologic Units

Under the federal system, the Neuse River basin is made up of hydrologic areas referred to as cataloging units (USGS 8-digit hydrologic units). Cataloging units are further divided into smaller watershed units (12-digit hydrologic units) that are used for smaller scale. HUC maps and table can be viewed in Appendices VII.

20.8.2 Minimum Streamflow

One of the purposes of the Dam Safety Law is to ensure maintenance of minimum streamflows below dams. Conditions may be placed on dam operations specifying mandatory minimum releases in order to maintain adequate quantity and quality of water in the length of a stream affected by an impoundment. The Division of Water Resources, in conjunction with the Wildlife Resources Commission, recommends conditions relating to release of flows to satisfy minimum instream flow requirements. The Division of Land Resources issues the permits.

The US Army Corps of Engineers operates Falls Lake dam (subbasin 03-04-01) in Wake County on the Neuse River. The drainage area is 769.9 square miles and has minimum release requirements of 65 cfs (cubic feet/second) from November to March and 100 cfs from April to October. The target flow below the dam at Clayton is 184 cfs from November to March and 254 cfs from April to October. During extreme drought conditions the flows may be lower.

The City of Wilson operates Buckhorn Reservoir dam (subbasin 03-04-07) on Contentnea Creek. Minimum release requirements are 7.6 cfs when water supply storage is above 70 percent. When water supply storage is below 70 percent and above 50 percent, 5.3 cfs minimum flow is required. Below 50 percent of water supply storage, a 1.4 cfs minimum flow is required.

Bass Lake (subbasin 03-04-02) operated by the Town of Holly Springs on Basal Creek has a minimum release of 5.2 cfs or inflow, whichever is less.

Presentwood Lakes No. 1 and No. 2 (subbasin 03-04-02) in Cary on Crabtree Creek have a minimum release of 0.2 cfs or inflow, whichever is less, from June to February and 0.4 cfs or inflow, whichever is less, from March to May.

Little River dam at Orange Factory (subbasin 03-04-01) in Durham County has a minimum release of 6 cfs from December to May and 2 cfs from June to November. A minimum release of 0.64 cfs is required when normal pool elevation is less than 70 percent of usable storage capacity.

Minimum flows on the Eno River are complicated and determined by two different methods. Table A-5 summarizes withdrawals and instream flow requirements for the portion of the Eno River above Durham. Additional information can be found at the Division of Water Resources' website
(http://www.ncwater.org/Permits_and_Registration/Capacity_Use/Eno_River_Management/).

Table 61 Maximum Allowable Surface Water Withdrawals and Instream Flow Requirements for the Western Eno River (NCDENR-DWR, October 2001[1]).

	Percent of Storage Remaining at Lake Orange	Allowable Surface Water Withdrawal (MGD)			Instream Flow Requirement at Hillsborough Gage (MGD)		
		Town of Hillsborough †	Orange-Alamance	Piedmont Minerals	From Lake Orange	From West Fork Eno Reservoir	Total Flow at Hillsborough Gage
	> 100	*†	*	**	1.10	0.65	1.75
Stage 1	100 - 80	1.51 †	0.82	0.43	1.10	0.65	1.75
Stage 2	80 - 60	1.36 †	0.74	0.38	0.65	0.65	1.30
Stage 3	60 - 50	1.28 †	0.70	0.36	0.45	0.65	1.10
Stage 4	50 - 40	1.28 †	0.70	0.32	0.45	0.65	1.10
Stage 5	40 - 30	1.13 †	0.62	0.19	0	0.65	0.65
Stage 6	<= 30	0.68 †	0.37	0	0	0.65	0.65

Notes:

† Allowable withdrawals for Hillsborough shown above do not include withdrawals of water supply releases from West Fork Eno Reservoir.

* - Adjusted to reflect outside source agreement for Hillsborough and Orange-Alamance.

- Excess withdrawals from Eno River based on outside source agreement may be made when flows at the Eno River at Hillsborough Gage are 10 cubic feet per second (cfs) and above, regardless of water level in Lake Orange. Maximum withdrawals shall be limited to the total of the contract amount and the allocated amount.
- A low flow period will begin on the 7th consecutive day of the average daily flow at the Hillsborough Gage dropping below 10 cfs. On the 4th day, the Orange County Engineer will request that affected parties prepare for a low flow period.
- When flows are between 10 cfs and 3 cfs at the Hillsborough Gage during a low flow period, withdrawals from the Eno River shall be limited to the Stage 1 amount shown above (100-80 percent of storage remaining), regardless of water level in Lake Orange.
- When flows are below 3 cfs at the Hillsborough Gage during a low flow period, withdrawals shall be limited to amounts shown above for percent of storage remaining at Lake Orange.
- A low flow period will be terminated when average daily flow at the Hillsborough Gage registers 10 cfs or greater for a period of 7 consecutive days. The Orange County Engineer will notify affected parties when the low flow period is terminated.

** For Piedmont Minerals: When flows at the Hillsborough Gage are 14 cfs and above, withdrawals from the Eno River will be limited to 900,000 gallons per day (GPD). Between 14 cfs and 4 cfs, withdrawals will be limited to 430,000 GPD, regardless of water level in Lake Orange. Below 4 cfs, withdrawals will be limited to amounts shown above for percent of storage remaining.

[1] Additional information can be found at the Division of Water Resources' website (http://www.ncwater.org/Permits_and_Registration/Capacity_Use/Eno_River_Management/).

20.8.3 Water Resources and Water Supply Planning

NC DENR Division of Water Resources administers programs for river basin management, water supply assistance, water conservation, and water resources development. The Division conducts special studies on instream flow needs and serves as the State liaison with federal agencies on major water resources related projects. The Division also administers two environmental education outreach programs, Stream Watch and Project WET. For more information about water quantity in the Neuse River basin visit http://www.ncwater.org/basins/Neuse/.

20.8.4 Water Withdrawal in the Neuse River Basin

The General Assembly established a water supply planning program under General Statute 143-355(l) and (m) to assure the availability of adequate supplies of good quality water to protect the public health and to support desirable economic growth. The original statute required units of local government that provide or plan to provide public water service to prepare a Local Water Supply Plan (LWSP). Session Law 2003-167 expanded the scope of water systems required to prepare a LWSP to include all community water systems that regularly serve 1,000 or more service connections or 3,000 or more individuals. It also required water systems preparing a local plan to explain how they plan to respond to water shortages caused by droughts.

The LWSPs must be updated at least every five years. They are submitted to and reviewed for completeness and consistency by the Division of Water Resources. The plans provide a valuable source of data for all local and regional water supply planning. Information from the local plans is available on the Division's web site www.ncwater.org. General Statute 143-215.22 requires any person that withdraws large quantities of water to register their withdrawal with DENR. Non-agricultural water users that withdraw 100,000 gallons per day or more of ground water or surface water are required to register their withdrawals. Agricultural water users that withdraw 1,000,000 gallons per day or more of ground water or surface water are required to register their withdrawals. Like the LWSPs water withdrawal registrations have to be updated at least every five years.

In the Neuse River basin, Carteret, Craven, Greene, Jones, Lenoir, Pamlico, Pitt, Wayne and Wilson counties are in the designated Central Coastal Plain Capacity Use Area established by the Environmental Management Commission in 2002. Permitting and water use in this area are regulated by the Central Coastal Plain Capacity Use Area rules (15A NCAC 2E .0500) a copy of which can be found on the DWR website at: www.ncwater.org. Water users that withdraw more than 100,000 gallons per day of ground water within the designated area must obtain a permit from the Division of Water Resources and regularly report the quantity of water withdrawn.

There are 176 registered water withdrawals in the Neuse River basin not including those associated with the 78 public water systems discussed below. Fifty-one of these are surface water withdrawals. Excluding the public water systems or power generating facilities, there is a cumulative permitted capacity to withdraw 192 MGD of water. For more information on water withdrawals, visit http://www.ncwater.org/Water_Withdrawals/ or call DWR at (919) 733-4064.

20.8.5 Water Supply in the Neuse River Basin

The following is summarized from the North Carolina Water Supply Plan developed by the Division of Water Resources (DWR) for the Neuse River basin (NCDENR-DWR, January 2001). The information is compiled from Local Water Supply Plans submitted to DWR by 78 public water systems.

Total water use in the Neuse River basin is reported to be approximately 191 MGD. Residential demand accounted for 79 MGD. Public water systems supplied 82 MGD from surface water and 30 MGD from groundwater. Self-supplied water accounted for 77 MGD. For more information or to view local water supply plans, visit http://www.ncwater.org/Water_Supply_Planning/Local_Water_Supply_Plan/ or call DWR at (919) 733-4064.

20.8.6 Interbasin Transfers

In addition to water withdrawals (discussed above), water users in North Carolina are also required to register surface water transfers with the Division of Water Resources if the amount is 100,000 gallons per day or more. These transfers are known as Interbasin Transfers (IBT). In addition, persons wishing to transfer two million gallons per day (MGD) or more, or increase an existing transfer by 25 percent or more, must first obtain a transfer certificate from the Environmental Management Commission (G.S. 143-215.22L). The river basin boundaries that apply to these requirements are designated on a map entitled *Major River Basins and Sub-Basins in North Carolina*, on file in the Office of the Secretary of State (see map at http://www.ncwater.org/Rules_Policies_and_Regulations/Regulation/IBTBasinMap.pdf). These DWR boundaries differ from the 17 major river basins delineated by DWQ. The 8-digit hydrologic unit boundaries (See appendix VII) correspond to these DWR basins within the Neuse River basin. Table 62 summarizes IBTs involving the Neuse River basin. This table lists the current IBT transfers and those that are in the certificate review process by the DWR and EMC. The EMC may not make a commitment on an IBT request prior the applicant's completion of the IBT process as outlined in the NC general statutes.

In determining whether a certificate should be issued, the state must determine that the overall benefits of a transfer outweigh the potential impacts. Factors used to determine whether a certificate should be issued include:

- the necessity, reasonableness and beneficial effects of the transfer;
- the detrimental effects on the source and receiving basins, including effects on water supply needs, wastewater assimilation, water quality, fish and wildlife habitat, hydroelectric power generation, navigation and recreation;
- the cumulative effect of existing transfers or water uses in the source basin;
- reasonable alternatives to the proposed transfer; and
- any other facts and circumstances necessary to evaluate the transfer request.

A provision of the Interbasin Transfer Law (GS § 143-215.22L) requires that an Environmental Assessment or Environmental Impact Statement be prepared in accordance with the State Environmental Policy Act as supporting documentation for a transfer petition. These documents are thoroughly reviewed to ensure that all primary, secondary, and cumulative environmental impacts are considered and addressed before the IBT is approved by the EMC. This process requires that a notice and the decision on the document be posted on the State Clearinghouse website for public comment. For more information on water withdrawals, visit http://www.ncwater.org or call DWR at (919) 733-4064.

Table 62 Estimated Interbasin Transfers in the Neuse River Basin (combined 2002 and 2004 Data).

				2002 or 2004 Data	
Source Basin	**Supplier**	**Receiving Basin**	**Receiver (if different from Supplier)**	**Average Transfer (in MGD)**	**Maximum Transfer (in MGD)**
Haw River	Cary, Apex, Morrisville & Wake Co (RTP South)	Neuse River		13.500	22.400
	Harnett County	Neuse River	Holly Springs	0.215	
Cape Fear River	Dunn	Neuse River	Benson	1.100	1.800
Neuse River	Durham	Haw River		19.400	29.200
	Goldsboro	Contentnea Creek	Wayne WD	0.000	
	Goldsboro	NE Cape Fear River	Wayne WD	0.000	
	Harnett County	Cape Fear River		0.446	1.399
	Hillsborough	Haw River	Orange Alamance WS	1.384	
	Orange Alamance WS	Haw River		0.670	0.930
	Raleigh	Contentnea Creek	Zebulon	0.478	
	Raleigh/Johnston County	Cape Fear River	Fuquay Varina	0.482	
	Raleigh	Cape Fear River	Holly Springs	0.487	
	Zebulon	Contentnea Creek		0.693	
	Wilson Co SWWD	Contentnea Creek			
Contentnea Creek	Wilson	Tar River	Elm City	<0.1	
Roanoke River	Roxboro	Neuse River		<0.1	
Tar River	Franklin Co	Neuse River	Youngsville	<0.1	
	Franklin Co	Neuse River		<0.1	
	Franklinton	Neuse River	Franklin Co	<0.1	
	Greenville Utilities	Neuse River			4.0*
	Greenville Utilities	Contentnea Creek			8.3*
	Louisburg	Neuse River	Franklin Co	<0.1	
	Wilson	Contentnea Creek		0.000	

* Draft IBT Petition received April 2009; Certificate has not been issued as of July 8, 2009. For more information on the Greenville IBT request, see DWR website at http://www.ncwater.org/Permits_and_Registration/Interbasin_Transfer/Status/Greenville/.

20.8.7 Water Quality Issues Related to Drought

Water quality problems associated with rainfall events usually involve degradation of aquatic habitats because the high flows may carry increased loadings of substances like metals, oils, herbicides, pesticides, sand, clay, organic material, bacteria and nutrients. These substances can be toxic to aquatic life (fish and insects) or may result in oxygen depletion or sedimentation. During drought conditions, these pollutants become more concentrated in streams due to reduced flow. Summer months are generally the most critical months for water quality. Dissolved oxygen is naturally lower due to higher temperatures, algae grow more due to longer periods of sunlight, and streamflows are reduced. In a long-term drought, these problems can be greatly exacerbated and the potential for water quality problems to become catastrophic is increased. This section discusses water quality problems that can be expected during low flow conditions.

The frequency of acute impacts due to nonpoint source pollution (runoff) is actually minimized during drought conditions. However, when rain events do occur, pollutants that have been collecting on the land surface are quickly delivered to streams. When streamflows are well below normal, this polluted runoff becomes a larger percentage of the water flowing in the stream. Point sources may also have water quality impacts during drought conditions even though permit limits are being met. Facilities that discharge wastewater have permit limits that are based on the historic low flow conditions. During droughts these wastewater discharges make up a larger percentage of the water flowing in streams than normal and might contribute to lowered dissolved oxygen concentrations and increased levels of other pollutants.

As stream flows decrease, there is less habitat available for aquatic insects and fish, particularly around lake shorelines. There is also less water available for irrigation and for water supplies. The dry conditions and increased removal of water for these uses further increases strain on the resource. With less habitat, naturally lower dissolved oxygen levels and higher water temperatures, the potential for large kills of fish and aquatic insects is very high. These conditions may stress the fish to the point where they become more susceptible to disease and where stresses that normally would not harm them result in mortality.

These are also areas where longer retention times due to decreased flows allow algae to take full advantage of the nutrients present resulting in algal blooms. During the daylight hours, algae greatly increase the amount of dissolved oxygen in the water, but at night, algal respiration and die off can cause dissolved oxygen levels to drop low enough to cause fish kills. Besides increasing the frequency of fish kills, algae blooms can also cause difficulty in water treatment resulting in taste and odor problems in finished drinking water.

On July 31, 2008, Gov. Easley signed House Bill 2499, commonly known as the, 2008 Drought Bill, into law as Session Law (SL) 2008-143. This drought legislation includes provisions to improve water use data; reduce drought vulnerability; and allows for quicker response to water shortage emergencies. Most of the provisions became effectively immediately upon the governor's signature. A copy of the legislation as well as a document summary can be found on the DWR drought webpage http://www.ncwater.org/drought/.

20.8.8 Source Water Assessment of Public Water Supplies

20.8.8a Introduction

The Federal Safe Drinking Water Act (SDWA) Amendments of 1996 emphasize pollution prevention as an important strategy for the protection of ground and surface water resources. This new focus promotes the prevention of drinking water contamination as a cost-effective means to provide reliable, long-term and safe drinking water sources for public water supply (PWS) systems. In order to determine the susceptibility of public water supply sources to contamination, the amendments also required that all states establish a Source Water Assessment Program (SWAP). Specifically, Section 1453 of the SDWA Amendments requires that states develop and implement a SWAP to:

- Delineate source water assessment areas;
- Inventory potential contaminants in these areas; and
- Determine the susceptibility of each public water supply to contamination.

In North Carolina, the agency responsible for the SWAP is the Public Water Supply (PWS) Section of the DENR Division of Environmental Health (DEH). The PWS Section received approval from the EPA for their SWAP Plan in November 1999. The SWAP Plan, entitled *North Carolina's Source Water Assessment Program Plan*, fully describes the methods and procedures used to delineate and assess the susceptibility of more than 9,000 wells and approximately 207 surface water intakes. To review the SWAP Plan, visit the PWS website at http://www.deh.enr.state.nc.us/pws/index.htm.

20.8.8b Delineation of Source Water Assessment Areas

The SWAP Plan builds upon existing protection programs for ground and surface water resources. These include the state's Wellhead Protection Program and the Water Supply Watershed Protection Program.

Wellhead Protection (WHP) Program
North Carolinians withdraw more than 88 million gallons of groundwater per day from more than 9,000 water supply wells across the state. In 1986, Congress passed Amendments to the SDWA requiring states to develop wellhead protection programs that reduce the threat to the quality of groundwater used for drinking water by identifying and managing recharge areas to specific wells or wellfields.

Defining a wellhead protection area (WHPA) is one of the most critical components of wellhead protection. A WHPA is defined as "the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield." The SWAP uses the methods described in the state's approved WHP Program to delineate source water assessment areas for all public water supply wells. More information related to North Carolina's WHP Program can be found at http://www.deh.enr.state.nc.us/pws/swap.

20.8.8c Water Supply Watershed Protection (WSWP) Program

DWQ is responsible for managing the standards and classifications of all water supply watersheds. In 1992, the WSWP Rules were adopted by the EMC and require all local governments that have land use jurisdiction within water supply watersheds adopt and implement water supply watershed protection ordinances, maps and management plans. SWAP uses the established water supply watershed boundaries and methods established by the WSWP program as a basis to delineate source water assessment areas for all public water surface water intakes. Additional information regarding the WSWP Program can be found at http://h2o.enr.state.nc.us/wswp/index.html.

20.8.8d Susceptibility Determination – North Carolina's Overall Approach

The SWAP Plan contains a detailed description of the methods used to assess the susceptibility of each PWS intake in North Carolina. The following is a brief summary of the susceptibility determination approach.

Overall Susceptibility Rating
The overall susceptibility determination rates the potential for a drinking water source to become contaminated. The overall susceptibility rating for each PWS intake is based on two key components: a contaminant rating and an inherent vulnerability rating. For a PWS to be determined "susceptible," a potential contaminant source must be present and the existing conditions of the PWS intake location must be such that a water supply could become contaminated. The determination of susceptibility for each PWS intake is based on combining the results of the inherent vulnerability rating and the contaminant rating for each intake. Once combined, a PWS is given a susceptibility rating of higher, moderate or lower (H, M or L).

Inherent Vulnerability Rating
Inherent vulnerability refers to the physical characteristics and existing conditions of the watershed or aquifer. The inherent vulnerability rating of groundwater intakes is determined based on an evaluation of aquifer characteristics, unsaturated zone characteristics and well integrity and construction characteristics. The inherent vulnerability rating of surface water intakes is determined based on an evaluation of the watershed classification (WSWP Rules), intake location, raw water quality data (i.e., turbidity and total coliform) and watershed characteristics (i.e., average annual precipitation, land slope, land use, land cover, groundwater contribution).

Contaminant Rating
The contaminant rating is based on an evaluation of the density of potential contaminant sources (PCSs), their relative risk potential to cause contamination, and their proximity to the water supply intake within the delineated assessment area.

Inventory of Potential Contaminant Sources (PCSs)
In order to inventory PCSs, the SWAP conducted a review of relevant, available sources of existing data at federal, state and local levels. The SWAP selected sixteen statewide databases that were attainable and contained usable geographic information related to PCSs.

20.8.8e Source Water Protection

The PWS Section believes that the information from the source water assessments will become the basis for future initiatives and priorities for public drinking water source water protection (SWP) activities. The PWS Section encourages all PWS system owners to implement efforts to manage identified sources of contamination and to reduce or eliminate the potential threat to drinking water supplies through locally implemented programs

To encourage and support local SWP, the state offers PWS system owners assistance with local SWP as well as materials such as:

- Fact sheets outlining sources of funding and other resources for local SWP efforts.
- Success stories describing local SWP efforts in North Carolina.
- Guidance about how to incorporate SWAP and SWP information in Consumer Confidence Reports (CCRs).

Information related to SWP can be found at http://www.deh.enr.state.nc.us/pws/swap.

20.8.8f Public Water Supply Susceptibility Determinations in the Neuse Basin

In April 2004, the PWS Section completed source water assessments for all drinking water sources and generated reports for the PWS systems using these sources. A second round of assessments were completed in April 2005. The results of the assessments can be viewed in two different ways, either through the interactive ArcIMS mapping tool or compiled in a written report for each PWS system. To access the ArcIMS mapping tool, simply click on the "NC SWAP Info" icon on the PWS web page (http://www.deh.enr.state.nc.us/pws/swap). To view a report, select the PWS System of interest by clicking on the "SWAP Reports" icon.

In the Neuse River Basin, 1,517 public water supply sources were identified. Seventeen are surface water sources, two are groundwater source that are under the influence of surface water (like springs) and 1,498 are groundwater sources. Of the 1,498 groundwater sources, 70 of them have a Higher, 1,231 have a Moderate and 216 have a Lower susceptibility rating. Table 63 identifies the 17 surface water sources, the two groundwater sources under the influence of surface water, and the overall susceptibility ratings for all of these sources. It is important to note that a susceptibility rating of Higher does not imply poor water quality. Susceptibility is an indication of a water supply's potential to become contaminated by the identified PCSs within the assessment area.

Table 63 SWAP Results for Surface Water Sources in the Neuse River Basin.

PWS ID Number	Inherent Vulnerability Rating	Contaminant Rating	Overall Susceptibility Rating	Name of Surface Water Source	PWS Name
0239107	L	L	L	Knapp of Reeds Creek	Town of Butner
0239015	L	L	L	Lake Rogers	City of Creedmore
0332010	L	H	M	Lake Michie	City of Durham
0332010	M	M	M	Little River Reservoir	City of Durham
0351010	H	M	H	Neuse River	Town of Smithfield
0351070	H	L	M	Neuse River	Johnston Co Water System
0368015	H	M	H	Eno River	Town of Hillsborough
0368020	H	L	M	Eno River/Corporation Lake	Orange-Alamance Water System
0392010	H	H	H	Falls of the Neuse	City of Raleigh
0392010	L	H	M	Lake Benson	City of Raleigh
0392010	L	H	M	Lake Wheeler	City of Raleigh
0392030	M	L	M	Smith Creek Reservoir	Town of Wake Forest
0392040	H	L	M	Little River	Town of Zebulon
0496010	H	M	H	Neuse River	City of Goldsboro
0496010	H	L	M	Little River	City of Goldsboro
0498010	M	M	M	Wiggins Mill Pond	City of Wilson
0498010	M	L	M	Toisnot Reservoir	City of Wilson
0392225*	H	L	M	Well #3	Neuse River Village MHP
0392225*	H	L	M	Well #4	Neuse River Village MHP

Chapter 21
State and Local Government Planning

21.1 The Role of State Government

Several commissions, agencies and programs handle state policies governing actions and activities in coastal areas. The *Environmental Management Commission* (EMC) is a 19-member panel that is appointed by the governor and legislative officials and is responsible for adopting rules for the protection, preservation and enhancement of the state's water and air. Water related rules include stormwater management, basinwide planning, nutrient management strategies and discharge permits.

The North Carolina Coastal Area Management Act (CAMA) established a cooperative program of coastal area management between local and state governments. The Act states that local governments shall have the initiative for planning, while the state government establishes areas of environmental concern. With regard to planning, the state government is directed to act primarily in a supportive, standard-setting, and review capacity, except in situations where local governments do not elect to exercise their initiative. In addition, the CAMA established the *Coastal Resource Commission* (CRC) within the Department of Environment and Natural Resources, whose duties include approval of Coastal Habitat Protection Plans and designation of Areas of Environmental Concern (AEC). After designation of these areas, the Commission is responsible for issuing all permits and establishes regulations to control development. The CRC is a 15-member board appointed by the governor to adopt rules and policies for coastal development and certify local land use plans for the 20 coastal counties and their communities. These regulations are implemented and permitted by the Division of Coastal Management (DCM) (see website http://dcm2.ehnr.state.nc.us/). An example of these rules is the establishment of a 30-foot buffer zone for building along estuarine waters.

The Division of Marine Fisheries is responsible for the stewardship of the state's marine and estuarine resources, which encompasses all coastal waters and extends to 3 miles offshore. Agency policies are established by the 9-member *Marine Fisheries Commission* and the Secretary of the Department of Environment and Natural Resources.

The N.C. Divisions of Water Quality, Coastal Management, Land Resources, Marine Fisheries, Soil and Water Conservation, Parks and Recreation and Environmental Health are responsible for activities and policies including stormwater management, development permits, erosion control programs, agriculture and land preservation, shellfish protection and recreation monitoring, just to name a few.

21.2 Coastal Habitat Protection Plan (CHPP)

North Carolina has approximately 2.9 million acres of estuarine and marine waters, comprising the largest estuarine system of any state along the Atlantic coast. North Carolina has a billion-dollar commercial and recreational fishing industry and ranks among the nation's highest seafood-producing states. Fish and shellfish species important to these industries depend on the quality and quantity of habitats found along our rivers, sounds and ocean waters. Pressures from development, loss of habitat, pollution and degraded water quality threaten fish habitats. Shellfish beds, mud flats, marshes, sea grass beds, freshwater streams and swamps are in jeopardy. The loss of these vital fish habitats threatens fishing industry central to North Carolina's history and economic growth.

Recognizing these threats, the N.C. General Assembly passed the Fisheries Reform Act of 1997. Included within this law is a requirement for three of the state's regulatory commissions (Marine Fisheries, Environmental Management, and Coastal Resources commissions) to adopt a plan to manage and restore aquatic habitats critical to North Carolina's commercial and recreational fisheries resources. DENR developed the Coastal Habitat Protection Plan (CHPP) through a cooperative, multi-agency effort with public input. The CHPP was adopted by the three commissions in December 2004 and sets the stage for unprecedented improvements in fish habitat protection and restoration in North Carolina.

The CHPP is a detailed document that describes the six major fish habitats (water column, shell bottom, submerged aquatic vegetation, wetlands, soft bottom and hard bottoms) and provides scientific information on their ecological functions and importance to the species that inhabit them. It identifies threats and management needs for each habitat and recommends administrative, regulatory and non-regulatory steps necessary to protect, restore and enhance each habitat. These recommendations are a result of scientific studies, deliberations of the three commissions, and input from citizens who attended 20 public meetings held during the development of the CHPP.

DENR and the three commissions developed and adopted specific plans to implement the CHPP recommendations, with a focus on actions that could be taken based on existing resources. The implementation actions are organized according to four habitat management goals:

GOAL 1. Improve effectiveness of existing rules and programs protecting coastal fish habitats
GOAL 2. Identify, designate and protect strategic habitat areas
GOAL 3. Enhance habitat and protect it from physical impacts
GOAL 4. Enhance and Protect Water Quality

Visit http://www.ncdmf.net/habitat/index.html to learn more about the CHPP recommendations. Refer questions and comments to chpps@ncmail.net or call (252) 726-7021 or (800) 682-2632.

21.3 Oyster Action Plan

Over the past several years efforts to restore North Carolina's native oyster populations have increased significantly and annual oyster harvests have also increased. However, since the early 1900s, the oyster population has declined an estimated 90 percent due to of a variety factors such as habitat loss, pollution, diseases, and harvest pressure. Recognizing the need for concerted action to reverse this trend and the value of a healthy oyster population, an Oyster Forum was sponsored by the North Carolina Coastal Federation in 2003 and is supported by CHPP. The forum participants, including scientists, fishermen, policymakers and educators, drafted the ***Oyster Restoration and Protection Plan for North Carolina: A Blueprint for Action***. Goals of this plan include:

- To restore and protect North Carolina's native oyster populations and habitat so that estuaries are again robust, diverse, & resilient ecosystems,
- To build broad public awareness & support for the value of estuarine conservation & sustainable fisheries, and
- To work with a strong coalition to make significant, demonstrable & meaningful progress towards oyster restoration in the next 3 - 5 years.

To achieve the goals of oyster protection and restoration there needs to be an increase in funding and resources allocated to oyster research, public education, regulation enforcement and land acquisition. The Blueprint identifies a need to increase resources available to the Division of Marine Fisheries' Shellfish Rehabilitation Program, planning oyster hatcheries at the NC Aquariums, and designating more oyster sanctuaries. Public education activities could focus on individual actions to include oyster shell recycling and oyster gardening. To promote a sustainable oyster industry opportunities for increasing mariculture are sought. Cleaning up existing sources of point and nonpoint source pollution in shellfish waters and watersheds is essential along with improving inspections and enforcement of permitted regulated activities. Communities not under stormwater regulations should voluntarily implement effective stormwater rules and include them in their CAMA Land Use Plans. DEH Shellfish Sanitation surveys are a valuable source for identifying water quality concerns and areas that threaten oyster health; supporting these surveys with resources and expanding their mapping capabilities is important for oyster restoration and protection. The Oyster Restoration and Protection Plan includes land acquisitions, resource enhancements, stormwater projects, and watershed restoration activities as potential projects.

21.4 NC Coastal Nonpoint Source Program

Section 6217 of the Federal 1990 Coastal Zone Act Reauthorization Amendments (CZARA) requires every state participating in the Coastal Zone Management Act Program to develop a Coastal Nonpoint Source Program (CNPSP). The purpose of this requirement, as stated in the Act, is to "strengthen the links between Federal and State coastal zone management and water quality management programs and to enhance State and local efforts to manage land use activities that degrade coastal waters and coastal habitats." To accomplish these goals, the federal agencies established 56 Management Measures that are to be used by each state to address the following nonpoint source pollution categories (first five items) and that provide tools to address the various sources of nonpoint pollution (last item):

- Agricultural Sources
- Forestry
- Urban Areas *(urban runoff; construction activities; existing development; on-site disposal systems; pollution prevention; and roads, highways and bridges)*
- Marinas and Recreational Boating *(siting and design; and marina and boat operation/maintenance)*
- Hydrologic Modification *(channelization and channel modification; dams; and streambank and shoreline erosion)*
- Wetlands, Riparian Areas and Vegetated Treatment Systems

The Management Measures are defined in Section 6217(g)(5) of CZARA as: "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through application of the best available nonpoint pollution control practices technologies, processes, siting criteria, operating methods or other alternatives." Detailed descriptions of the management measures, where they are intended to be applied, their effectiveness, and their costs can be found in EPA's /Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters/ at the following website: http://www.epa.gov/owow/nps/MMGI/.

At the federal level, the program is called the Coastal Nonpoint Pollution Control Program and is administered jointly by the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA). Within North Carolina, the state program is administered by the Division of Water Quality (DWQ) and the Division of Coastal Management (DCM) and is referred to as the Coastal Nonpoint Source Program.

North Carolina received approval from NOAA and EPA for its state program in August 2003. As part of the approval process, North Carolina had to demonstrate it has enforceable policies and mechanisms for the 56 Management Measures, and establish its program boundary. The State is required to develop a strategy to ensure all applicable Management Measures to protect and restore water quality are implemented within 15 years. In addition, the State must develop 5-year implementation plans to ensure adequate progress in achieving the 15-year program strategy.

North Carolina is relying on existing authorities and programs and proposed projects to meet federal requirements, but it may become apparent in the future that additional Management Measures and new regulations are needed to address significant sources of nonpoint sources. If a need arises for new or modified regulations, they would be proposed under existing agency frameworks.

The core of the state's CNPSP is increased communication and coordination between DWQ and key state agencies that have regulatory responsibilities for controlling nonpoint sources of pollution. This increased dialogue is facilitated in part by the state's CNPSP Coordinator and promotes identification of gaps, duplications, inadequacies and/or inefficiencies of existing programs and policies. Responsibilities of the state program coordinator also include developing the 15-year Strategy and successive 5-year implementation plans, serving as a liaison between DWQ and DCM, and participating in the development of nonpoint source outreach and educational activities. For information on the Program's activities, including final reports on projects funded, go to: http://h2o.enr.state.nc.us/nps/CNPSCP/cnpcp.htm or contact Rich Gannon, DWQ Nonpoint Source Unit Supervisor at 919-807-6440.

21.5 The Role of Local Government in Land Use Planning

As residential and commercial development expands inward from the coast, many local governments are now faced with making land use decisions to limit the extent and areas of land development. Several coastal counties still have no zoning ordinances, or have large areas of the county that are not under zoning ordinances. In addition, property owners are being faced with the decision to continue historical uses of their land or sell their property for development. Local governments and planning units within the Neuse River basin are listed in Table 64.

Table 64 Local Governments and Planning Units within the Neuse River Basin

County	Region	Municipality
Beaufort	Q	None
Carteret	P	None
Craven	P	Bridgeton, Cove City, Dover, Havelock, New Bern, River Bend, Trent Woods, Vanceboro
Durham	J	Durham, Butner
Franklin	K	Wake Forest, Youngsville
Granville	K	Butner, Creedmoor, Stem
Greene	P	Hookerton, Snow Hill, Walstonburg
Johnston	J	Benson, Clayton, Four Oaks, Kenly, Micro, Pine Level, Princeton, Selma, Smithfield, Wilson's Mills
Jones	P	Pollocksville, Trenton
Lenoir	P	Grifton, Kinston, La Grange, Pink Hill
Nash	L	Bailey, Middlesex
Orange	J	Hillsborough
Pamlico	P	Alliance, Arapahoe, Bayboro, Grantsboro, Mesic, Minnesott Beach, Oriental, Stonewall, Vandemere
Pitt	Q	Ayden, Farmville, Greenville, Grifton, Winterville
Wake	J	Apex, Cary, Fuquay-Varina, Garner, Holly Springs, Knightdale, Morrisville, Raleigh, Rolesville, Wake Forest, Wendell, Zebulon
Wayne	P	Eureka, Fremont, Goldsboro, Mount Olive, Pikeville, Seven Springs, Walnut Creek
Wilson	L	Black Creek, Kenly, Lucama, Saratoga, Sims, Stantonsburg, Wilson

Region	Name	Website
J	Triangle J Council of Governments	http://www.tjcog.dst.nc.us/
K	Kerr-Tar Regional Council of Governments	http://www.kerrtarcog.org/
L	Upper Coastal Plain Council of Governments	http://www.ucpcog.org/
P	Eastern Carolina Council	http://www.eccog.org/
Q	Mid-East Commission	http://www.mideastcom.org/

21.5.1 Land Use Plans

The Coastal Area Management Act (CAMA) requires each of the 20 coastal counties to have a local land use plan in accordance with guidelines established by the Coastal Resources Commission (CRC). A land use plan is a collection of policies, maps, and implementation actions that serves as a community's blueprint for growth. Each land use plan includes an inventory and assessment of existing environmental conditions along with local policies and a future land use map that address growth issues related to designated Management Topics: land use compatibility, infrastructure carrying capacity, natural hazards, public access, areas of local concern, and water quality.

Inventory and assessment specific to water quality include the identification of existing surface water quality, current situations and trends on permanent and temporary closures of shellfish waters, areas with chronic wastewater treatment system malfunctions, areas with water quality or public health problems related to nonpoint source pollution, and locations where land use and water quality conflicts exist. Policies to address water quality issues are prepared based on the management goal, CRC planning objective, and land use plan requirements specified for the water quality Management Topic. For water quality, the management goal is to maintain, protect, and where possible enhance water quality in all coastal wetlands, rivers, streams, and estuaries. The CRC's planning objective is for communities to adopt policies for coastal waters within the planning jurisdiction to help ensure that water quality is maintained if not impaired and improved if impaired. Local communities are required to devise policies that help prevent or control nonpoint source discharges (sewage and stormwater) through strategies such as impervious surface limits, vegetated riparian buffers, maintenance of natural areas, natural area buffers, and wetland protection. They are also required to establish policies and future land use map categories that are aimed at protecting open shellfishing waters and restoring closed or conditionally closed shellfishing waters.

The CRC's guidelines provide a common format for each plan and a set of issues that must be considered during the planning process; however, the policies included in the plan are those of the local government, not of the CRC. By law, the role of the CRC is limited to determining that plans have been prepared consistent with State Land Use Plan guidelines, do not conflict with State or federal rules, and are consistent with the State's Coastal Management program. Once a land use plan is certified by the CRC, the Division of Coastal Management (DCM) uses the plan in making CAMA permit decisions and federal consistency determinations. Proposed projects and activities must be consistent with the policies of a local land use plan or DCM cannot permit a project to go forward.

At the local level, land use plans provide guidance for both individual projects and a broad range of policy issues, such as the development of regulatory ordinances and public investment programs. Although DCM monitors use of the land use plans through an implementation status report, strict adherence to land use plan policies and implementation actions is largely up to the local government. For this reason, community and local official support of the land use plan is critical to successfully achieving the goals for each management topic, including water quality.

21.5.2 Land Use Plans for Communities in the Neuse River Basin

The Division of Coastal Management's website provides a link to current land use plans, see: http://www.nccoastalmanagement.net/Planning/planning.htm

After review of several CAMA Land Use Plan (LUP) drafts, DWQ recommends that all communities adopt low impact development strategies and technologies for both new development and as options in retrofitting existing infrastructure. It is important for communities to undertake stronger stormwater controls and to update old or failing wastewater systems (e.g., on-site and treatment plants) to prevent future deterioration in water quality. Communities need to address development issues in regards to water quality by implementing the best available control options and by implementing enforcement. DWQ views LUPs as a tool to improve and protect the water quality that these communities' economies depend on. Unfortunately, many of the reviewed LUPs do not adequately reflect proactive planning above and beyond state minimum criteria. DWQ also recognizes and supports the importance of low impact development and appropriate technologies education for developers and local leaders. Overall, LUP policy framework is too general. A large number of policies address adoption of ordinances and procedures by the local government, or defer to the State and Federal agencies' rules to meet the LUP requirements. The policies should provide specific guidance to aid in the development of local ordinances and procedures, not merely state that they will be adopted.

An evaluation of 40 CAMA LUPs written during the mid 1990's concluded, "local planning efforts are procedurally strong, addressing the ranges of issues they are required to cover, but analytically and substantively weak, providing little meaningful attention to regional environmental protection concerns" (Norton, 2005). This evaluation found that many LUPs completed the various required analysis in regards to identifying hazards, flood zones, soil limitations and environmentally sensitive areas, but later in the plan made future land classifications for development with no reference to these analyses (e.g., high density development on oceanfront property zoned as high hazard) (Norton, 2005). The plans did not adequately explain how land was determined suitable for future growth and development and did not adequately address potential adverse environmental impacts, beyond state compliance standards (Norton, 2005). Almost all the communities addressed the environmental impacts and thus need for improved wastewater systems, but "they uniformly failed to discuss the potential growth-inducing effects and resulting environmental impacts that come with infrastructure expansions" (Norton, 2005). In addition, stormwater management was addressed for controlling runoff and associated flooding, but the LUPs did not address the water quality related issues associated with stormwater management (Norton, 2005). In conclusion, regional environmental concerns and cumulative and secondary impacts of development were not addressed with specific management strategies in the LUPs.

DWQ and DCM should work with the local governments in implementing their water quality protection policies and other natural resource protection strategies outlined in their local land use plans.

21.6 Using Land Use Planning as a Tool to Reduce Impacts of Future Development

Proactive planning efforts at the local level are needed to assure that development is done in a manner that maintains water quality. These planning efforts can find a balance between water quality protection, natural resource management, and economic growth. Growth management requires planning for the needs of future population increases, as well as developing and enforcing environmental protection measures. These actions are critical to water quality management and the quality of life for the residents of the basin. DWQs review of draft CAMA Land Use Plans finds that the planning efforts do not adequately protect water quality. Many plans do not consider the compounded impact from development on water quality. Land Use Plans need to incorporate proactive measures to meet future growth demands to prevent water quality deterioration.

To prevent further impairment in urbanizing watersheds local governments should:

(1) Identify waters that are threatened by development.
(2) Protect existing riparian habitat along streams.
(3) Implement stormwater BMPs during and after development.
(4) Develop land use plans that minimize disturbance in sensitive areas of watersheds.
(5) Minimize impervious surfaces including roads and parking lots.
(6) Develop public outreach programs to educate citizens about stormwater runoff.

Planning Recommendations for New Development

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking & narrower slots).
- Place sidewalks on only one side of residential streets.
- Minimize culvert pipe and hardened stormwater conveyances.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.

Action needs be taken at the local level to plan for new development in urban and rural areas. For more detailed information regarding recommendations for new development found in the text box (above), refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection, the Center for Watershed Protection website at www.cwp.org, and the Low Impact Development Center website at www.lowimpactdevelopment.org. The NC Division of Coastal Management with NC Sea Grant and NCSU College of Design developed ***The Soundfront Series***, informational guides to assist property owners and community planners and managers. The guides are available in print and on the web. http://www.ncseagrant.org/. Additional information regarding environmental stewardship for coastal homeowners is available at http://www.soil.ncsu.edu/assist/coastindex.html.

21.7 Planning for Sea Level Changes

Sea level rise will adversely impact North Carolina's coastline and specifically the northern coastline because of its underlying geologic structure (Riggs and Ames, 2003). There is a predicted acceleration in coastal erosion and an increase in estuarine shoreline erosion if oceanic processes are altered by increased barrier island elevation through natural or human modifications (Riggs and Ames, 2003). Major loss of land is predicted in Currituck, Camden, Dare, Hyde, Tyrrell, Pamlico and Carteret counties if glacial melting rates increase significantly, as projected by the Intergovernmental Panel on Climate Change (Riggs and Ames, 2003; IPCC, 2001).

Drowning the North Carolina Coast: Sea-Level Rise and Estuarine Dynamics by S. Riggs and D. Ames (2003) published by North Carolina Sea Grant provides information specifically addressing northeastern NC. This book provides images and figures explaining sea level rise and coastal erosion. This book should be used as a resource for coastal town and municipality planners as new developments, utility infrastructure and other land use decisions are made. Several universities are researching the impacts of sea level rise on North Carolina's coastal economy, more information about their findings can be found at the website: http://econ.appstate.edu/climate/. Information about sea level forecasts being developed by

National Oceanic and Atmospheric Association and several universities in North Carolina can be found at: http://www.cop.noaa.gov/stressors/climatechange/current/slr/welcome.html.

21.8 Management Recommendations for Local Governments

Below is a summary of management actions recommended for local authorities, followed by discussions on large, watershed management issues. These actions are necessary to address current sources of impairment and to prevent future degradation in all streams. The intent of these recommendations is to describe the types of actions necessary to improve stream conditions, not to specify particular administrative or institutional mechanisms for implementing remedial practices. Those types of decisions must be made at the local level.

Because of uncertainties regarding how individual remedial actions cumulatively impact stream conditions and in how aquatic organisms will respond to improvements, the intensity of management effort necessary to bring about a particular degree of biological improvement cannot be established in advance. The types of actions needed to improve biological conditions can be identified, but the mix of activities that will be necessary – and the extent of improvement that will be attainable – will only become apparent over time as an adaptive management approach is implemented. Management actions are suggested below to address individual problems, but many of these actions are interrelated (NCDENR-DWQ, 2003).

(1) Feasible and cost-effective stormwater retrofit projects should be implemented throughout the watershed to mitigate the hydrologic effects of development (e.g., increased stormwater volumes and increased frequency and duration). This should be viewed as a long-term process.

    (a) Over the short-term, current feasible retrofit projects should be identified and implemented.
    (b) In the long-term, additional retrofit opportunities should be implemented in conjunction with infrastructure improvements and redevelopment of existing developed areas.
    (c) Grant funds for these retrofit projects may be available from EPA initiatives, such as EPA Section 319 funds, or the North Carolina Clean Water Management Trust Fund.

(2) A watershed scale strategy to address inputs should be developed and implemented, including a variety of source reduction and stormwater treatment methods. As an initial framework for planning input reduction efforts, the following general approach is proposed:

    (a) Implementation of available best management practice (BMP) opportunities for control of stormwater volume and velocities. These BMPs will help remove pollutants from stormwater and improve aquatic habitat potential.
    (b) Development of a stormwater and dry weather sampling strategy in order to facilitate the targeting of pollutant removal and source reduction practices.
    (c) Implementation of stormwater treatment BMPs, aimed primarily at pollutant removal, at appropriate locations.

(d) Development and implementation of a broad set of source reduction activities focused on: reducing non-storm inputs of toxics; reducing pollutants available for runoff during storms; and managing water to reduce storm runoff.

(3) Actions recommended above (e.g., stormwater quantity and quality retrofit BMPs) are likely to reduce nutrient/organic/bacterial loading, and to some extent, its impacts. Activities recommended to address this loading include the identification and elimination of illicit discharges; education of homeowners, commercial applicators, and others regarding proper fertilizer use, street sweeping, catch basin clean-out practices, animal and human waste management, and the installation of additional BMPs targeting biological oxygen demand (BOD) and nutrient removal at appropriate sites.

(4) Prevention of further degradation will require effective post-construction stormwater management for all new development in the study area.

(5) Effective enforcement of sediment and erosion control regulations will be essential to the prevention of additional sediment inputs from construction activities. Development of improved erosion and sediment control practices may also be beneficial.

(6) Watershed education programs should be implemented and continued by local governments with the goal of reducing current stream damage and preventing future degradation. At a minimum, the program should include elements to address the following issues:

(a) Redirecting downspouts to pervious areas rather than routing these flows to driveways or gutters,
(b) Protecting existing woody riparian areas on all streams,
(c) Replanting native riparian vegetation,
(d) Reducing and properly managing pesticide and fertilizer use,
(e) Reducing and properly managing animal waste, and
(f) Reducing and properly managing septic systems.

Planning for sustainable growth in the Neuse Basin requires awareness, understanding and implementation of sound design and management options. Natural resources contribute to our quality of life while supporting and promoting economic growth. Communities should anticipate growth while incorporating Low Impact Development technologies in their planning to promote long-term sustainability of our natural resources.

Chapter 22
Water Quality Initiatives

22.1 The Importance of Local Initiatives

As the Basinwide Planning Program completes its fourth cycle of plan development, there are many efforts being undertaken at the local level to improve water quality. Information about local efforts particular to a watershed or subbasin is included in Chapters 1-14. DWQ encourages local agencies and organizations to learn about and become active in their watersheds.

An important benefit of local initiatives is that citizens make decisions that affect change in their own communities. There are a variety of limitations local initiatives can overcome including: state government budgets, staff resources, lack of regulations for nonpoint sources, the rulemaking process, and many others.

Local organizations and agencies are able to combine professional expertise in a watershed. This allows groups to holistically understand the challenges and opportunities of different water quality efforts. Involving a wide array of people in water quality projects also brings together a range of knowledge and interests, and encourages others to become involved and invested in these projects. By working in coordination across jurisdictions and agency lines, more funding opportunities become available, and it is easier to generate necessary matching or leveraging funds. This will potentially allow local entities to do more work and be involved in more activities because their funding sources are diversified. The most important aspect of these local endeavors is that the more localized the project, the better the chances for success.

The collaboration of these local efforts are key to water quality improvements. There are good examples of local agencies and groups using these cooperative strategies throughout the state. The following local organizations and agencies are highlighted to share their efforts towards water quality improvement. Additional projects are also described in the subbasin chapters.

DWQ applauds the foresight and proactive response to potential water quality problems. Federal and State government agencies are interested in assisting local governments and citizen groups in developing their water quality management programs. The distribution of several grantors is discussed.

22.2 Local Initiatives

22.2.1 Ellerbe Creek Watershed Association

Dedicated to restoring Ellerbe Creek and making it an asset for the citizens of Durham, the Ellerbe Creek Watershed Association gained official 501(c)(3) nonprofit status in April of 1999. In July 1999, it was awarded a matching grant by Durham County to purchase six wooded acres along Ellerbe Creek for an urban nature reserve and public trail. ECWA is working with NC State and NC Wetlands Restoration Program watershed specialists to restore sections of Ellerbe Creek and demonstrate ways to utilize stormwater in wetland gardens. ECWA is promoting the creation of a unique wildlife/recreation area on waste ground behind Durham's closed landfill and working with developers, homeowners and city government to reduce stormwater impacts on the creek and preserve greenspace. ECWA is also involving volunteers in periodic monitoring of Ellerbe Creek's water quality through a Stream Watch Program. Long-term goals for the organization include the establishment of a volunteer network throughout the watershed, completion of an urban trail system throughout the watershed, preservation of Ellerbe Creek's headwaters and other special features, and restoration of the creek's lower floodplain. Visit the association's website at http://www.ellerbecreek.org/.

22.2.2 Friends of South Ellerbe Creek

The Friends of South Ellerbe Creek is an informal group of citizens dedicated to conserving and enhancing the scenic, recreational, natural and historic qualities of South Ellerbe Creek and its landscape. From its headwaters near Greystone Baptist on Hillsborough Road, South Ellerbe Creek flows for three miles through some of Durham's oldest and most densely developed neighborhoods: Old West Durham, Walltown, Northgate Park, Trinity Park. Another branch of South Ellerbe flows north out of downtown Durham, through Durham Central Park and Trinity Park. South Ellerbe then joins Ellerbe Creek in a small forest just northwest of the I-85/Roxboro Road interchange. Along some wooded stretches, the creek quietly flows through areas as scenic as any in North Carolina. Elsewhere, South Ellerbe is a troubled creek.

Efforts to clean up urban streams throughout the city of Durham are paying off. But nowhere is that progress more evident than in the Ellerbe Creek watershed. The Friends of South Ellerbe Creek and other neighborhood volunteer groups are helping to focus community awareness on the need to protect and restore streams in Durham. For more information or to get involved, visit http://www.owdna.org/fosec.htm.

22.2.3 Eno River Association

The Eno River Association is a 501c3 non-profit conservation organization whose mission is to conserve and protect the natural, cultural and historic resources of the Eno River basin. Since 1966, the Association has worked actively to protect the lands and waters along the Eno River and its tributaries**.** Efforts to date have resulted in almost 5,500 acres of protected lands. These acres are largely contained within five public parks: the Eno River State Park, the Occoneechee Mountain State Natural Area, West Point on the Eno Durham City Park, Penny's Bend Nature Preserve and the Little River Regional Park. For more information, call (919) 620-9099 or visit http://www.enoriver.org/.

22.2.4 Upper Neuse River Basin Association

In 1996, fourteen local governments formed the Upper Neuse River Basin Association (UNRBA) to provide an ongoing forum to address watershed management issues of mutual concern in the 770-square mile watershed above the Falls Lake Dam. The upper Neuse basin includes nine man-made water supply reservoirs that serve about one-half million people. It also includes water resources that are essential for a variety of wildlife and a variety of recreational opportunities.

The UNRBA has created a comprehensive, integrated watershed management plan for the Upper Neuse River Basin. The plan was developed in partnership with the state Division of Water Quality and accepted by the UNRBA Board of Directors in 2003. It aims to support, coordinate, and build upon local and state government water resource management efforts. The plan includes:

- an assessment of water quality and related water quantity management in the Upper Neuse River Basin;
- a description of the goals and objectives for protection and improvement of water quality and related water quantity management in the basin; and,
- a work plan that describes proposed water quality protection strategies, including point and nonpoint source programs, for achieving the specified goals and objectives

UNRBA is currently developing an Implementation Approach for the Watershed Management Plan, a process that will produce an Implementation Plan. The Technical Advisory Committee (TAC) is responsible for developing the Implementation Plan, with assistance from UNRBA staff and the Implementation Steering Committee (ISC). The Implementation Plan will specify:

- tasks,
- timetables for action,
- responsibilities of state and local agencies,
- a water quality monitoring framework,
- and sources of funding.

It will also include a system of performance indicators and benchmarks that will be used to measure progress on implementing the Watershed Management Plan.

UNRBA is currently developing two components of the Implementation Plan:

- templates for Local Management Strategy Reviews, which will be used to assess progress on implementation
- recommendation sheets, which detail how a given watershed management strategy might be implemented, locally or regionally

For more information on the UNRBA or the Watershed Management Plan, visit http://www.unrba.org.

22.2.5 Upper Neuse Clean Water Initiative

Overview of the Upper Neuse Clean Water Initiative:
The Upper Neuse Clean Water Initiative is a partnership effort to prioritize and, through voluntary actions, protect those lands most critical for the long-term safety and health of all drinking water supplies for the communities in the Upper Neuse River Basin (UNRB). The project prioritizes lands that meet water supply protection goals, but also considers local land conservation goals, such as recreation and natural lands protection, as well as stormwater retention.

The Initiative is comprised of three major components: comprehensive conservation planning; outreach to landowners, local governments, and the public; and acquisition through the purchase or donation of land or conservation easements from willing sellers of properties identified in the plan as high priority. Land conservation provides a voluntary, non-regulatory option for protecting water supplies and is one of the most cost-effective tools for ensuring safe drinking water.

Conservation Planning Methods and Results:

The Triangle J Council of Governments (TJCOG), in collaboration with The Trust for Public Land (TPL), used Geographic Information System (GIS) technology and computer modeling to identify properties within the UNRB that offer the greatest protection value for the Basin's water quality. TPL and TJCOG assembled a Technical Advisory Team of local experts in water quality, water resources management, and GIS to help develop and weight model criteria and identify the highest quality data. The final model included data on land use cover, hydrology, elevation, headwater catchments, parcel data, groundwater wells, vertical hydraulic conductance, critical catchment areas, and soil type. Priority tracts are typically found along streams or water bodies, at headwater areas, and/or contain wetland areas. Because the model considers parcels throughout the 770 square mile Basin and considered all of the Basin's nine drinking water supplies equally, the priority parcels are scattered throughout the Basin. For more detailed information and specific parcel priorities, contact Conservation Trust for North Carolina at (919) 828-4199 or www.ctnc.org.

Local governments, land trusts, watershed associations and others have been working for years to conserve sensitive lands in the Upper Neuse River Basin. As a result of these efforts, over 50,000 acres of land have been permanently protected (as of 5/06) which are park lands and nature preserves; lands managed for preservation by local/regional land trusts; and privately owned lands protected by conservation agreements. Of UNRB lands not already protected, the model identified approximately 24,000 acres as high priority for conservation to protect water quality. Together, these high-priority acres represent fewer than 5 percent of the Upper Neuse River Basin.

Continuing their collaborative work, state and local government programs, the Ellerbe Creek Watershed Associations, Upper Neuse River Basin Association, Eno River Association, Tar River Land Conservancy, Triangle Greenways Council, Triangle Land Conservancy, Trust for Public Land, and willing landowners, as well as other critical partners can utilize a variety of conservation options including conservation easements/agreements, fee-simple purchase, donations, bargain sales, etc to address conservation of the plan's priority parcels.

Due to population growth and development however, the opportunities for protecting these priority tracts may be short-lived. Most experts agree there is a threshold ratio of impervious surface to natural land which, when crossed, results in a measurable decline in water quality in the watershed. Many believe the threshold occurs when the watershed is 10 percent impervious. Based on the region's current rate of population growth, more than one-third of the sub-watershed in UNRB will exceed the 10 percent threshold by 2025.

Additionally, a report released by Triangle Green Print Project (2002), the current rate of land protection in the region must double to increase protected land from 8 percent to a region-wide goal of 15 percent within 25 years.

Updated status of the Upper Neuse Clean Water Initiative:

Since the inception of the Upper Neuse Clean Water Initiative, 1669 acres bordering over 15 miles of streams have been protected. Currently, the local land trusts are working on 31 projects that would result in protecting an additional 3,785 acres along over 36 miles of stream.

For a copy of the plan and additional information on the Upper Neuse Clean Water Initiative please go to: http://www.ctnc.org/upperneuse.htm

22.2.6 Wake County Watershed Plan

The Wake County Commissioners established a task force to provide input to the watershed management plan. The task force included an elected official from each of the other local governments within the county. A member of the Soil and Water Conservation District Board, the Open Space Advisory Committee, and the Human Services Board was also appointed. There were eight at-large appointments that included members of the development community, local landowners, agriculture and citizens groups. The task force met monthly throughout the project. Other stakeholders were invited to each meeting and were given opportunity to participate in the discussion.

The assessment of current conditions included reviewing available biological and chemical data. Benthic data were collected at an additional 24 sites within the county, and habitat/geomorphology data were collected at 86 sites within the county. These data along with land use information such as the percentage of impervious cover and amount of forested land within riparian buffers were used to classify each of the watersheds into one of the following categories: healthy, impacted, impacted/restorable, degraded, degraded/restorable. Thirty watersheds were classified as healthy, 33 as impacted/restorable, four as impacted, eight as degraded/restorable, and five as degraded.

The task force reached consensus on 23 recommendations in several categories, including buffers, floodplain protection, conservation subdivisions and open space conservation. Some highlights of those recommendations are:

- Require 100-foot stream buffers on perennial streams within priority watersheds, and 50-foot buffers in other watersheds. These are strips of trees, grass or shrubs along river and stream banks. Buffers help protect streams from runoff and temperature changes, and provide a source of organic material for stream aquatic life.
- Allow no development or filling in the 100-year floodplain with the exception of utilities and infrastructure.
- Allow and encourage conservation subdivisions, which preserve large tracts of open space within new subdivisions.
- If municipal water and sewer are available to a site, a minimum of 30 percent open space should be preserved to qualify as a conservation subdivision.
- Use incentives to help meet targets for less impervious surfaces in priority watersheds. Impervious surfaces, such as pavement and rooftops, keep water from soaking into the soil, creating more stormwater runoff.
- Better educate homeowners about well and septic system maintenance.

For more information see website at http://www.wakegov.com/water/watershed/taskforce/default.htm.

22.3 Regional Initiatives

22.3.1 Riparian Corridor Conservation Program

An additional source of information on the Basin's land conservation priorities are riparian corridor conservation plans. The Clean Water Management Trust Fund (CWMTF) – Conservation Trust for North Carolina (CTNC) Riparian Corridor Conservation Program facilitates the identification and establishment of integrated networks of protected areas and forested riparian corridors. More specifically, the program involves pass through funding from CWMTF, through CTNC, to the state's 24 local and regional land trusts to develop conservation plans with detailed analysis of a defined project area and prioritization of waterfront parcels for protection and restoration based on each property's impacts on water quality in a targeted stream segment. Additionally the program funds implementation of existing plans in which land trusts undertake landowner outreach, education (often in the form of workshops), easement negotiations, acquisition negotiations and other recommendations laid out in previously established riparian corridor conservation plans. This statewide coordinated effort to protect and restore riparian buffers and greenways represents the most cost-effective long-term protection of water quality possible.

Riparian Corridor Conservation Plans developed thus far in the Upper Neuse River Basin include:

- Upper and Lower Eno River – written by the Eno River Association (919) 620-9099
- Little River (Orange & Durham Counties) - written by the Eno River Association (919) 620-9099
- Upper Neuse River Basin – written by Triangle Greenways Council (www.trianglegreenways.org).

22.3.2 Conservation Trust for North Carolina

The Conservation Trust for North Carolina and CWMTF have funded three riparian corridor conservation plans in the Neuse River basin. Plans were prepared for the Eno River, upper Neuse subbasin and Lower Swift Creek.

22.3.3 Triangle Greenways Council

The Triangle Greenways Council is an advocacy group for the promotion of greenways in the RTP area. The Conservation Trust for North Carolina awarded the Triangle Greenways Council a grant to prepare a riparian corridor conservation design for the upper Neuse River basin. The goal of the design project is to identify and prioritize areas where preservation and restoration projects would have the greatest positive effect on water quality. Potential parcels have been identified on Walnut Creek, Crabtree Creek, Reedy Creek and the Flat River. For more information, visit http://www.trianglegreenways.com/.

22.3.4 Triangle Land Conservancy

Triangle Land Conservancy (TLC) is a local non-profit land trust in the Triangle with over 3000 members. Since 1983, TLC has been protecting important open space—stream corridors, forests, wildlife habitat, farmland and natural areas—in Chatham, Durham, Johnston, Lee, Orange and Wake counties to help keep the Triangle Region a healthy and vibrant place to live and work. To accomplish this goal, TLC identifies the most significant and threatened lands in the triangle region; plans with local communities for their protection; conserves these lands through purchase or private conservation agreements; manages these lands; and promotes positive conservation approaches and the protection of open space. In doing so, TLC helps keep our water and air clean, makes sure we have places for recreation, and helps families stay on their farms. To date, TLC has protected more than 10,000 acres of our community's most important open space.

In the Neuse River Basin, TLC helps implement the Upper Neuse Clean Water Initiative through land owner outreach and conservation of priority lands. Additionally, TLC focuses its efforts in three other core areas in the basin including the Marks Creek Rural Lands Initiative (at the Johnston/Wake County Line), Swift Creek (in Wake and Johnston Counties), and the Neuse River Lowlands (in southern Johnston County). TLC has created conservation assessments for each of these areas and works to protect water quality through voluntary conservation of high priority lands. TLC also focuses on regional connectivity of important conservation areas and was instrumental in creating the Triangle Greenprint (http://www.trianglegreenprint.org/) which identifies key conservation areas and connectors in the Triangle Region. For more information on TLC, call (919)-833-3662 or visit http://www.tlc-nc.org/.

The Conservation Trust for North Carolina awarded the Triangle Land Conservancy a grant to prepare a conservation assessment for the Lower Swift Creek. The assessment recommends conservation strategies designed to protect water quality in Swift Creek in Wake and Johnston counties.

22.3.5 Triangle J Council of Governments

The Triangle J Council of Governments is recognized as a leader in water supply protection efforts. TJCOG assisted local governments in the development of their watershed management regulations and has strongly encouraged the development of the state's minimum standards for protection of public water supplies. It has also played an important role in the ongoing effort to develop an initial watershed protection plan for Falls of the Neuse Reservoir.

TJCOG has worked closely with local, state and federal agencies to develop the Triangle Area Water Supply Monitoring Project. Under way since 1988, the program involves systematic sampling and analysis of water quality at several major water supplies in the region. Through this effort local communities now have important information about the existing and potential quality of the public's water supply. For more information on The Triangle Council of Governments water quality initiatives, visit http://www.tjcog.dst.nc.us/.

22.3.6 Neuse River Foundation

The Neuse River Foundation, Inc. is a membership-based, 501(c)(3) nonprofit organization with more than 2,400 members. Since its inception in 1980, NRF has been educating the public, advocating for clean water and fighting to stop water pollution. In 1993, NRF hired North Carolina's first Riverkeeper. In late 2001, NRF hired a second Riverkeeper to provide coverage throughout the river basin. The upper Neuse Riverkeeper is based in Raleigh and looks after the Neuse from its headwaters down to Goldsboro. The lower Neuse Riverkeeper is based in New Bern and is responsible for the river from Goldsboro to the Pamlico Sound. For more information on the NRF or to contact the Neuse Riverkeeper®, visit http://www.neuseriver.org/.

22.3.7 Lower Neuse Basin Association

The Lower Neuse Basin Association (LNBA) is an association that represents 23 permitted facilities owned by 18 municipalities and industries with wastewater treatment facilities permitted to discharge treated wastewater into the Neuse River below Falls of the Neuse Dam. The association was formed for information exchange and undertakes activities best accomplished by a group effort. The LNBA currently monitors water quality 48 sites in 9 counties.

The Lower Neuse River Basin Association and the Neuse River Compliance Association have estimated that their members have spent in excess of 200 million dollars to construct and retrofit their wastewater treatment plants to comply with the nutrient reduction requirements. In addition, they have spent over 17 million dollars to construct reuse projects which will further reduce the nutrient load to the river. For more information on the LNBA, visit their website at http://www.lnba.net/.

22.4 Federal and State Initiatives

22.4.1 Federal Clean Water Act – Section 319 Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration and restoration projects (Table 56). Through annual base funding, there is approximately $1 million available for demonstration and education projects across the state. An additional $2 million is available annually through incremental funds for restoration projects. All projects must provide nonfederal matching funds of at least 40 percent of the project's total costs. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution (NPS). Information on the North Carolina Section 319 Grant Program application process is available online at http://h2o.enr.state.nc.us/nps/application_process.htm. Descriptions of projects and general Section 319 Program information are available at http://h2o.enr.state.nc.us/nps/Section_319_Grant_Program.htm.

Many 319 projects are demonstration projects and educational programs that allow for the dissemination of information to the public through established programs at NC State University (NCSU) and the NC Cooperative Extension Service. Other projects fund stream restoration activities that improve water quality. Table 65 describes the 319 funded projects in the Neuse River basin.

Table 65 Neuse River Basin 319 Projects (1999 – 2006).

Fiscal Year	Contract Number	Name	Description	Agency	Funding
1999	EW20008	Crabtree Creek Urban Planning BMP	Urban Stormwater, Education, BMP Installation	NCSU	$86,152
1999	EW20012	Watershed Septic System Training	Onsite Wastewater, Education	NCSU	$100,000

Fiscal Year	Contract Number	Name	Description	Agency	Funding
1999	E2145	Upper Neuse NPS Team	Education	NC DENR, DWR	$45,000
1999	EW01068	Nutrient Management for Agriculture in NC	Agriculture, BMP Modeling	NCSU	$23,100
1999	EW200025	Mid Neuse NPS Team	Education	Wayne County CES	$97,000
1999	EW04062	Cleanwater Education Partnership	Urban Stormwater, BMP Demonstration	Triangle J COG	$15,000
1999, 2000, 2001, & 2003	EW05067	Rocky Branch Creek Restoration	Stream Restoration, Urban Stormwater	NCSU, Sea Grant	$625,000
1999 & 2002	EW03021	Superior Alternative Technology	Agriculture	USGS	$38,500
2000	EW02003	Toisnet Creek	Urban Stormwater, Education, BMP Installation	NCSU	$90,000
2000	EW01042	Crabtree Creek Urban Planning BMP Phase II	Urban Stormwater, BMP Demonstration	NCSU	$89,543
2000	EW01023	Facilitating Accurate Nutrient Management Via Yield Records	Agriculture, Database	NCSU	$150,000
2000 & 2001	EW05071	Water Quality Improvement to North Creek	Urban Stormwater, Stream Restoration	NCSU	$80,000
2001	EW02022	Demo BMPs for Restoration of Degraded Coastal Plain Stream System	Coastal NPS, BMP Demonstration	NCSU Sea Grant	$100,000
2001	EW06035	Enviroscape Educational Tool	Construction, Education	City of Wilson	$686
2001	EW03034	Restoration of Small Urban Stream, Raleigh (Greenroofs)	Urban Stormwater, BMP Demonstration	NCSU	$80,000
2001	EW02018	Contentnea Creek Geology & Geomorphological Framework to Support Groundwater Model Upscaling	Groundwater Protection, Mapping, GIS	NC DENR, DLR, NCGS	$96,000
2002	EW03004	Clemmons Educational Forest Education Program	Forestry Education	NC DENR, DFR	$8,697
2002	EW03003	Comparison of onsite & offsite wastewater treatment	Onsite Wastewater, Monitoring	NC DENR, DEH	$96,500

Fiscal Year	Contract Number	Name	Description	Agency	Funding
2002	EW03011	Carteret Upper South River Watershed BMP Demo Project	Agriculture, Innovative BMP	Duke University Marine	$210,000
2002	EW04001	NPS Land Use Data Collection and Inventory Development	Mapping, GIS	NC DENR, DSWC	$37,700
2002	EW03053	Development of GIS Tools for Evaluating Impact of BMP & Restoration Projects on Nitrogen Loading from Coastal Plain Watersheds	Agriculture, Mapping, GIS	NCSU, Greene & Pitt Counties	$100,000
2002	EW04022	Wetland and Buffer Enhancement of a Pond	Urban Stormwater, Wetlands Protection	NCSU, Craven County	$12,320
2003	EW04036	Continuation Upper Neuse River NPS Team	Urban Stormwater, Planning	NC DENR, DWR	$53,000
2003	EW04035	Shallow Aquifers and Confining Units in the Neuse River Basin: Surry to Suffolk Scarp	Groundwater Protection, Modeling	NCGS, DLR	$150,000
2003	EW06012	Installation & Comparative Evaluation of Bioretention for Treatment of run off from Vehicle Fleet Service Facility	Urban Stormwater, BMP Demonstration	City of Raleigh	$34,000
2003	EW04015	LID Demo & Education, Raleigh UT to Marsh Creek	Urban Stormwater, Education, BMP Installation	NCSU	$170,100
2003 & 2004	EW07015	Evaluation & Remediation of Nitrate Flux from Biosolid Application Fields to Surface Waters of Neuse River	Innovative BMP, Monitoring, Education	NCSU	$101,329
2004	EW06010	Pigeon House Branch Water Quality Improvement Project Wet Detention Pond & Monitoring at Fred Fletcher Park	Urban Stormwater, BMP Implementation	City of Raleigh	$328,000
2004	EW05082	Stoney Creek Watershed Demonstration of BMPS for LID	Agriculture, Education, BMP Installation	NCSU, Wayne County	$159,500
2004	EW05018	Adapt a Site Evaluation Tool (SET) for use by local governments in Upper Neuse Basin in determining w/stormwater performance standards for new development	Urban Stormwater, BMP Modeling	Upper Neuse River Basin Association	$39,750

Fiscal Year	Contract Number	Name	Description	Agency	Funding
2004	EW06077	Cost Effectiveness of Agricultural and Urban BMPs	BMP Modeling	NCSU	$30,000
2005	EW06076	Continuation Upper Neuse River NPS Team	Education, BMP Installation, Planning	Neuse River	$46,000
2005	EW06062	NC Survey of Stormwater Enterprises for Region J	Planning	Triangle J COG	$8,616
2005	EW06065	Black Creek Watershed Assessment, Monitoring, & Restoration Planning	Stream Restoration	NCSU	$175,765
2006	EW07026	Lick Creek Watershed Restoration Plan	Watershed Restoration	Upper Neuse River Basin Association	$145,140
2006	EW07025	Developing a Comprehensive Assessment of the TMDL for the Neuse River Estuary, NC. Using Advanced Unattended Water Quality Monitoring	TMDL Development	UNC Chapel Hill	$244,024
2006	EW07060	An Integrated Approach to Watershed Management Planning and Implementation in Selected Watersheds of the Falls Lake Reservoir	Watershed Restoration	Wake County	$180,500
				Total Funding	$4,046,922

22.4.2 North Carolina Ecosystem Enhancement Program (NCEEP)

The NC Ecosystem Enhancement Program (NCEEP) combines an existing wetlands-restoration initiative by the NC DENR with ongoing efforts by the NC Department of Transportation (DOT) to offset unavoidable environmental impacts from transportation-infrastructure improvements. The U.S. Army Corps of Engineers joined as a sponsor in the historic agreement, which is committed to restoring, enhancing and protecting the wetlands and waterways across the State of North Carolina. NCEEP can provide:

- High-quality, cost-effective projects for watershed improvement and protection;
- Compensation for unavoidable environmental impacts associated with transportation-infrastructure and economic development; and
- Detailed watershed-planning and project-implementation efforts within North Carolina's threatened or degraded watersheds.

NCEEP can perform restoration projects cooperatively with other state or federal programs or environmental groups. For example NCEEP efforts can complement projects funded through the Section 319 Program. Integrating wetlands or riparian area restoration components with Section 319 funded or proposed projects will often improve the overall water quality and habitat benefits of the project. The NCEEP actively seeks landowners throughout the state that have restorable wetland, riparian, and stream restoration sites. For more information about NCEEP, visit http://www.nceep.net/ or call (919) 715-7452.

22.4.3 Coastal and Estuarine Land Conservation Program

The Coastal and Estuarine Land Conservation Program **(**CELCP) was established by Congress "for the purpose of protecting important coastal and estuarine areas that have significant conservation, recreation, ecological, historical, or aesthetic values, or that are threatened by conversion from their natural or recreational state to other uses." The program provides funding for projects that ensure conservation of these areas for the benefit of future generations, giving priority lands which can be effectively managed and protected, and that have significant ecological value. The Division of Coastal Management administers the CELCP program in North Carolina. For more information on funding opportunities and guidelines see http://www.nccoastalmanagement.net/Facts/CELCP.htm.

22.4.4 Community Conservation Assistance Program

Community Conservation Assistance Program (CCAP) is a voluntary, incentive-based program designed to improve water quality through the installation of various best management practices (BMPs) on urban, suburban and rural lands, not directly involved in agricultural production. CCAP consists of educational, technical and financial assistance provided to landowners by local Soil and Water Conservation Districts. CCAP will focus its efforts on stormwater retrofits to existing land uses. It will not be used to assist in new development sites to meet state and federal stormwater mandates. CCAP encourages local governments, individual landowners and businesses to incorporate stormwater BMPs within their landscape. Interested landowners submit applications to their local Soil and Water Conservation Districts. Applications will be ranked based on local water quality priorities. If eligible, a conservation plan is prepared for the applicant to install the BMP (a landscaper may be used). The landowner may be reimbursed up to 75 percent of the pre-established average cost of the BMP.

The Soil and Water Conservation Commission have approved standards and specifications for 15 BMPs. These practices include: impervious surface conversion, permeable pavement, grassed swale, critical area planting, bioretention areas, backyard rain gardens, stormwater wetlands, backyard wetlands, diversion, riparian buffer, stream restoration, streambank and shoreline protection, cisterns, abandoned well closure and pet waste receptacles.

As North Carolina's land use is changing and rapidly becoming more urbanized, CCAP can educate landowners on water quality and stormwater management, as well as retrofit practices to treat polluted stormwater runoff and ultimately improve the water quality of our state's waterways.

22.4.5 Clean Water Management Trust Fund

The CWMTF offers approximately $40 million annually in grants for projects within the broadly focused areas of restoring and protecting state surface waters and establishing a network of riparian buffers and greenways. In the Neuse River basin, -- projects have been funded for a total of $27,814,098 (Table 66). For more information on the CWMTF or these grants, call (252) 830-3222 or visit the website at www.cwmtf.net.

Table 66 Clean Water Management Trust Fund Projects.

Application Name	Proposed Project Description	Amount Funded	County	Approval Date
Neuse River Foundation- Gum Thicket Acq/Neuse River	Acquire a conservation easement on 238 acres of riparian land and wetlands along the Neuse River and Gum Thicket Creek. Includes removal of homesites, and density and impervious limits on 118 acres. Also includes protection of an additional 212 acres.	$1,250,000	Pamlico	5/15/2001
Wake Forest - Acq & Greenway/ Smith Creek	Acquire through fee simple purchase 141 acres along Smith and Toms Creek that will become part of a greenway system.	$1,128,300	Wake	10/23/2000
Cape Fear RC&D - Nash Co/ No-till Drill/Tar & Neuse	Provide funds for a no-till drill to be used primarily in the watersheds for Stoney Creek, Tar River, and Fishing Creek of the Tar-Pamlico River Basin, as well as Beaverdam Creek and Turkey Creek in the Neuse River Basin.	$20,000	Nash	10/23/2000
NC Div Parks & Recreation - Eno River Acq	Acquire through fee simple purchase 71 acres along the Eno River. CWMTF funds to purchase 20 riparian acres.	$141,000	Durham	11/15/2001
Wake County Parks & Recreation- Cedar Ck Acq & Greenway	Acquire through fee simple purchase and permanent conservation easements 112 acres along Cedar Creek. CWMTF funds to purchase 46 riparian and wetland acres.	$350,000	Wake	5/15/2001
Craven County Board of Educ- WW Discharge Removal/Neuse R	Connect West Craven Middle School to Town of New Bern's wastewater collection and treatment system. Rescind NPDES NC 0029904 wastewater discharge permit.	$292,500	Craven	5/15/2001
Smithfield, Town of - Stormwater Wetland Prelim Design/Spring Branch	Design an off-line constructed wetland pond capable of treating water from 204 acre watershed (40% impervious surface).	$90,000	Johnston	5/15/2001
Kinston, City of - Adkins Branch Sewer Rehabilitation	Replace one of the major sewer outfalls. Phase 1 of the project includes the replacement of 21,200 linear feet of and 62 manholes. Phase 2 of the project includes the replacement of 8,500 feet and 26 manholes. Monitor results.	$3,000,000	Lenoir	11/15/2001
Kinston, City of - Pocket Stormwater Wetland/ Peters Creek	Construct a 1.5 acre pocket stormwater wetland to treat runoff (runoff from first inch of rainfall) from the City's Public Service Complex & upstream 56 acre watershed. City to establish permanent conservation easement on wetland and buffers. Monitor wq.	$124,000	Lenoir	11/13/2002
NC Coastal Land Trust - Weyerhaeuser Tracts	Purchase permanent conservation easement on 785 riparian acres along Swift Creek and the Neuse River. Landowner to donate an additional 949 acres and other funding sources to purchase an easement on 894 acres. Total of 2,628 acres to be protected.	$1,376,000	Craven	7/22/2003
Triangle Greenways Council- Acq Minigrant	Minigrant to pay for reacquisition costs for six tracts (64 acres) that border Walnut Creek.	$25,000	Wake	11/15/2001
Ellerbe Creek Watershed Association-Design For Stream Restoration & Stormwater Wetland/ Ellerbe Cr.	Provide funds to design a stream restoration project for 3,000 linear feet of Ellerbe Creek using natural channel design and for a 6.6 acre stormwater wetland to treat runoff from a 160 acre drainage area.	$75,000	Durham	12/10/2002
Wake Forest - Stream Restoration/ Richlands Cr. Restoration & Greenway	Fund restoration design for 2,250 linear feet of Richland Creek (segments 1&2) and provide funds to cover acquisition transaction costs for about 48 donated acres (10 tracts). NC Wetlands Restoration Program to restore a third segment.	$240,000	Wake	7/22/2003
Application Name	**Proposed Project Description**	**Amount Funded**	**County**	**Approval Date**

NC Div Parks & Recreation - Acq./Eno R. State Park	Acquire through fee simple purchase 815 acres along the Eno River. This tract will become part of the Eno River State Park.	$47,000	Orange	7/22/2003
Pitt Soil & Water Conservation District - Acq./Little Contentnea	Acquire through fee simple purchase 3.03 acres along Little Contentnea Creek. The tract, along with 7 adjacent acres, would become part of a greenway and environmental educational facility.	$25,000	Pitt	7/22/2003
Smithfield, Town of - Restoration/Buffalo Cr.	Design and permit a natural channel restoration project for 1,600 linear feet of an unnamed tributary to Buffalo Creek, including a design for improved stormwater treatment through the use of level spreaders and wetland plantings.	$71,000	Johnston	11/18/2003
Dover, Town of - Wastewater Regionalization/Mosely Cr	Eliminate 279 failing septic tanks in the Town by constructing a collection system and 10 miles of force main and pumping the waste to Kinston's WWTP. Would reduce pollutant delivery to Mosley Creek.	$333,000	Craven	7/22/2003
LaGrange, Town of - Septic Systems/Mosely Cr.	Rehabilitate 6,305 feet of collection sewer line and replace 110 sewer service lines along Moseley Creek.	$400,000	Lenoir	7/22/2003
Pitt County Comm. Schools and Rec Mini-Grant/ Swift Creek	Minigrant to pay for preacquisition costs for approximately 15 acres that border Swift Creek.	$25,000	Pitt	2/17/2003
NC Div Forest Resources - Acq./ Clemmons Forest, Strickland Creek	Acquire through fee simple purchase 355 acres along Strickland and Beddingford Creeks. Property to become part of Clemmons Educational State Forest.	$1,772,000	Wake	11/18/2003
Triangle Land Conservancy - Acq./ Regional Park, Marks Creek (Assigned to Wake County)	Acquire through fee simple purchase 358 acres along Marks Creek, including 180 acres of riparian or floodplain acres. Property will eventually become part of a greenway system.	$1,776,000	Wake	11/18/2003
Bridgeton, Town of-Wastewater/ Neuse Non-discharge	Design, permit and fund acquisition costs of a project to upgrade Bridgeton's wastewater treatment plant and land apply the wastewater. If built, the Town would retire its discharge permit of 0.75 MGD and eliminate its waste discharge to the Neuse River.	$116,000	Craven	11/18/2003
Farmville, Town of-Wastewater/ Little Contentnea Creek	Design and permit an alternative sludge treatment system for its land application system near Little Contentnea Creek. System would reduce amount of sludge to be applied and produce a Class A pathogen-free product that could be used in landscaping.	$119,000	Pitt	11/18/2003
Bay River Metropolitan Sewer District- Septic Tanks/ Reelsboro, Goose & Broad creeks	Design and permit a wastewater reuse project near Oriental. If constructed, project would allow BRMSD to expand centralized sewer collection to a number of unsewered communities with chronic septic system failures.	$136,000	Pamlico	11/18/2003
Trent Woods, Town of- Septic Tanks/ Trent River	Design and permit a collection system to hook up 800 septic systems in the Town of Trent Woods that drains to the Trent River. If constructed, wastewater would be treated by the City of New Bern's WWTP.	$524,000	Craven	11/18/2003
Kinston, City of - Storm./Country Club, Catfish Branch	Design & permit stormwater BMPs along 4,000 LF of Catfish Branch. BMPs to treat runoff from 135 acres (59% impervious) and would include dry retention ponds, revegetation and resloping of the channel, and grassy swales.	$25,000	Lenoir	11/18/2003
Application Name	**Proposed Project Description**	**Amount Funded**	**County**	**Approval Date**

Smithfield, Town of - Storm./ Spring Branch Constructed Wetland	Design, permit and construct a 3-acre off-line stormwater wetland and greenway on Spring Branch. Wetland will treat stormwater runoff from a 640 acre watershed (22% impervious). Monitor water quality. Includes donation of permanent CE on wetland site.	$660,000	Johnston	11/18/2003
Goldsboro - Acq./ Stoney Creek, Seymour Johnson AFB	Acquire through fee simple purchase and permanent conservation easements 531 riparian and wetland acres on streams & perennial drainage to Walnut and Stoney Creeks. Project would also eliminate agricultural impacts to those waters and restore wetlands.	$1,737,000	Wayne	7/12/2004
Durham Soil & Water Conservation District - Rest./ Lick Creek	Fund design and permitting costs of a proposed natural channel stream restoration project on 3,100 linear feet of Lick Creek.	$97,000	Durham	7/12/2004
Lucama, Town of - Wastewater/ Outfall Reroute, Black Creek	Replace 8,800 linear feet of deteriorated collection lines and construct a new pump station. Project would reduce sewage overflows to Black Creek, a tributary to Contentnea Creek.	$349,000	Wilson	8/8/2005
Trenton, Town of - Wastewater/ Land Application, Trent River	Relocate wastewater discharge from the Trent River to a land application site. CWMTF funds to install collection system and force main, and construct holding lagoon and irrigation system.	$1,369,000	Jones	7/12/2004
Wilson, City of- Wastewater/ Reuse, Toisnot Swamp	Design, permit and construct expanded wastewater reuse collection system for 2 additional industries, commercial lawn irrigation and a City-owned carwash. Includes 15,000 linear ft of reclaimed water mains & associated equipment to benefit Toisnot Swamp.	$1,196,000	Wilson	7/12/2004
Cove City, Town of - WW/Septic/ Core Creek	Construct wastewater collection system to hook up 230 residences in Cove City to Kinston's Northside WWTP. Many of the existing septic systems are failing or in unsuitable soils. Reduces bacterial and nutrient input into Core Creek.	$333,000	Craven	7/12/2004
Durham County- Acq/ Little River Corridor, South Fork Little River	Protect through fee simple purchase 50 acres along the South Fork Little River, which contains an endangered aquatic species. Includes the purchase of 15.7 riparian acres.	$170,000	Durham	11/15/2004
NC Coastal Land Trust - Acq/ Hughes Tract, Upper Broad Creek	Protect through permanent conservation easements 130 acres along Upper Broad Creek, an anadromous fish spawning area. CWMTF funds to purchase easement on the 47 riparian acres. Tract is in close proximity to other conservation lands.	$394,000	Craven	8/8/2005
NC Div Parks & Recreation - Acq/ Umstead State Park Expansion, Big Lake	Protect through fee simple purchase 125 acres to expand Umstead State Park and protect Big Lake and Sycamore Creek.	$2,000,000	Wake	11/15/2004
Wake County-Acq/ Southeast County Park, Middle Creek	Protect through fee simple purchase 132 acres along Middle Creek. Wake County will manage the property as part of a County park.	$714,000	Wake	8/8/2005
Ayden, Town of - WW/ Sewer Rehabilitation, Swift Creek	Design, permit and construct a new 8,000 LF force main and pump station to replace an existing 1,100 LF gravity line plagued with infiltration/inflow problems. Project will decrease fecal coliform and nutrient delivery to Swift Creek.	$300,000	Pitt	11/15/2004
Contentnea Metropolitan Sewerage District - WW/ Grifton Sewer Rehabilitation	Rehabilitate sewer line between Grifton and Ayden by inspecting, cleaning and lining 107,000 LF of collection line. Includes funds to design and permit associated by-pass pumping and manhole replacement. Will reduce wastewater overflows to Swift Creek.	$962,000	Pitt	11/15/2004
Application Name	**Proposed Project Description**	**Amount Funded**	**County**	**Approval Date**

Kinston, City of - WW/ Land Application Enhancement, Neuse River	Design, permit and construct an expanded land application system for a portion of the City's wastewater (max 500,000 gpd). Purchase 135 ac for wastewater system, with 79 acres available for irrigation and 56 riparian bottomland acres put into conservation.	$1,290,000	Lenoir	11/15/2004
LaGrange, Town of - WW/ Reuse, Mosely Creek	During the growing season, eliminate nearly 100% of discharge to Mosely Ck by routing 0.5 MGD wastewater flow from the Town's WWTP to Wight Nursery, which will use the reuse quality wastewater for irrigation. Construct sewer line & pump stations.	$1,075,000	Lenoir	8/8/2005
Friends of the NC Museum of Natural Sciences - Storm/ Green Environmental Education Center, Richlands Creek	Design, permit and construct a stormwater wetland and bioretention area to treat and reuse runoff from 20 acres (50% impervious) as part of an environmental education center. Stormwater BMP areas will become part of an existing greenway.	$49,000	Wake	11/15/2004
Grifton, Town of - Plan/ Stormwater Planning, Contentnea Creek	Develop a plan to address stormwater management needs for Buckleberry and Contentnea Creeks.	$40,000	Pitt	11/15/2004
Triangle Greenways Council- Minigrant/Young Heirs Tract, Walnut Creek	Minigrant to pay for pre-acquisition costs associated with the fee simple purchase of 28 acres along Walnut Creek.	$25,000	Wake	11/15/2004
Goldsboro - Acq/ Seymour Johnson AFB, Stoney Creek, Phase II	Protect through fee simple purchase and conservation easements 850 acres along Caraway and Walnut Creeks. Tracts are near Seymour Johnson Air Force Base landing fields and the represent the second phase of acquisitions near the landing fields.	$3,000,000	Wayne	8/8/2005
Kinston, City of - Acq/ Floodplain Protection and Open Space Project, Adkin Branch	Protect through fee simple purchase 588 acres impacted by hurricanes, including 422 riparian acres, along the Neuse River, Adkins Branch and tributaries. CWMTF funds to purchase 182 floodplain acres. Tracts will become part of a greenway system.	$1,181,000	Lenoir	8/8/2005
NC Coastal Land Trust - Acq/ Cherry Point, Piney Island	Protect through fee simple purchase or permanent conservation easements 4,904 ac, including 3,972 riparian or wetland ac, along several waterbodies in association with Cherry Point Marine Corps Air Station's base in Havelock & Piney Island bombing range.	$3,000,000	Statewide/Regional	8/8/2005
Triangle Greenways Council - Acq/ Young Heirs Tract, Walnut Creek	Protect through fee simple purchase 28 floodplain acres along Walnut Creek. Tract complements other protection efforts in area & will become part of the Walnut Creek Wetlands Park. Project includes donation of an additional 5-acre conservation easement.	$65,000	Wake	8/8/2005
Ayden, Town of - WW/ Collection System Rehabilitation, Swift Creek	Rehabilitate 1,000 LF of sewer collection lines as part of an extensive on-going effort to reduce infiltration and inflow to the Contentnea Metro Sewerage District and exfiltration of fecal coliform bacteria and nutrients to Swift Creek.	$178,000	Pitt	8/8/2005
Pikeville, Town of - WW/ Collection Rehabilitation, The Slough	Address infiltration/inflow problems by rehabilitating or replacing 22,000 LF of sewer line (CWMTF to fund 9,000 LF) & associated equipment and manholes. Project will reduce nutrient & fecal coliform delivery to The Slough, a tributary to Nahunta Swamp.	$750,000	Wayne	

22.4.6 Clean Water Bonds – NC Rural Center

Outdated wastewater collection systems, some more than 70 years old, allow millions of gallons of untreated or partially treated wastewater to spill into the state’s rivers and streams. The NC Rural Economic Development Center, Inc. (Rural Center) has taken the lead role in designing public policy initiatives to assist rural communities in developing and expanding local water and sewer infrastructure. The Rural Center is a private, nonprofit organization. The Rural Center's mission is to develop sound, economic strategies that improve the quality of life in North Carolina, while focusing on people with low to moderate incomes and communities with limited resources.

To support local economic growth and ensure a reliable supply of clean water, the Rural Center administers three Water and Sewer Grant Programs to help rural communities develop water and sewer systems. See Table 67 for more information on the current grants programs. For each grant program, priority is given to projects from economically distressed counties of the state as determined by the NC Department of Commerce (www.nccommerce.com).

The water and sewer grant programs are made possible through appropriations from the NC General Assembly and through proceeds from the Clean Water Bonds. In 1998, North Carolina voters approved an $800 million clean water bond referendum that provided $330 million to state grants to help local governments repair and improve water supply systems and wastewater collection and treatment. The grants also address water conservation and water reuse projects. Another $300 million was made available as clean water loans.

Since the program's beginning, the Rural Center has awarded nearly 500 communities and counties more than $64 million to plan, install, expand, and improve their water and sewer systems. As a result, these communities have served new residential and business customers, created and preserved thousands of jobs, and leveraged millions of dollars in other water and sewer funds. Table 67 lists the grants that were awarded in the Neuse River basin between 1999 and 2005. For more information on the Water and Sewer Grants administered by the Rural Center visit www.ncruralcenter.org/grants/water.htm.

Table 67 Funded Grant (Clean Water Bond or SRG) Projects.

Projects on this list are either funded or are anticipated to be funded (i.e. offer not yet made)

Applicant	Grant Offered	Project	Date of Offer
New Bern	$3,000,000	Provide reuse quality water to Quarry and Turf Farm	7/29/2002
Wilson	$1,586,003	New sewer interceptor, reclaimed water lines & nutrient removal facilities	7/29/2002
Farmville	$3,000,000	Sewer line rehabilitation and new effluent reuse facilities	12/18/2002
Zebulon	$1,928,340	Rehabilitation of sewers & WWTP upgrade with effluent reuse system	12/18/2002
Bay River MSD	$3,000,000	New collection and transport sewers to serve Reelsboro area	2/26/2003
Benson	$932,267	Rehabilitation of sewers & addition of an effluent reuse system	8/18/2003
Pikeville	$3,000,000	Expand & upgrade existing land application WWTP & sewer rehabilitation	4/14/2004
Ayden	$3,000,000	Sewer rehabilitation & land application system at Contentnea MSD	6/24/2004
Pink Hill	$1,400,000	Provide sewer service to 2 schools and expand land application WWTP	6/29/2004
Kinston	$1,550,000	Adkins branch sewer rehabilitation	2/11/2003
Neuse Reg. W&S	$1,831,600	Regional water system for the Neuse Regional Water & Sewer Authority	9/30/2003
Cary	$1,314,750	Addition of a biosolids dryer facility	9/14/2004

Funded State Revolving Loan (SRL) Projects

Applicant	Loan Offered	Project	Date of Offer
Clayton	$916,667	WWTP for nitrogen removal	12/10/2001
Wilson	$463,810	New sewer interceptor, reclaimed water lines & nutrient removal facilities	7/23/2004
Farmville	$2,000,000	Sewer line rehabilitation and new effluent reuse facilities	1/16/2003
Walnut Creek	$1,564,897	Close WWTP and pump to Goldsboro for treatment	4/14/2004
Pikeville	$500,000	Expand & upgrade existing land application WWTP & sewer rehabilitation	12/15/2004

Funded State Emergency Loan (SEL) Projects

Applicant	Loan Offered	Project	Date of Offer
Contentnea MSD	$900,000	Sewer rehabilitation	4/28/2005

Funded State Revolving Fund (SRF) Projects

Applicant	Loan Offered	Project	Date of Offer
Cary	$11,084,334	Thermal Biosolids Dryer	11/6/2003
Cary	$5,000,000	Western Wake Planning Loan	1/14/2005
Johnston County	$2,131,000	Central Johnson County WWTP Improvement	7/23/2001
Johnston County	$4,552,601	Reclaimed Water System, Biosolids	4/24/2002
Johnston County	$16,000,000	WWTP upgrade to 7MGD	7/29/2002
Wilson	$932,024	Interceptor replacement, and increased reuse capacity	5/23/2001
Wilson	$19,794,886	Hominy Creek WWTP Upgrade	4/21/2004
Clayton	$3,921,798	Little Creek Water Reclamation	1/14/2005
New Bern	$20,000,000	WWTP Upgrade	5/23/2001
New Bern	$1,420,350	Diffuser	12/18/2002
Kinston	$1,879,554	North Side WWTP Expansion	8/29/2002
Kinston	$765,000	Upper Adkin Branch sewer rehabilitation	2/26/2003
Goldsboro	$3,359,512	Supplemental Loan to Previous Loan (CS370482-04)	7/4/2001
Farmville	$1,453,000	Upgrade existing WWTF	3/10/2005

Clean Water Bonds as administered by the NC Rural Economic Development Center, Inc.

Supplemental Grants Program - Enables local governments and qualified non-profit corporations to improve local water and sewer systems. Projects may address public health, environmental and/or economic development critical needs. The maximum grant amount for this program is $400,000. Rural Center funds must be used to match other project funds.

Capacity Building Grants Program - Provides funding for local governments to undertake planning efforts that support strategic investments in water and sewer facilities. Funds typically are used to prepare preliminary engineering reports, master water/sewer plans, capital investment plans, water/sewer feasibility studies, rate studies and grant applications. The maximum amount for this program is generally $40,000.

Unsewered Communities Grants Program - Provides funding for the planning and construction of new central, publicly-owned sewer systems. Qualified communities must be unserved by wastewater collection or treatment systems. Unsewered communities grants are designed to cover 90 percent of the total cost of a project but will not exceed $3 million.

22.4.7 Oyster Shell Recycling

The North Carolina Oyster Shell Recycling Partnership is encouraging restaurants, seafood dealers, community organizations and individuals to participate in the effort to collect oyster shells and use them to build oyster reefs in protected oyster sanctuaries. More information about this recycling effort can be found at http://www.ncfisheries.net/shellfish/recycle1.htm. Oyster recycling sites within the Neuse River basin include

Craven County:

Havelock: Tripp's Seafood Market (172 W. Hwy 70)
Vanceboro: Juanita's Seafood (7065 Hwy 17 N.)
GDS Solid Waste and Recycling Locations:
Bridgeton (Hwy 55), New Bern (Thurman Rd. off Hwy 70)
Tuscarora: Tuscarora Landfill (7400 Old Hwy 70 W.)

Pamlico County:

Alliance: Crop Production Services (Hwy 55)
Grantsboro: Grantsboro Recycling Center (Hwy 306), Fresh Ketch Seafood (2492 Hwy)
Oriental: Town "N" Country Grocery (Broad St., Hwy 55)

22.4.8 Clean Marina Program

The Clean Marina is a voluntary program that began in the summer of 2000. The program is designed to show that marina operators can help safeguard the environment by using management and operations techniques that go above and beyond regulatory requirements. This is a nationwide program developed by the National Marine Environmental Education Foundation, a nonprofit organization that works to clean up waterways for better recreational boating. The foundation encourages states to adapt Clean Marina principles to fit their own needs. North Carolina joins South Carolina, Florida and Maryland as states with Clean Marina programs in place. The Division of Coastal Management should have a Clean Marinas coordinator in place in early 2009. The Division of Water Quality will work closely with the coordinator of the program to insure compliance with water quality standards at and around marinas in the Neuse River basin.

Marina operators who choose to participate must complete an evaluation form about their use of specific best management practices. If a marina meets criteria developed by N.C. Marine Trades Services and the Division of Coastal Management, it will be designated as a Clean Marina. Such marinas will be eligible to fly the Clean Marina flag and use the logo in their advertising. The flags will signal to boaters that a marina cares about the cleanliness of area waterways. Marinas that do not meet the standards will be able to learn about improvements needed for Clean Marina designation. Marina owners can reapply after making the necessary changes. DWQ encourages all marinas within the Neuse River basin to participate in the Clean Marina Program and encourages DCM to consider making this a mandatory program for all new marinas and 10-slip docking facilities.

For more information about the program, see http://dcm2.enr.state.nc.us/Marinas/clean.htm or http://www.nccoastalmanagement.net/Marinas/marinas.htm, or contact N.C. Coastal Reserve Education at 252-728-2170 or Coastal Management at 919-733-2293.

In the Neuse River basin, DEH reports 45 acres of closed shellfishing waters because of marina slips between growing areas F-1 to F-7. There are three Clean Marinas and nine marinas with pump-out facilities in the Neuse River basin, as listed below:

Clean Marinas

Deaton Yacht Service and Sales
1306 Neuse Drive
Oriental, NC 28571
Phone: 252-249-1180

Northwest Creek Marina
104 Marina Drive
New Bern 28560
Phone: 252-638-4133

Matthews Point Marina
2645 Temples Point Road
Havelock, NC 28532
Phone: 252-444-1805

Marinas with Pump-Out Facilities

BridgePointe Marina, New Bern
Phone: 252-637-7372, Trent and Neuse Rivers
River Bend Marina & Café, New Bern
Phone: 252-633-2006, Trent River
Wayfarers Cove Marina, Arapahoe
Phone: 252-249-0200, Neuse River
Hurricane Harbor Marina, Bayboro
Phone: 252-229-7500, Bay River
Marine Mechanical, Oriental
Phone: 252-249-2925, Neuse River
Oriental Harbor Village Center & Marina, Oriental
Phone: 252-249-3783, Neuse River
Pecan Grove, Oriental
Phone: 252-249-2532, Neuse River
Sea Harbour Yacht Club, Oriental
Phone: 252-249-0808, Neuse River (Pierce Creek)
Whittaker Creek Yacht Harbor, Oriental
Phone: 252-249-1020, Neuse River

A coastal marine pump-out station locator tool can be found at http://dcm2.enr.state.nc.us/Marinas/map.html

Chapter 23
North Carolina's Impaired Waters List

23.1 Reporting Requirements of the Federal Clean Water Act

The *North Carolina Water Quality Assessment and Impaired Waters List* is an integrated report that includes both the 305(b) and 303(d) reports. The *305(b) Report* is compiled to meet the federal Clean Water Act (CWA) Section 305(b) reporting requirements. The 305(b) portion of the integrated report presents how well waters support designated uses (e.g., swimming, aquatic life, water supply), as well as likely stressors (e.g., sediment, nutrients) and potential sources of impairment. The *303(d) List* is a comprehensive account of impaired waters that require total maximum daily loads (TMDLs).

Section 303(d) of the CWA enacted in 1972 required States, Territories and authorized Tribes to 1) identify and establish a priority ranking for waters for which technology-based effluent limitations are not stringent enough to attain and maintain water quality standards, 2) establish TMDLs for the pollutants causing impairment in those waters, and 3) develop and submit the list of impaired waters and TMDLs to the U.S. Environmental Protection Agency (EPA). EPA is required to approve or disapprove the state-developed 303(d) list within 30 days. For each segment impaired by a pollutant and identified in the 303(d) list, a TMDL must be developed.

23.2 Introduction to TMDLs

A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can still attain its designated uses. The calculation must also account for seasonal variation and critical conditions in water quality.

For more information on TMDLs and the 303(d) listing process, visit the NC TMDL website at http://h2o.enr.state.nc.us/tmdl/.

23.3 Contents of the Integrated Report

The Integrated Report includes descriptions of monitoring programs, the use support methodology (see appendix VIII for detail Neuse Methodology), and the impaired waters list. Guidance from EPA encourages placement of all waterbody assessment units into one unique assessment category. Each category is described in detail below:

Category 1: Attaining the water quality standard and no use is threatened. This category consists of those waterbody assessment units where all applicable use support categories are rated "Supporting". Data and information are available to support a determination that the water quality standards are attained and no use is threatened. Future monitoring data will be used to determine if the water quality standard continues to be attained. However, because of the statewide fish consumption advice for mercury, there are no Category 1 waters.

Category 2: Supporting or not Impaired for all monitored uses. This category consists of those waterbody assessment units where at least one of the applicable use support categories are rated "Supporting" and the other use support categories are rated "Not Rated" or “No Data”. Also included in this category are waters where at least one of the applicable use support categories, except Fish Consumption, are rated "Supporting"; the remaining applicable use support categories, except Fish Consumption, are rated "Not Rated"; and the Fish Consumption category is rated "Impaired-Evaluated". Data and information are available to support a determination that some, but not all, uses are attained. Attainment status of the remaining uses is unknown because there are insufficient or no data or information. Future monitoring data will be used to determine if the uses previously found to be in attainment remain in attainment, and to determine the attainment status of those uses for which data and information were previously insufficient to make a determination.

Category 3: No data or insufficient information to determine if any designated use is attained. This category consists of those waterbody assessment units where all applicable use support categories, except Fish Consumption, are rated "Not Rated", and the Fish Consumption category is rated "Impaired-Evaluated". Measured data or information to support an attainment determination for any use are not available. Supplementary data and information, or future monitoring, will be required to assess the attainment status. This category contains distinct sub-categories:

Category 3a- Instream/monitoring data are inconclusive
Category 3c- No Data available for assessment
Category 3t- No Data available for assessment – Assessment Unit is in a watershed with an approved TMDL

Category 4: Impaired or threatened for one or more designated uses but does not require the development of a TMDL. This category contains distinct sub-categories:

Category 4a: TMDL has been completed. This category consists of those waterbody assessment units for which EPA has approved or established a TMDL and water quality standards have not yet been achieved. Monitoring data will be considered before moving an assessment unit from Category 4a to Categories 1 or 2.

Category 4b: Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future. This category consists of those waterbody assessment units for which TMDLs will not be attempted because other required regulatory controls (e.g., NPDES permit limits, Stormwater Program rules, implemented watershed plan, etc.) are expected to attain water quality standards within a reasonable amount of time. Future monitoring will be used to verify that the water quality standard is attained as expected.

Category 4c: Impaired- Loss of use because impairment is not caused by a pollutant. This category consists of assessment units that are impaired by pollution, not by a pollutant. EPA defines pollution as "The man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water." EPAs staff have verbally stated that this category is intended to be used for impairments related to water control structures (e.g., dams). Future monitoring will be used to confirm that there continues to be an absence of pollutant-caused impairment and to support water quality management actions necessary to address the cause(s) of the impairment.

Category 4cr: Impaired- Loss of recreation use because swimming advisories were posted; however, no data is available for TMDL development.

Category 4cs: Impaired- Loss of shellfish harvesting use because the growing area is not approved for shellfish harvesting by the Department of Environmental Health and no data is available for TMDL development.

Category 4ct: Impaired- Assessment Unit is in a watershed that is part of a TMDL study area for the parameter of interest.

Category 4s: Impaired ecological/biological integrity with a concurrent category 5 aquatic life parameter of interest.

Category 5: Impaired for one or more designated uses by a pollutant(s) and requires a TMDL. This category consists of those waterbody assessment units that are impaired by a pollutant and the proper technical conditions exist to develop TMDLs. As defined by the EPA, the term pollutant means "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into the water". When more than one pollutant is associated with the impairment of a single waterbody assessment unit in this category, the assessment unit will remain in Category 5 until TMDLs for all listed pollutants have been completed and approved by the EPA.

Category 5s: Impaired ecological/biological integrity and stressor study does not indicate any aquatic life standard violations.

The draft 2008 North Carolina 303(d) list for the State of North Carolina only includes Category 5 waters. An impaired waters list (Categories 4 & 5) and the complete use support summary of monitored waterbodies in the North Carolina (Integrated Report/305(b)) will be available for downloading on the DWQ website:
http://h2o.enr.state.nc.us/tmdl/General_303d.htm.

23.4 How North Carolina Delists Waters

Waters appearing on the previously approved impaired waters list will be moved to Categories 1, 2, 3 or 4 under the following circumstances:

- Applicable water quality standards are being met (i.e., no longer impaired for a given pollutant).
- The basis for putting the water on the list is determined to be invalid (i.e., was mistakenly identified as impaired in accordance with 40 CFR 130.7(b)(6)(iv) and/or National Clarifying Guidance for State and Territory 1998 Section 303(d) Listing

Decisions. Robert Wayland, III, Director. Office of Wetlands, Oceans and Watersheds. Aug 27, 1997).
- A water quality variance has been issued for a specific standard (e.g., chloride).
- Removal of fish consumption advisories or modification of fish eating advice.
- Typographic listing mistakes (e.g., the wrong water was identified).
- EPA has approved a TMDL.

23.5 Scheduling TMDLs

Category 5 waters, those for which TMDLs are required, are at many different stages on the path to an approved TMDL. Some require additional data. Some require more outreach to increase stakeholder involvement. Others need to have a technical strategy budgeted, funded and scheduled. Some are ready for EPA submittal.

According to EPA guidance (EPA 2004), prioritization of waterbody assessment units for TMDLs need not be reflected in a "high, medium or low" manner. Instead, prioritization can be reflected in the TMDL development schedule. Generally, North Carolina attempts to develop TMDLs within 8-13 years of the original pollutant listing. TMDLs under development are listed on the NC TMDL website at http://h2o.enr.state.nc.us/tmdl/.

23.6 Revising TMDLs

Current federal regulations do not specify when TMDLs should be revised. However, there are several circumstances under which it would seem prudent to revisit existing TMDLs. The TMDL analysis of targets and allocations is based upon the existing water quality standards, hydrology, water quality data (chemical and biological), and existing, active NPDES wastewater discharges. Conditions related to any of these factors could be used to justify a TMDL revision. Specific conditions that the Division will consider prior to revising an existing, approved TMDL include the following:
- A TMDL has been fully implemented and the water quality standards continue to be violated. If a TMDL has been implemented and water quality data indicate no improvement or a decline in overall water quality, the basis for the TMDL reduction or the allocation may need to be revised;
- The addition or removal of hydraulic structures to a waterbody (e.g., dams). Substantial changes to waterbody hydrology and hydraulics have the potential to change many aspects of target setting, including the water quality standard upon which the TMDL was developed, the water quality data, and the water quality modeling;
- Incorrect assumptions were used to derive the TMDL allocations. This would include errors in calculations and omission of a NPDES permitted discharge.

Should a TMDL be revised due to needed changes in TMDL targets, the entire TMDL would be revised. This includes the TMDL target, source assessment, and load and wasteload allocations. However, the Division may elect to revise only specific portions of the TMDL. For example, changes may be justifiable to the load and wasteload allocation portions of a TMDL due to incorrect calculations or inequities. In these cases, revisions to the TMDL allocations would not necessarily include a revision of TMDL targets. Any TMDL revisions would include a public notice and comment period.

23.7 Alternatives to TMDLs

Watershed restoration efforts include many other activities besides TMDLs. Protection and prevention of impairment are least expensive and most efficient in the long term. Local direct action to correct water quality problems, before a TMDL is developed, is preferable in many cases. The division will consider postponing TMDL development at the request of local governments and/or organizations actively attempting to achieve water quality standards. Factors such as funding, ordinances, expertise, planning, and timetable will be evaluated. Another more formal alternative to TMDL development is a Category 4b demonstration. Such demonstrations must include the following six EPA required elements:

1) Identification of segment and statement of problem causing the impairment;
2) Description of pollution controls and how they will achieve water quality standards;
3) An estimate or projection of the time when WQS will be met;
4) Schedule for implementing pollution controls;
5) Monitoring plan to track effectiveness of pollution controls; and
6) Commitment to revise pollution controls, as necessary.

For more information about the Clean Water Act Sections 303(d), 305(b), and 314 integrated reporting and listing decisions see EPA's watershed website:
http://www.epa.gov/owow/tmdl/2008_ir_memorandum.html.
For more information on watershed planning see EPA's website:
http://iaspub.epa.gov/watershedplan/watershedPlanning.do?pageId=48&navId=35

Chapter 24
Nutrient Sensitive Waters (NSW) Management Strategy

24.1 Introduction

Eutrophication became a water quality concern in the lower Neuse River basin in the late 1970s and early 1980s. Nuisance algal blooms prevalent in the upper estuary prompted investigations by DWQ. These investigations, as well as other studies, indicated that algal growth was being stimulated by excess nutrients entering the estuarine waters of the Neuse River. In 1988 the lower Neuse River basin received the supplemental classification of nutrient sensitive waters (NSW). As part of this early nutrient strategy, new and expanding NPDES discharges, as well as existing facilities with design flows greater than 0.05 MGD, were given a quarterly average phosphorus limit of 2 mg/l. Phosphorus loading was greatly reduced and algal blooms in the river and freshwater portions of the estuary were reduced as a result of this action.

The 1993 Neuse River Basinwide Water Quality Plan recognized that eutrophication continued to be a water quality problem in the estuary below New Bern. Extensive fish kills in 1995 prompted further study of the problem. Low dissolved oxygen levels associated with algal blooms were determined to be a probable cause of many of the fish kills. Researchers also suggested that the toxic dinoflagellate, *Pfiesteria piscida*, may have been responsible for a number of the fish kills.

The severe fish kills, algal blooms, and correspondingly high levels of chlorophyll *a* prompted DWQ to place the Neuse River estuary on the 1994 303(d) list of impaired waters. In 1996, the NC Senate Select Committee on River Water Quality and Fish Kills sponsored a workshop with numerous scientists familiar with the Neuse River water quality problems. The group reached consensus that a 30 percent reduction in total nitrogen entering the estuary was a good starting goal to reduce the extent and duration of algal blooms. In 1996, the 30 percent reduction was put into law (Session Laws 1995, Section 572). The state funded the Neuse Modeling and Monitoring Project (MODMON) to quantitatively assess the interactions and pathways between nutrients, phytoplankton and dissolved oxygen in the estuary. A Total Maximum Daily Load (TMDL) was developed in two stages and approved by EPA in 2002 to address the nitrogen overloading to the estuary. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant. The TMDL developed for the Neuse estuary showed a 30% reduction in nitrogen loading is needed.

The North Carolina Environmental Management Commission (EMC) adopted a comprehensive set of permanent rules that became effective August 1, 1998 to implement the Neuse Nutrient Strategy. While individual implementation dates varied, all of the rules were fully implemented by 2003. Below is a summary of the current progress of the nutrient strategy followed by an evaluation of the strategy which identifies additional opportunities and research needs to address nutrient loading to the Neuse Estuary. For the complete NSW rules, visit http://h2o.enr.state.nc.us/admin/rules/documents/redbook_1may07_full_with_cover.pdf. For the approved TMDL, visit http://h2o.enr.state.nc.us/tmdl/TMDL_list.htm

24.1.1 Summary of key findings/opportunities

The Neuse River Basin nutrient management strategy has been fully implemented since 2003. Since this time there have been a number of implementation successes as well as challenges to the nutrient reduction strategy in the basin as whole. The goal of a 30% reduction in nitrogen loading to the Neuse Estuary has not yet been achieved. However, it is important to note that the data window for this basin plan cycle ends in 2006 and the assessment of progress under the strategy is based on just four years of post implementation water quality data (2003-2006) at this time. Due to the complex dynamics of the estuarine system, the variability associated with climatic change, and the time required to discern trends, staff believes it will likely be a number of years before a definitive assessment of the effect of the reduction strategy on the estuary can be made. However, since the loading data to date do not show distinct improvement, and given the estuary's continued impairment, DWQ believes it is appropriate to continue to evaluate the limitations of the current strategy and identify additional research needs that may reveal opportunities for developing a better understanding of the nutrient dynamics of this complex system.

Successes:

- Point source dischargers as a whole met and surpassed their 30% nitrogen reduction target years in advance of the 2003 rule compliance deadline. Through 2006 they have reduced delivered N load by as much as 65% below the 1995 baseline.

- Annual reports from the Basin Oversight Committee (BOC) established under the agriculture rule estimate that agriculture has met and exceeded its goal of 30% reduction in nitrogen loss since 2003. In crop year 2006, basin agriculture collectively achieved an estimated 45% nitrogen reduction compared to the 1991-1995 baseline, and seven of the seventeen counties reported a reduction of more than 40%.

- Each of the fifteen local governments covered under the Neuse Stormwater Rule have adopted and are implementing permitting programs to require new residential and commercial development activities to control stormwater runoff and the resulting nitrogen loading. All fifteen communities' implemented ordinances and programs that in addition to requiring the nutrient export goal be met, carry out public education activities, and identify and remove illegal discharges.

Challenges:

- Two recent nutrient loading studies conducted by DWQ conclude that the goal of a 30% reduction in nutrient load to the Neuse Estuary has not yet been achieved.

- The estuary remains impaired and the total acreage of impairment has expanded.

Opportunities

- Existing developed lands were not assigned a loading allocation under the strategy and are not addressed through rules. Evaluate the magnitude of nitrogen loading in runoff from existing development areas and develop recommendations on the need to address this source under the strategy.

- Only forty percent of the Neuse Basin is subject to the Neuse Stormwater Rule nutrient export goal requirements. Develop a full assessment and recommendations on stormwater programmatic coverage gaps and need to meet nutrient strategy goals on new development activities. Include recommendations on most appropriate regulatory approach.

- Research indicates that atmospheric contributions accounts for approximately 24% of the total nitrogen load to the Neuse Estuary. Atmospheric N deposition has risen over the last twenty years, largely as volatilized ammonia (NH_3) from confined animal feeding operations (CAFOs) (Walker et al, 2004). These NH_3 emissions from CAFOs have not been directly regulated. Coordinate efforts with the Division of Air Quality to assess atmospheric nitrogen contributions to the watershed and develop recommendations on better ongoing characterization of atmospheric nitrogen deposition and emission source regulatory considerations. Specifically address better characterization of the contribution of ammonia emissions from CAFO operations.

- Groundwater may be a significant pathway of nutrient loading to the Neuse Estuary. Nutrients in groundwater can result from fertilization of vegetation as well as land application of treated wastewater and biosolids from municipal wastewater treatment plants and confined animal feeding operations (CAFOs) and may take as long as decades to appear in surface waters. This loading from groundwater sources is not being captured in the overall nutrient accounting process. Characterize the potential for groundwater contamination and transport of nutrients from biosolids and wastewater land application fields to the surface waters of the Neuse Basin.

- Develop a more detailed analysis of current and historic data in order to better quantify the status of nutrient loading to the estuary; conduct additional trend and loading analysis upstream of the Neuse estuary focusing on smaller watersheds with dominant land use types; this will allow staff to better gauge the effectiveness and progress of strategy implementation.

24.1.2 Neuse River TMDL for Total Nitrogen

A Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant. Pollutant sources are characterized as either point sources or nonpoint sources. The nutrient rules put in place in the Neuse River Basin were adopted in 1997 using a 30 percent reduction goal established through a legislative mandate (Session Laws 1995, Section 572). A TMDL was subsequently developed with the potential to revise the goal at some point in the future. The Neuse estuary TMDL specifically addresses chlorophyll *a* as its endpoint and seeks to manage total nitrogen, which is the nutrient that has the best potential to limit excessive growth of algae, and thus, chlorophyll *a* in the estuary. Specifically, the TMDL target is to have less than 10 percent of chlorophyll *a* samples collected in the estuary over a specific time period to be over 40 µg/l. The TMDL assesses the amount of total nitrogen load reduction that is necessary to comply with this criterion. The second phase of the TMDL was completed in July 2001. The EPA approved the TMDL in March 2002. The second phase of the TMDL model results and estuary monitoring indicate that a 30 percent total nitrogen load reduction from the 1991-1995 baseline is currently sufficient. However, based on the overall range of results seen in the TMDL modeling, more than a 30 percent total nitrogen reduction may be needed in the future.

The second phase incorporated the latest tools and data from the Neuse River Modeling and Monitoring Project (MODMON). Continued monitoring will be used to evaluate the effectiveness of the TMDL and to make adjustments in the implementation strategy as needed to recover the Neuse River estuary. Specifically, the Neuse River will continue to be monitored to determine if the 30 percent total nitrogen load reduction is being achieved, and the estuary will continue to be monitored to determine if the chlorophyll *a* criterion is met. This information will inform an adaptive management approach to TMDL compliance.

With continued data collections and updating the models and analyses, DWQ and MODMON will be able to improve analysis of various input scenarios and reduce the prediction uncertainty to narrow the range of total nitrogen load reduction that may be required. It is important to note that no matter where the reduction target is set in this phase of the TMDL, the estuary will not be removed from the list of impaired waters until it meets its designated uses.

Reductions in nutrient inputs may take time to detect in measured loading, due to year-to-year variability in precipitation and flow. Based on the results of recent trend analysis (see trend analysis summary review section) in the basin, it is evident that it will take more than five years to discern a 30 percent decrease in load to the estuary.

24.1.3 Wastewater Discharge Rule

Rule Requirements

The Wastewater Discharge Requirements rule (02B .0234) was adopted in 1997 and technical corrections were made in 2002. The rule applies to all wastewater treatment facilities in the basin that receive nutrient-bearing wastewaters and are governed by individual NPDES permits. The aim of the rule is to achieve the mandated 30% reduction in nitrogen load from these dischargers to the Neuse River estuary. The point source strategy:

- establishes nitrogen allocations for the affected dischargers that:
  - are calculated to achieve the necessary 30% reduction.
  - are technology-based.
  - are assigned to existing dischargers.
  - account for differences in transport losses at points of discharge across the basin.
- requires nitrogen limits for discharges ≥ 0.5 MGD.
- extends phosphorus limits to a greater number of dischargers.
- provides dischargers a group compliance option.

- provides for the transfer of allocation upon regionalization or consolidation of discharges.

The rule caps the total delivered loading from the affected dischargers to the estuary at 1.64 million lb/yr Total Nitrogen (TN). This is the same as the Wasteload Allocation established in the Phase I TN TMDL for the estuary and approved by the EPA in July 1999 and verified in the Phase II TMDL, approved by the EPA in March 2002.

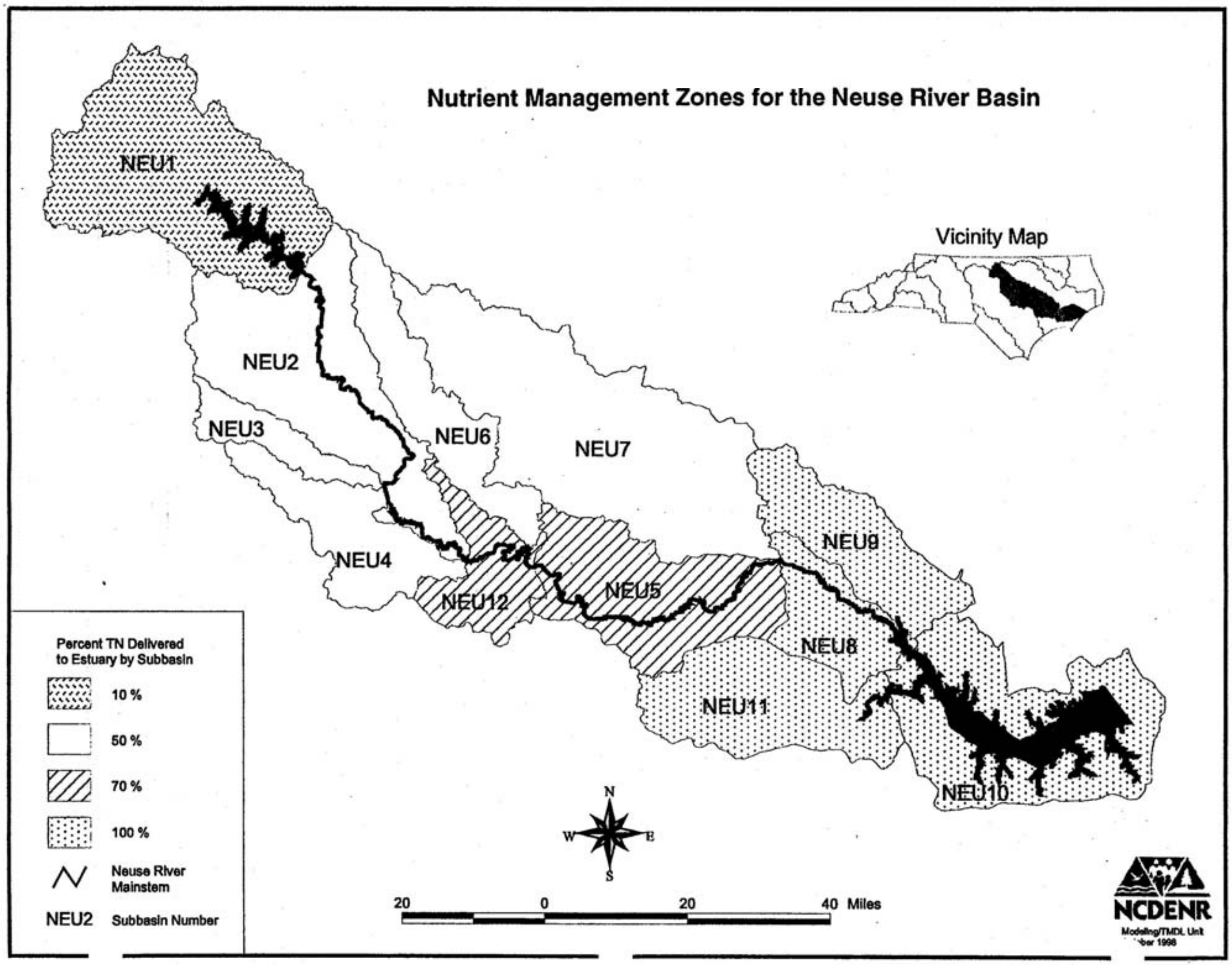
The rule divides the total allocation among groups of dischargers according to their size, type, and location. The discharger groups are large ($\geq$0.5 MGD) municipal WWTPs upstream of Falls Lake Dam, large municipal WWTPs downstream of the dam, large industrial WWTPs (all are downstream of the dam), and small facilities (those <0.5 MGD, regardless of location). Facilities with flows less than 0.5 MGD are not subject to nitrogen limits under the rule. They contribute relatively little of the point source load, and the estuary allocation assigned in the rule is 25% greater than their 1995 loading. Thus, they were not expected to need limits for at least one or two permit cycles. If the group does, in fact, approach its allocation, the Division would have to take additional steps - perhaps adding nitrogen limits to those permits - to ensure continued compliance with the nitrogen TMDL.

The rule requires permit limits for dischargers permitted at or above 0.5 MGD. Thus, the strategy focuses on the largest dischargers, which comprise 30% of the affected permits but accounted for over 95% of the point source nitrogen load in 1995. The rule does not list the individual dischargers' allocations but does specify that each group allocation is to be divided among the dischargers in proportion to their permitted flows. As a result, every allocation within a group is equivalent to the same TN concentration, meaning that comparable treatment facilities are ultimately expected to all provide the same degree of nitrogen treatment technology.

The rule assigned all total nitrogen allocation available to existing dischargers. It requires new and expanding discharges to acquire allocation from existing dischargers or from the Ecosystem Enhancement Program prior to applying for the necessary NPDES permit modification. It also requires that new or expanding facilities provide greater nitrogen treatment than required of existing facilities.

The allocations set in the rule take into account the fate and transport of nitrogen in the river system. A considerable portion can be "lost" as the result of nutrient uptake, denitrification, and other instream processes before it can reach the estuary. The basin is divided into four “transport zones” with average delivery rates of 10, 50, 70, and 100% (see Figure 50), and the supporting calculations behind the nitrogen allocations take into account the losses affecting the various discharge points across the basin.

Figure 50 Nutrient Management Zones



The rule provides NPDES dischargers the option of forming a compliance association in which members work collectively to reduce their nitrogen loadings to the estuary. Association members are subject to a combined nitrogen limit rather than to their individual permit limits and can decide the most practical and cost-effective means of meeting the group limit. Any such association and its members are governed under a special NPDES permit issued by the DWQ, in addition to the individual permits already issued to the members.

Discharger Population

In 1995, 168 facilities held individual NPDES permits and discharged into the Neuse River or one of its tributaries. Of these, 111 facilities treated and discharged nitrogen-bearing wastewaters, mostly domestic, and were directly affected by the nutrient rule; 34 were large enough to be subject to permit limits for nitrogen in 2003. The remaining 58 facilities included water treatment plants (filter backwashes), groundwater remediation sites, utility discharges (boiler blowdown, cooling tower blowdown, etc.), and other less significant sources of nitrogen.[2]

Table 68 summarizes the make-up of the discharger groups in 1995 and the nitrogen allocations and equivalent concentrations for each group.

Table 68 Discharger Groups and Allocations, Point Source Rule – 1995.

Discharger Group	No.	Q_{pmt}	Discharge TN Allocation (lb/yr)	Delivered TN Allocation (lb/yr)	Equivalent Discharge TN Conc. (mg/L)
Municipal ≥ 0.5 MGD					
- upstream of Falls Dam	3	26.5	443,678	44,368	5.5
- downstream	28	179.5	2,021,401	1,150,139	3.7
Industry ≥ 0.5 MGD (downstream only)	3	40.6	396,900	361,902	3.2
Small (all < 0.5 MGD)	77	6.8	137,979	83,591	6.6
Total	111	253.4	2,999,958	**1,640,000**	---

Notes: Qpmt = Permitted Flow

By the end of 2006, the total number of permitted facilities has decreased from 168 to 138, a net reduction of 30 facilities. Changes from 2003 to 2006 include the rescission of approximately 40 permits, mostly for facilities that ceased discharge after connecting to neighboring utilities; and approximately 10 new permits for water treatment plants or groundwater remediation systems (neither considered to be significant sources of nitrogen). By that time, 74 of the original 111 facilities with nitrogen allocations remained in operation.

Table 69 Discharger Groups and Allocations, Point Source Rule – 2006.

Discharger Group	No.	Q_{pmt}	Delivered TN Allocation (lb/yr)
Municipal ≥ 0.5 MGD			
- upstream of Falls Dam	3	28.5	
- downstream	25	189.8	
Industry ≥ 0.5 MGD (downstream only)	2	35.6	
Small (all < 0.5 MGD)	44	5.0	
Total	71	258.9	**1,640,000**

Implementation Results

In the 2000 renewal cycle[3], the DWQ modified all Neuse wastewater permits to include nitrogen and phosphorus monitoring and reporting. Where appropriate, the permits included nutrient limits

[2] Facilities covered under NPDES general permits or the state's non-discharge (land application and/or reuse) permits are handled under the nonpoint provisions of the Strategy or considered *de minimus* sources.

and related conditions. The limits were written as annual mass limits equal to the assigned allocations and became effective with calendar year 2003.

General WWTP Improvements

Large dischargers continued to make improvements in their treatment facilities and have invested in excess of two hundred million dollars in construction and retrofit projects to improve their nutrient reduction capabilities. New Bern completed construction of its new facility with biological nutrient removal. Goldsboro completed the planned expansion and upgrade of its facility and a constructed wetlands system. Kinston eliminated its Peachtree plant and expanded and upgraded its Northside plant to treat all of its wastewater flows. The Cherry Point MCAS made dramatic improvements in its treatment capabilities between 2003 and 2005 with the encouragement and support of the Neuse River Compliance Association.

Neuse River Compliance Association

In 2002 interested permittees established the Neuse River Compliance Association (NRCA) to pursue the rule's group compliance option. DWQ issued the first group permit of its kind to the Association and its co-permittee members that same year. In 2006, the Association was comprised of 21 permittees with 24 facilities and had a combined estuary limit of 1,138,739 lb/yr TN. Most of the NRCA members are also members of the Lower Neuse Basin Association, an ambient monitoring coalition that has operated in the basin since 1994.

The Association's permit establishes the group's nitrogen limit, representing the sum of its members' individual delivered allocations. It also contains monitoring and reporting requirements and describes how compliance with the group and individual limits will be determined. If the Association meets its group limits, all members are deemed to have complied with their individual limits for the year. However, if the group exceeds its limit, both the Association and any members exceeding their limits are in violation of the permit and subject to enforcement by the DWQ. The Association has internal enforcement procedures to insure its members comply with their individual nitrogen allocations. If an individual member does exceed their allocation they are required to pay an assessment to the association which would increase each year that the member stays in noncompliance. As an additional enforcement incentive, members of the Association can be removed from membership for failure to comply.

Point Source Performance In Meeting The Nutrient Reduction Targets

The point source dischargers, as a whole, met and surpassed their 30% reduction target from 2003 through 2006. In 2003, the dischargers reported a total *delivered* load of 1.18 million pounds. This represented a 50% reduction from their 1995 baseline load. In 2006, they reported a delivered load of 0.83 million pounds, a 65% reduction from 1995 levels. Figure 51 illustrates the delivered nitrogen loading for all point sources in 1995, 2003, and 2006 and partitions the portion of the combined load and subsequent reductions over time attributed to the NRCA and non-NRCA point sources.

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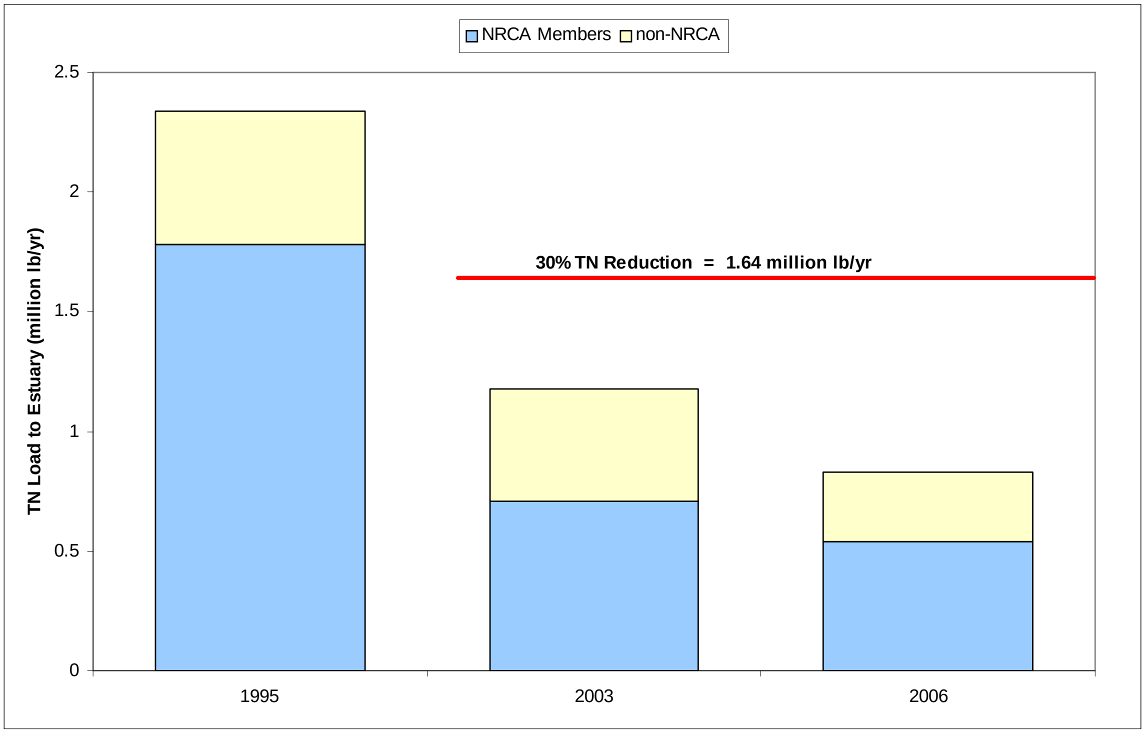
[3] The regular schedule for the renewals was 1998, but action was delayed until the rule could be modified with a temporary rule in 2000.

Figure 51 Point Source Performance, 1995 -2006



The members of the Neuse River Compliance Association account for three-quarters of the permitted flow among the dischargers with nitrogen allocations. Figure 52 shows the performance of the NRCA members' facilities from 1995 through 2006. The group achieved a 70% loading reduction even though wastewater flows had increased by 23. The group's actual discharge flows have varied with changes in membership and with changes in precipitation; for example, their 2003 flow reflect drought conditions in much of the basin.

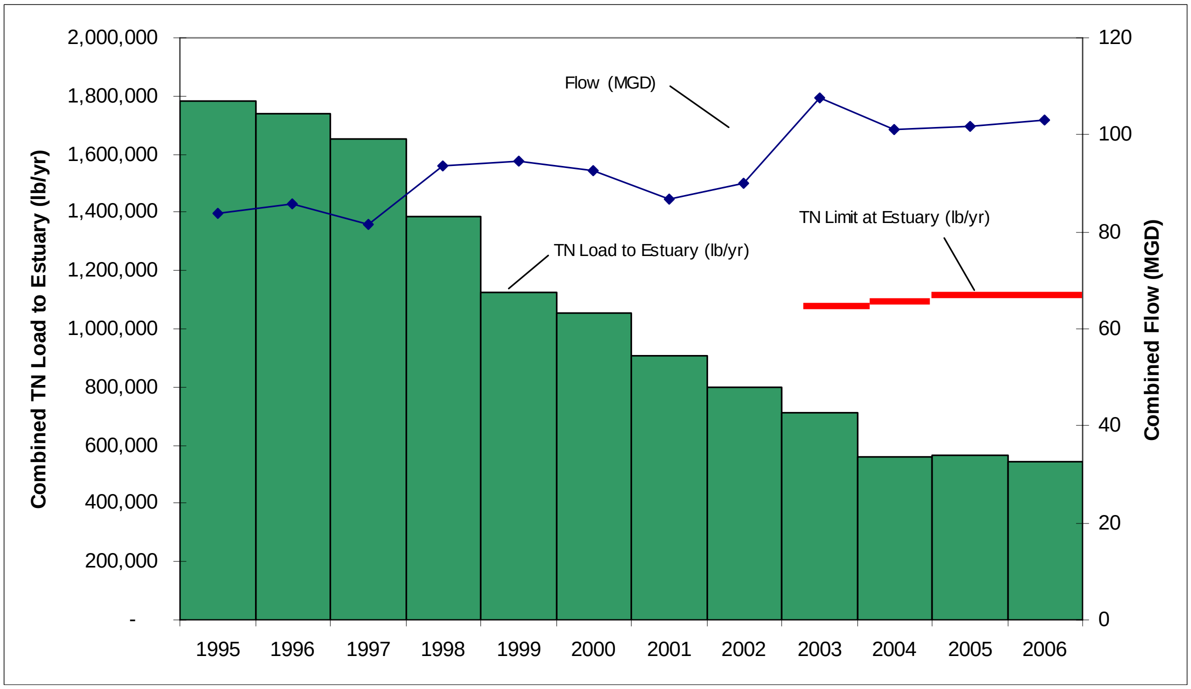


Figure 52 NRCA Performance, 1995 - 2006

24.1.4 Stormwater Rule

Rule Requirements

The Neuse stormwater rule establishes a set of objectives for reducing nitrogen runoff from new development projects within the planning and zoning jurisdictions of fifteen of the largest and fastest-growing local governments in the Neuse River basin including Cary, Durham, Garner, Goldsboro, Havelock, Kinston, New Bern, Raleigh, Smithfield, Wilson; and Durham, Johnston, Orange, Wake and Wayne counties. Each of these local governments was required to develop and adopt a local stormwater program that includes the following:

- Review of stormwater management plans for new development,
- Protection of riparian buffers
- Public education action plans
- Removal of illegal discharges and identification of stormwater retrofits.

Under the requirements of the rule, the nutrient export goal for new development projects is limited to a total nitrogen export of 3.6 lbs/acre/yr with limits on peak flows to not exceed the predevelopment conditions for the 1-year 24-hour storm. The 3.6 lbs/ac/yr export target represents the 30% reduction goal applied to new development. It represents a 30% reduction from the average pre-development loading conditions. The nitrogen export goal is achieved through a combination of site design and the use of on-site best management practices (BMPs). Developers also have the option to offset the nutrient export offsite by participating in the North Carolina Ecosystem Enhancement Program (NCEEP) nutrient offset program. If the nitrogen export for a planned project site is calculated to be greater than 6.0 lbs/ac/yr or 10.0 lbs/ac/yr for residential or commercial development respectively, the developer must first implement onsite BMPs or take part in an approved regional or jurisdiction-wide stormwater strategy to lower the nitrogen export to at least those levels before being allowed to “buy down” the remainder of their nitrogen export to the 3.6 lbs/ac/yr target through the NCEEP nutrient offset program.

Implementation Results

By 2002, each of the fifteen local governments subject to the Neuse Stormwater Rule adopted and implemented their local permitting programs requiring new development projects to control stormwater runoff. As of December 2006 EEP has received 1,338 nutrient offset payments for new development projects to offset 837,387 pounds of nitrogen over the next 30 years, which equates to offsetting approximately 29,113 pounds of nitrogen annually from new development in the basin.

A number of public education programs have been implemented in the various communities, as required under the rule. All of the local governments under the rule are supporting partners of the Clean Water Education Partnership (CWEP) which is a cooperative effort between local governments, state agencies, and nonprofit organizations to educate the general public about water quality in the Tar-Pamlico, Neuse, and Cape Fear River Basins. The education and outreach programs conducted include workshops, development of web sites, newsletters, brochures, storm drain stenciling, participation at school programs such as science fairs, field days, development of environmental fact sheets, and implementation of demonstration projects for stormwater control. Several communities have also partnered with other agencies such as the NC Cooperative Extension Service and local Soil and Water Conservation Districts to aid in the development of their public education and outreach programs.

All of the local governments subject to the Neuse Stormwater Rule have also developed ordinances and programs that, in addition to requiring the nutrient export goal be met, establish local authority for the removal of illegal discharges. This includes establishing a 24-hour hotline the public can use to report an illegal discharge. Each local program is also responsible for maintaining a database that tracks illicit discharge detection and removal activities, and a number of local governments have noted in their annual reports to DWQ that this element of the stormwater program has resulted in the removal of several illicit dischargers to date.

Each reporting year, local governments also identify a pre-set number of viable stormwater retrofit sites for existing developments in their jurisdictional areas. These sites are made available to groups that may have funding to implement retrofit activities for nitrogen reduction. In addition to identifying retrofit sites, a few local governments have reported activities completed or underway that have worked to reduce existing nitrogen loading. One example of such an effort is the development of local programs to buy out properties in floodplain areas and restore these areas to natural conditions for water quality improvements.

24.1.5 Agriculture Rule

Rule Requirements
The Neuse Agricultural Rule requires all persons engaging in agricultural operations in the basin to collectively achieve and maintain a 30% net nitrogen loading reduction from the 1991-1995 baseline. The agricultural rule provides each farmer with the option of becoming part of a collective local strategy for implementing BMPs or independently implementing standard BMPs as specified in the rule. A Basin Oversight Committee (BOC) and seventeen Local Advisory Committees (LACs) were established to implement the rule and to assist farmers with compliance. The BOC is required to submit an annual progress report to the Environmental Management Commission.

Implementation Results
The BOC began submitting annual reports in 2001, and agriculture has been meeting its goal of 30% reduction in nitrogen loss since 2003. As of 2006, agriculture achieved an estimated 45% nitrogen loss reduction compared to the 1991-1995 baseline for the entire basin. In 2006, seven of the seventeen counties reported a reduction in nitrogen loss from agricultural lands of more than 40%. The seven counties that reported reduction estimates exceeding 40% were Carteret; Craven; Greene; Johnston; Jones; Wake; and Wilson county. To view the Annual Progress Reports on the Neuse Agriculture Rule, visit http://h2o.enr.state.nc.us/nps/ag.htm.

Nitrogen loss reduction from agricultural land was accomplished through best management practice (BMP) installation, fertilizer application reduction, and cropland attenuation. The BOC will continue to focus its efforts in maintaining the loss reductions that have been achieved and promoting further implementation of conservation practices. Table 70summarizes estimates of each factors relative contribution to the cumulative percent reduction in nitrogen loss.

Table 70 Factors Influence on Nitrogen Reduction by Percentage on Agricultural Lands, Neuse River Basin.

Factor	2006
BMP Implementation	8%
Fertilization Management	16%
Cropping Shift	5%
Cropland converted to grass/tree	1%
Cropland lost to idle land	10%
Cropland lost to development	5%
Total	45%

Local nitrogen reduction strategies were based on BMP implementation projections done by the LACs to meet the 30 percent reduction target using NLEW. The LACs determined the practices that would be most acceptable to participating farmers and predicted the number of acres that could be enrolled in these practices. Table 71 summarizes the BMP implementation goals and current status.

Table 71 Best Management Practices Receiving Nitrogen Reduction Credits Installed in the Neuse River Basin from 1996 to 2006.

BMP Types	BMP Enrollment Goals (ac)	Actual Enrollment 1996-2006 (ac)	Goal Exceedence as of 2006 (ac)
20' Buffer	1,370	70,017	68,647
30' Buffer	700	10,442	9,742
50' Buffer	2,000	30,613	28,613
70' Riparian buffer	0	11,483	11,483
100' Riparian buffer	0	109,656	109,656
Scavenger crop	5,200	31,209	26,009
Nutrient management	280,000	267,869	-12,131

The BOC and LACs rely on information generated from the Nitrogen Loss Evaluation Worksheet (NLEW), developed to provide a scientifically valid accountability method for nitrogen reduction. The essence of NLEW is an empirically derived spreadsheet model that estimates nitrogen export from agricultural management units. The primary use of NLEW is to estimate relative reduction in nitrogen export through a pre and post-BMP implementation calculation, rather than estimating delivery to surface waters. The results generated by NLEW represent edge of field nutrient reductions and not actual load inputs to stream and river segments directly discharging to the estuary.

The NLEW tool was developed to serve a five-fold purpose:

1. Estimate nitrogen losses from agricultural sources in the Neuse River Basin during the baseline period of 1991-1995.
2. Distribute goals for nitrogen reduction to local entities.
3. Facilitate local BMP planning and implementation.
4. Track implemented BMPs.
5. Account for reduction in nitrogen losses due to the implementation of BMPs throughout the basin.

In September 2007, NCSU scientists completed a revised version of NLEW. This latest version incorporates updated soil series data and nitrogen reduction values based on buffer width. The use of buffers now generates a percent reduction in nitrogen that is not tied to a specific vegetation type. The revised nitrogen reduction credit for buffers ranges from 30% for buffers that are 20 feet wide, to 60% reduction credit for buffers that are 100 feet wide. Because of these revisions, the estimated nitrogen loss during the baseline period has been recalculated using the updated version of NLEW.

Significant quantities of agricultural BMPs have been installed since the adoption and implementation of the nutrient management strategy. However, the measurable effects of these BMPs on overall in-stream nitrogen reduction may take years to develop due to the nature of nonpoint source pollution.

24.1.6 Protection and Maintenance of Existing Forested Riparian Areas

Rule Requirements

The riparian buffer protection rule requires that existing vegetated riparian buffers in the basin be protected and maintained on both sides of intermittent and perennial streams, lakes, ponds, and estuarine waters. Where the rule applies, a total of 50 feet of riparian area is required on each side of waterbodies. Within this 50 feet, the first 30 feet, referred to as zone 1, is to remain undisturbed with the exception of certain activities. The outer 20 feet, referred to as zone 2, must be vegetated, but certain additional uses are allowed. This rule does not establish new buffers unless the existing use in the buffer area changes. Implementation of the riparian buffer protection rule is done by DWQ staff out of the Raleigh and Washington Regional Offices unless a local government is granted delegation of local authority by the EMC.

Implementation Results

Since implementation of the Neuse buffer rule there have been a total of 39 major variances and 168 minor variances. A major variance request pertains to activities that are proposed to impact any portion of Zone 1 or any portions of Zone 1 and Zone 2 of the riparian buffer. A minor variance request pertains to activities that are proposed only to impact any portion of Zone 2 of the riparian buffer. DWQ began tracking buffer enforcement cases in 2005 and records indicate that from 2005 through 2006 there were 5 buffer violations resulting in enforcement cases with $24,500 in civil penalties assessed. Delegation of local authority for implementing the buffer rule was granted to Orange County and Pitt County in 2001 and 2006 respectively.

24.1.7 Nutrient Management Rule

Rule Requirements

The Nutrient Management Rule requires landowners, leasees and commercial applicators that are applying nutrients to 50 or more acres of residential, agricultural, commercial, recreational or industrial land as of the effective date of the rule, August 1, 1998, to either attend nutrient management training or to develop nutrient management plans for their lands within five years of the rule's effective date.

Implementation Results

Through a partnership between the NCSU Soil Science Department and North Carolina Cooperative Extension staff, seventeen nutrient management training sessions were held throughout the basin between 2000-2001, resulting in 1,850 applicators being trained. In December 2007 a follow-up training was promoted and conducted by NC Cooperative Extension staff in Wilson County. That supplemental offering trained an additional 48 applicators from both the Neuse and Tar-Pamlico Basins that had not been originally. A similar joint training session will be held once a year for the foreseeable future. DWQ continues to seek opportunities to improve participation in the training programs through outreach to turf industry applicators.

24.2 Trends in Nutrient Loading to the Neuse Estuary

This section provides brief summaries of two nutrient loading studies conducted by DWQ to answer the question of whether the TMDL is being met; that is, whether the required 30% reduction in nitrogen loading to the Neuse Estuary is being achieved. The following two analyses were chosen because they directly evaluate the effect of the nutrient strategy on nitrogen inputs to the estuary at the TMDL compliance point (Fort Barnwell) using strategy implementation timeframes. In addition, over the past decade a number of nutrient concentration and load studies by various researchers and DWQ staff have measured nutrient trends in the Neuse Estuary and elsewhere using different timeframes. All of these studies shed light on the dynamics of eutrophication and changes over time. For this reason we provide brief summaries of these studies in Appendix V.

24.2.1 Trend Analysis of N&P in the Neuse River at Fort Barnwell Ambient Monitoring Station (Rajbhandari, 2007)

This DWQ study concluded that there was no significant trend in total nitrogen(TN) loading at the Ft. Barnwell station in the Neuse Basin. This study was a monotonic trend evaluation of seasonally adjusted nutrient concentration at the Ft. Barnwell ambient monitoring station, which is the TMDL compliance point and is located 23 miles above New Bern, over the study period (1991-2006) to evaluate the Phase II Neuse Estuary TMDL from the baseline period (1991-1995). A monotonic trend is the determination of whether the nutrient concentrations are consistently increasing and never decreasing or consistently decreasing and never increasing. Seasonal adjustment is a statistical technique that attempts to measure and remove influences of predictable seasonal patterns to reveal how concentrations change from month to month. These seasonal adjustments make it easier to observe the underlying trend and other non-seasonal movement in the data set.

The Water Quality/ Hydrology Graphics / Analysis System (WQHYDRO) was used in this study to compute the nonparametric Seasonal Kendall test to determine nutrient concentration trends. A Seasonal Kendall test is a nonparametric trend test that is used with data sets that are non-normal, vary seasonally and contain outliers and censored values. Analysis used average monthly concentrations for TKN, NO_x, TN, and TP.

This trend analysis was not performed for flow adjusted concentrations because there was no significant trend in flow at the 95% confidence interval (Figure 53). The results of the Seasonal Kendall test found significant decreasing trends in concentration of TN (-24%) (Figure 54), TP (-27%) and NO_x (-56%) at the Ft. Barnwell station when compared to the baseline period at the 95% confidence interval. TKN concentrations were shown to be slightly increasing but the trend is not significant at the 95% confidence interval. However, a significant upward trend of TKN load (+45%) was observed. Upward trends of TP and TN load were also observed but they were not statistically significant at the 95% confidence interval (Figure 55).

There are multiple factors contributing to variation in water quality over time, many of which can hide or exaggerate trend components in the data. In this case the upward trend in TKN load and increase in flow, though the flow increase was not statistically significant, likely played a large role in the inability to discern a clear TN loading trend as a result of this study. Load is the product of flow and concentration with the flow being the dominant factor in the calculation. The annual variability of flow from year to year expressed in this basin can hide or "mask" the reduction in TN concentration when calculating the total load. Similarly, TN load is the sum of TKN and NO_2 and NO_3 loads. In this study TKN load was found to have increased by 45% while the NO_x load only dropped by 8% and was not statistically significant. This increase in TKN load factors strongly in the TN load calculation and offsets the decrease in NO_x load calculated. In the end, the variability of flow with its fluctuation of high and low flow years over the study period along with the increase in TKN load overshadow the measured drop in TN concentration when calculating total load at the Fort Barnwell station.

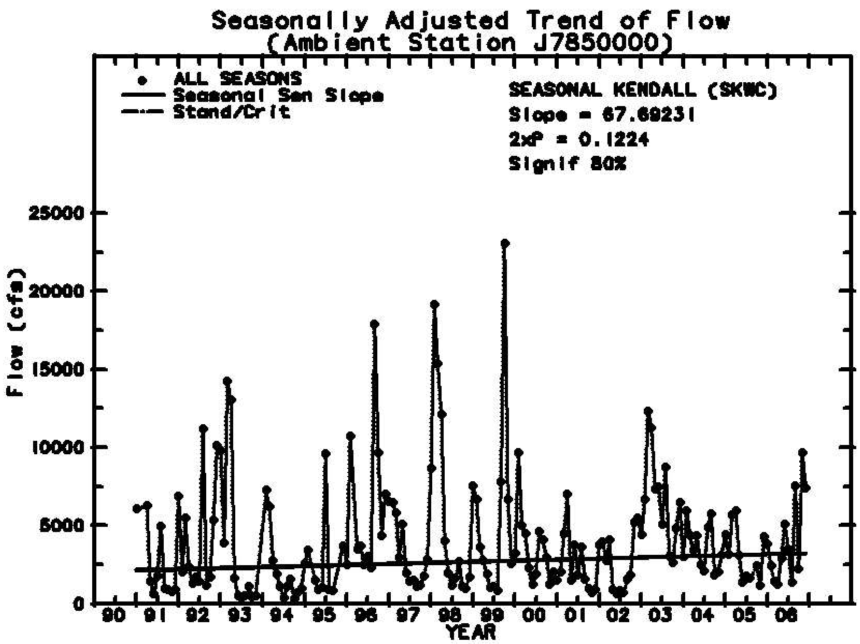


Figure 53 Trend slope representing flow rates during water sample collected period at ambient Fort Barnwell station from 1991 through 2006.

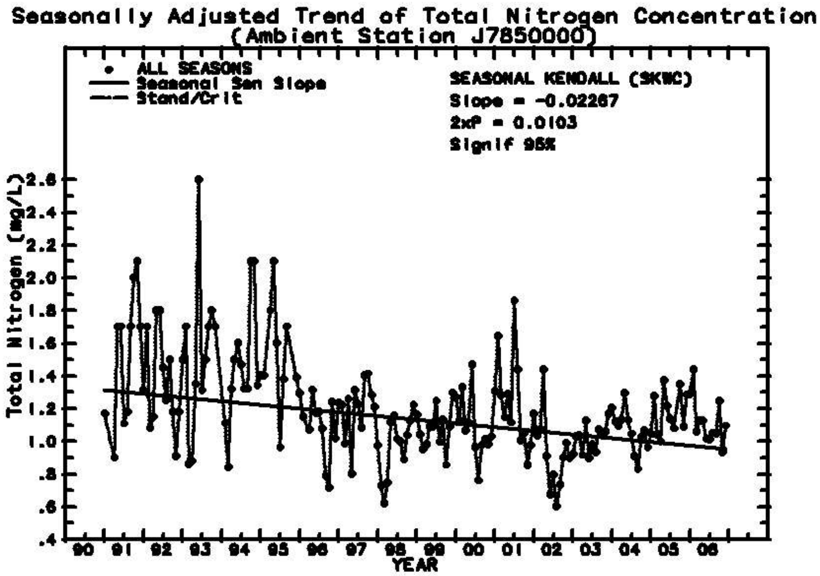


Figure 54 Trend slope representing average rate of change in seasonal-adjusted total nitrogen concentration at ambient Fort Barnwell station from 1991 through 2006.

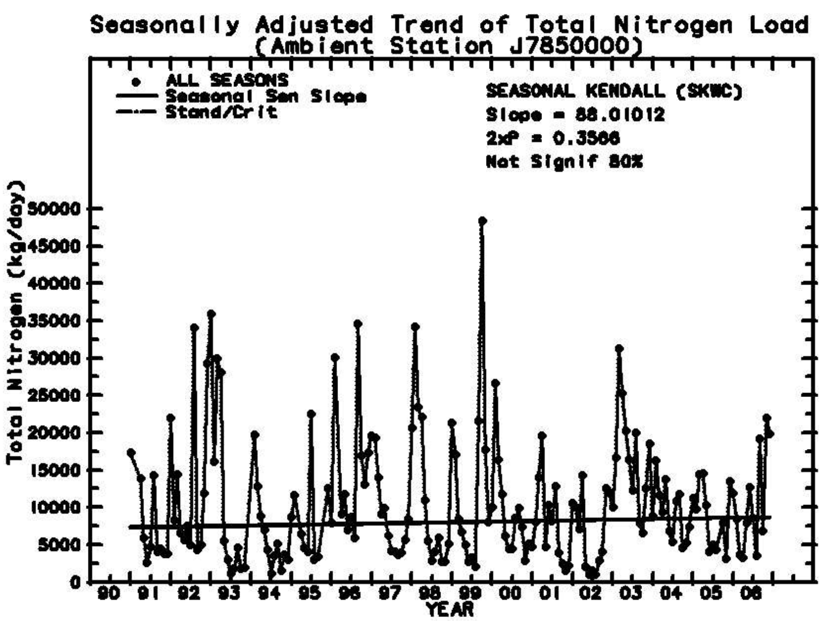


Figure 55 Trend slope representing average rate of change in seasonal-adjusted total nitrogen load at ambient Fort Barnwell station from 1991 through 2006.

24.2.2 "Pre & Post" Strategy Implementation Analysis: Fort Barnwell Ambient Station (McNutt, 2007)

This DWQ analysis was conducted to begin to evaluate compliance with the Neuse estuary TMDL. It is a pre/post comparison of unadjusted annual mass loading of nutrients to the estuary using DWQ ambient data collected at the Fort Barnwell station. The 'pre' data spans the time period from January 1991 to December 1996, which corresponds to the baseline for the Neuse NSW Rules. The 'post' data spans from January 1999 to December 2006. This post period includes five years during which implementation was carried out, 1999-2003, and four years following full implementation. The following parameters were reviewed: ammonia, TKN, nitrate, nitrite, and total phosphorus. Daily and monthly nutrient concentrations and flows were combined into monthly average loads, which were totaled into annual loads that were then averaged across each set of years.

It is important to note that this is not a statistical analysis of the data and does not take variability or confidence intervals into account. The findings of this analysis show average total nitrogen loads at the Fort Barnwell station during the baseline and the post implementation periods were 7.53 million lbs/year and 8.35 million lbs/year respectively. This equates to an increase in nitrogen loading at Fort Barnwell of approximately 11% as opposed to the 30% reduction target (Figure 56). As discussed in Section 24.2.3, below, these study results do provide a meaningful assessment of progress, or lack thereof, towards meeting the 30 percent load reduction goal. The graph, however, does effectively demonstrate the high variability and influence of annual mean flow on nitrogen loading, thus pointing out the significant contribution of nonpoint sources of nitrogen.

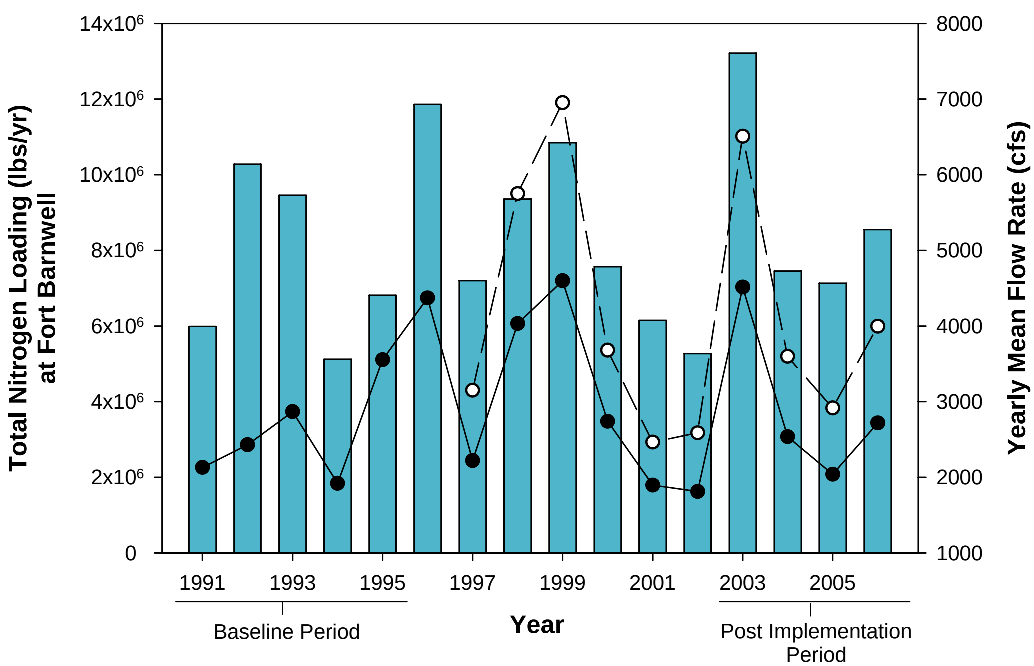


Figure 56 Estimated TN Loading at Fort Barnwell Ambient Monitoring Station (1991-2006)

24.2.3 Trend Analysis Conclusions & Next Steps

The two studies summarized above appear to indicate that not only has the 30% goal not been reached, but that nitrogen load to the estuary may have remained unchanged or even increased. In evaluating these results, we first discuss how they may compare to general expectations based on the strategy results reported in the previous section. We then recognize inherent limitations of the trend studies themselves. Lastly, we consider factors within the basin and with the strategy design that may contribute to the trend study results seen.

Based on implementation results reported in the previous section, in general it would seem reasonable to expect both concentrations and loads of N to the estuary to decrease substantially post-baseline. Wastewater discharge load estimates carry probably the greatest certainty given the relative ease and frequency of monitoring. In the baseline period, these were estimated to contribute on the order of one-quarter of N load flowing into the estuary, and are estimated to have decreased by approximately 65% post-baseline. For a number of reasons, significantly greater uncertainty is associated with agricultural reduction estimates. Some of the factors contributing to this uncertainty include the relative variability of nonpoint source BMP effectiveness, the inherent uncertainty of the baseline nitrogen loss estimates which current reductions are compared against, and the fact that reductions reported for agriculture are edge of field reduction estimates and not in stream load reduction calculations based on water quality monitoring data. With this in mind, agriculture was estimated to contribute over half of all N load to the estuary in the baseline, and annual implementation reports estimate that N loss from basin agricultural lands has decreased by approximately 45% post-baseline. Based on these estimates, reductions from these two sources together might be expected to have substantially achieved the 30% goal.

The gap between these expectations and the trend study results may be explained in part by the inherent limitations of the trend studies. Climatic variability plays an important role in the mobilization, processing, and delivery of nutrients to the Neuse estuary. The estuarine water quality response is affected by climatic events and this variability obscures clear trends in nutrient loading and the estuary's response to these loads, despite efforts to reduce point and non-point source loads. Several factors that are in a state of change must be included in the consideration of the data analysis. (Paerl, 2008). The first study discussed above yields seemingly conflicting results. A downward trend in N concentration and concurrently no change in N load should only be explainable with an increase in flow over the study period, since load is the product of concentration and flow. But the analysis found no trend in flow. Perhaps the most plausible explanation lies in the relative uncertainties associated with each of these determinations. However, we can say that 24% and 27% decreases in concentration at a 95% confidence provide relatively strong indication of real and substantial improvement. In the longer term, we might expect the loading trend to follow suit as the variability in year-to-year flow averages out over time. In the interim, we intend to both conduct additional evaluations on the data used here toward clarifying the apparent inconsistencies, and to continue collecting data and conducting additional trend studies at intervals into the future.

The second study has two key limitations. First, the 'post' period contains only three years of true post-implementation data. While this limitation was unavoidable, a statistical comparison using such a brief data span is of relatively limited value. Its value is further limited by the inclusion of

5 years of 'during' implementation data, years in which compliance was not yet required. The second limitation is that this analysis did not include steps to remove the influence of known sources of variability, primarily season and flow. As with the first study, we might expect the value of this type of analysis to grow when repeated with additional data over time as these sources of variability tend to average out over longer time spans.

By expanding the analysis outside of the TMDL compliance point and focusing on specific watersheds with dominant land use types, staff may be able to better gauge the effectiveness and progress of strategy implementation. For this reason will be necessary to conduct additional trend analysis on tributaries within the basin that represent predominately agriculture and urban watersheds respectively. While we believe that further analysis of existing data and additional years of data collection will provide greater certainty as to the effect of the strategy on the estuary, we also recognize other basin factors that may contribute to the results seen in these analyses and the lack of improvement in the estuary. We first note two key biophysical process factors, then in the following sections we enumerate factors involving the design of the strategy and individual rules.

An important factor in interpreting agricultural effects is the variable rate of groundwater movement to surface waters. Research is increasingly finding that some fraction of water introduced to groundwater through infiltration may take as long as decades to reach surface waters, while some does so on much shorter timeframes, years or months. Thus to some degree the effects of recent improvements in N application rates through both inorganic fertilizer and animal waste are not likely to be seen instream for years or decades to come.

A factor that bears on estuary improvement directly is the generally complex nature of estuary dynamics and more specifically the potential for nutrient cycling out of sediments for some time as water column nutrient concentrations decrease. Study is needed to gauge the extent to which purging of estuary sediments may be expected to delay improvements in estuary productivity response.

Section 24.3 identifies gaps and potential gaps in strategy design that may present opportunities for further reducing nutrient inputs to the estuary.

24.3 Strategy Analysis and Opportunities for Additional Nutrient Reductions

While DWQ recognizes the need to take a longer-term view on judging success in decreasing nitrogen inputs to the estuary and the estuary's response to reduced inputs, we also believe it is appropriate to begin evaluating the potential limitations of the current strategy and the limitations in our understanding of nutrient input sources and opportunities for improving both. This section of the Basin Plan discusses possible opportunities to strengthen the existing nutrient reduction strategy and identifies potential nitrogen loading sources not addressed by the strategy that may merit further evaluation and management recommendations.

24.3.1 New Development Stormwater Rule

The Neuse stormwater rule establishes a nutrient export goal of 3.6 lbs/ac/yr of TN for new residential and commercial development projects within the planning and zoning jurisdictions of 15 of the largest and fastest-growing local governments in the Neuse River Basin. Each of these local governments has successfully implemented its stormwater program since 2001 and continues to achieve the nutrient export target through a combination of onsite BMPs and off site nutrient offsets. DWQ has begun to assess the extent to which the stormwater rule does not address new development activities in the basin. A key factor in this assessment is increases in population and the corresponding growth in residential and commercial development activities in municipalities and counties that are currently not subject to the stormwater rule.

Tables 72 & 73 below detail the population growth of the major municipalities and counties in the Neuse River Basin. Table 74 provides an analysis of the percentage of basin area covered by the requirements of the Neuse Stormwater Rule. The tables are sorted in descending order of total population growth, and local governments currently subject to the rule are shown in bold. Those currently subject to Phase II stormwater requirements are italicized.

Between 2000 and 2006, approximately 68% of the population growth within the 33 municipalities in the basin with populations greater than 2,000 occurred in areas subject to the Neuse stormwater rule. However, the remaining 45% of the total growth during this same period occurred in areas of the basin where the rule does not apply. In terms of geographic coverage, the Neuse Stormwater Rule currently applies to approximately 40% of the basin. Adding population growth within the nine fastest growing municipalities not currently subject to the rule represents an additional 92% of the total population based on this data. Approximately 18% of the population growth during this same period took place in areas within the basin that are not subject to either the Neuse stormwater rule or Phase II.

In addition to the ten municipalities subject to the Neuse Stormwater Rule, three of the remaining twenty-three communities with populations greater than 2,000 are subject to Phase II stormwater regulations. The requirements of Phase II stormwater regulations and the Neuse Stormwater Rule do share some similarities in that they both include provisions for implementing illicit discharge detection and elimination programs, public outreach and education, and some type post construction stormwater controls. However, there are additional protective measures provided for in the Neuse Stormwater Rules that specifically address nutrients that are not present in the Phase II regulations. As shown in Table 74 below, an additional 8% of the basin area not subject to the rule is subject to Phase II stormwater regulations. While Phase II stormwater regulations do not currently address nutrients, DWQ could consider including nutrient requirements under Phase II programs when existing permits are renewed or future Phase II designations are made.

Table 72 Growth of Largest Municipalities from April 2000 to July 2006 (Population > 2K).

Municipality	Year 2000 Population	Year 2006 Population	% Growth 2000-2006	Total Growth
Raleigh	**276,094**	**352,919**	**21.8%**	**76,825**
Cary	**94,536**	**122,139**	**22.6%**	**27,603**
Durham	**187,035**	**214,492**	**12.8%**	**27,457**
Greenville	61,209	72,227	15.3%	11,018
Wake Forest	12,588	22,628	44.4%	10,040
Apex	20,212	28,830	29.9%	8,618
Morrisville	5,208	13,501	61.4%	8,293
Holly Springs	9,192	17,165	46.4%	7,973
Garner	**17,787**	**23,507**	**24.3%**	**5,720**
Fuquay-Varina	7,898	12,913	38.8%	5,015
Clayton	8,126	12,118	32.9%	3,992
Wilson	**44,405**	**48,316**	**8.1%**	**3,911**
Winterville	4,794	8,192	41.5%	3,398
Knightdale	5,958	8,671	31.3%	2,713
New Bern	**23,111**	**25,456**	**9.2%**	**2,345**
Smithfield	**10,867**	**12,456**	**12.8%**	**1,589**
Wendell	4,247	5,421	21.7%	1,174
Selma	5,914	7,008	15.6%	1,094
Hillsborough	5,446	6,240	12.7%	794
Zebulon	4,046	4,781	15.4%	735
Creedmoor	2,232	2,718	17.9%	486
Benson	2,993	3,450	13.2%	457
Havelock	**22,442**	**22,772**	**1.4%**	**330**
Grifton	2,123	2,365	10.2%	242
Ayden	4,622	4,861	4.9%	239
Farmville	4,421	4,619	4.3%	198
Roxboro	8,696	8,866	1.9%	170
River Bend	2,923	3,028	3.5%	105
Trent Woods	4,224	4,321	2.2%	97
Mount Olive	4,567	4,594	0.6%	27
La Grange	2,844	2,804	-1.4%	-40
Kinston	**23,688**	**22,962**	**-3.2%**	**-726**
Goldsboro	**39,147**	**37,396**	**-4.7%**	**-1,751**
Total	**1,143,736**	**933,595**	**18.4%**	**210,141**

Notes:
Bold = Subject to Neuse stormwater rule

Italics= Subject to Phase II stormwater rule

Table 73 Growth of All Counties in the Basin from April 2000 to July 2006.

County	% County in the Basin	Year 2000 Population	Year 2006 Population	Population in Basin 2006	% Growth 2000-2006	Total Growth in Basin 2000-2006
Wake	**85**	**627,866**	**790,007**	**533,686**	**20.5%**	**137,820**
Johnston	**98**	**121,900**	**151,589**	**119,462**	**19.6%**	**29,095**
Durham	**73**	**223,314**	**246,824**	**163,019**	**9.5%**	**17,162**
Pitt	42	133,719	146,403	56,162	8.7%	5,327
Orange	**49**	**115,537**	**123,766**	**56,613**	**6.6%**	**4,032**
Craven	95	91,523	95,558	86,947	4.2%	3,833
Wilson	81	73811	77,468	59,787	4.7%	2,962
Carteret	50	59,383	63,558	31,779	6.6%	2,088
Greene	100	18,974	20,833	18,974	8.9%	1,859
Wayne	**91**	**113,329**	**114,930**	**103,129**	**1.4%**	**1,457**
Granville	25	48,498	53,840	12,125	9.9%	1,336
Nash	20	87,385	92,220	17,477	5.2%	967
Franklin	10	47,260	55,315	4,726	14.6%	806
Person	32	35,623	37,448	11,399	4.9%	584
Pamlico	83	12,934	13,097	10,735	1.2%	135
Beaufort	2	44,958	46,346	927	3.0%	28
Jones	81	10,419	10,318	8,439	-1.0%	-82
Lenoir	99	59,598	58,172	59,002	-2.5%	-1,412
Total	**N/A**	**1,926,031**	**2,197,692**	**1,560,271**	**12.4%**	**207,997**

Notes:
Bold = Subject to Neuse stormwater rule

Italics= Subject to Phase II stormwater rule

Table 74 Neuse Stormwater Rule and Phase II Stormwater Program Coverage.

Stormwater Program	Basin Area (%)	Approximate Area (Square Miles)
Total Area Subject to Neuse Rule	**40%**	2,433
Neuse Only	**14%**	844
Both Neuse and Phase II	**26%**	1,589
Additional Area Subject to Phase II Only	**8%**	509

Notes:
% Area covered based on 2005 municipal boundaries and Phase II designations as of February 1, 2008

Total basin area = 6,109 square miles

DWQ also recognizes that greater oversight of local stormwater programs by the state should provide more assurance of full implementation of the rule as well as provide better data to assess the effectiveness of the rule and its various components. One method being considered by staff is conducting periodic audits of each individual stormwater program. The audits would serve to help identify improvements needed in both implementation and reporting.

In addition to the rule's geographic coverage limitations, it does not set a quantitative reduction target for nitrogen loading from existing developed lands. According to land cover data collected by the National Resources Inventory (NRI), as of 1997 there were 481,000 acres of urban and built-up land cover in the Neuse Basin, or approximately 13% of the entire basin. Since the current nutrient strategy addresses stormwater from new development starting in 2001, the stormwater runoff from these 481,000 developed acres, plus any lands developed between 1997 and 2001, and any land developed after 2001 on which a vested development right was established, has not been subject to the rule. The great majority of these lands are not being treated to achieve nutrient reductions. Treating nutrient runoff from existing development through stormwater retrofit BMPs and other load reducing measures, both structural and management oriented, represents a real opportunity to further reduce existing nutrient loads to the basin from this significant source. A rule to address nutrient contributions from stormwater runoff from existing development could provide municipalities opportunities to receive nutrient reduction through practices such as removing existing impervious cover, buffer restoration, street sweeping, and removal of illicit discharges, in addition to structural retrofits.

There are also potential low cost opportunities to address existing sources of nutrients in runoff from existing development. Existing sources include nutrients from pet waste and over fertilization of turf and landscape areas. Controls could be incorporated into local stormwater programs and ordinances to address these two sources of nutrients. Educational opportunities addressing these issues could be incorporated into the public education and outreach requirement already part of the established local stormwater programs. Some local governments in North Carolina already implement pet waste ordinances. Local governments in other parts of the country are beginning to place limitations on home fertilizer use with success as well. One recent example is the 2005 Minnesota phosphorus fertilizer law (18C.60, MN Statutes 2006) which prohibits use of phosphorus lawn fertilizer unless new turf is being established or a soil or tissue test shows need for phosphorus fertilization. The law also requires fertilizer of any type to be cleaned up immediately if spread or spilled on a paved surface, such as a street or driveway.

24.3.2 Agriculture Rule

The progress achieved by the agriculture sector in implementing the Neuse Agriculture Rule is well documented in the Annual Agricultural Progress Reports submitted to the EMC every fall since 2002. As discussed in section 24.1.5, as of 2003 the agriculture sector exceeded its collective 30% nutrient reduction goal and as of 2006 is reporting a 45% reduction in estimated nitrogen loss to the basin through a combination of BMP implementation, crop shifts, fertilization rate reductions, and loss of overall cropland acres. During implementation, improvements have been made to the accounting of these reductions as more research and data becomes available concerning the effectiveness of agriculture BMPs. Opportunities remain for further improvement to the accounting process and identifying additional agricultural sources that may be contributing nutrients that are not accounted for under the current strategy.

Staff will continue to consult with University researchers and Division of Soil and Water Conservation (DSWC) staff as more data becomes available concerning the efficiencies of agricultural BMPs and how this information can be used to further refine the nutrient reduction credits applied under the current program. In addition to revisiting BMP efficiencies, DWQ plan to continue collaborating with an interagency workgroup started in 2007 to identify methods to better track land use changes. Specifically, staff will be working to develop a "whole basin" land accounting strategy that will work to ensure that accounting for land that goes out of agriculture does not result in double counting of nutrient reductions.

One potential limitation of the agriculture rule involves pastured livestock nitrogen contributions. Nutrient loading from pasture-based livestock operations has not been well characterized generally, including in NC, and the accounting tool used for rule compliance does not include the ability to quantify the effects of livestock management on N loading. A recent survey conducted by DSWC staff estimates that at least 50% of the pasture acres within the basin use fencing out practices to keep livestock out of streams. However, additional research is still needed to better quantify the nutrient benefits of various pasture management practices like fencing out livestock and restoring riparian buffers. While pasture operations were originally considered to be a small part of agriculture in the basin, their contributions to agriculture nitrogen loading have not been well quantified and could represent an opportunity to achieve additional nutrient reductions to the basin.

In addition to better potential nutrient loading from pasture, staff also recognizes the need to better understand the role that artificial drainage, such as subsurface tile drains, plays in contributing nutrient loads to the basin. Interception of shallow ground water beneath agricultural fields through tile drains to ditches can increase nitrogen loading into receiving streams. While the number of ditches (channelized runoff) and tile drains has likely not increased since the baseline, the "short circuiting" effect these existing systems create represents an opportunity for improvement that could result in additional nutrient load reductions. Quantifying the extent of the drains has proven challenging because tile drain maps are either outdated or nonexistent. Additional research is needed to determine the location and geographic extent of tile drains in the Neuse, since available studies have shown evidence of elevated nitrate-nitrogen concentrations in tile drainage water. Such a study should also include some form of functional assessment that will allow for the evaluation of potential options for mitigating the impacts of tile drains.

There is also a need to better understand the potential magnitude of nutrient loading from spray fields and directly from animal housing and holding, and waste storage facilities on confined animal feeding operations (CAFOs), such as dairies, hog farms, and poultry operations. Also, subsurface seepage from waste lagoons and ammonia emissions from CAFOs are not captured under the Neuse agriculture rule, but are to some degree addressed under other state rules and programs addressing animal operations. These programs are discussed in the groundwater and atmospheric portions of this section.

Through our interactions with DSWC staff, Division staff will focus particularly on increasing the coverage of certain more lasting and verifiable practices like water control structures and restoring riparian buffers. To help address some of the knowledge questions raised here, funding from the EPA 319 grant program has been awarded to fund a project that would statistically sample farms in the basin and conduct on-ground surveys of a host of current conditions and practices. This project, to be conducted by NCSU Department of Soil Science and the USDA National Agriculture Statistical Survey, would be a follow-up to a similar study carried out in 2000 and would also allow evaluation in changes over the intervening years. Since the performance of certain BMPs like water control structures rely on their proper management, it would be useful to evaluate the effectiveness of current compliance processes at ensuring these practices are being maintained and operated properly throughout their contract lives.

24.3.3 Point Source Rule

As summarized in Section 24.1.3, wastewater discharge nitrogen loading reductions have been substantial. Point sources are meeting their nutrient allocations and have reduced their combined wastewater discharge nitrogen loads by 65% through 2006 compared to the baseline. One question relates to increases in land application of treated wastewater that has occurred as a means of complying with this rule. It would be useful to evaluate the extent to which such land application may be yielding a net increase in nutrient loading over previous uses of the acres involved. Other questions relate to land application program compliance and compliance criteria.

A recent example of how nutrient loading to groundwater can occur from land application of biosolids is the situation at the City of Raleigh WWTP. Errors in the estimation of agronomic rates resulted in long-term over-application of biosolids. This led to elevated nitrate levels in private wells in the vicinity of the land application site. Previous studies showed that nitrogen loads are being delivered to the Neuse River from the application field previously used by the Raleigh WWTP due to this over-application (Showers et al, 2006). Land application practices have ceased at the facility while negotiations to resolve the issue are ongoing. This situation, while an extreme case, demonstrates the need for more research to quantify the potential for groundwater contamination and transport of nutrients from biosolids and wastewater land application fields to the surface waters of the Neuse Basin.

A variation on new land application systems is the growing practice in the coastal plain of high-rate infiltration systems. This recent innovation is being proposed to address wastewater needs of some new developments where receiving waters would not accommodate direct discharge of treated wastewater and no POTW is available. The new nutrient load from these systems is not captured by the point source rule or other strategy accounting mechanisms and concerns have been raised that the ability of landscape features to treat these discharges prior to entering the surface waters has not been well quantified.

24.3.4 Nutrient Contributions from Land Application Sources of Waste

As touched on in the previous sections pertaining to indirect nutrient loads from point sources and agriculture, groundwater is a significant source of nutrient loading to the Neuse Estuary. While there is a limited amount of research available that explores the nutrient contributions or changes in those contributions from this source in the basin, initial research shows that land application of treated wastewater, biosolids from municipal wastewater treatment systems, animal waste from confined animal feeding operations (CAFOs) and onsite wastewater systems are all considered likely sources of nutrients found in groundwater in the Neuse River Basin.

The predominant wastewater treatment systems used in CAFOs are lagoons and sprayfields, in which waste is flushed from confined animal housing units into large waste lagoons and then periodically sprayed onto agricultural fields. Similarly, municipal wastewater treatment plants commonly land apply the sludge that is a bi-product of the treatment process to agriculture fields as a means of disposal. In both cases the nitrogen contained in the land-applied products will either be assimilated by crops, volatilize into the atmosphere, run off into adjacent streams, or infiltrate into the groundwater system and eventually discharge into streams in the basin (Paerl, 2002).

While most regulations require that land application not exceed realistic yield-based agronomic rates, recent studies have shown that nitrate concentrations are higher in groundwater under crop fields sprayed with animal wastes than in groundwater beneath crop fields fertilized with commercial fertilizers (Spruill, 2004). Ideally, nutrient application should be based on crop needs and for a given crop, there should be no difference in nitrogen loss between nutrient types applied. Given the use of land application is expected to continue, and in light of the projected increase in human population in the Neuse Basin, the continued use of this waste disposal method from such high volume sources highlights the importance of seeking a better understanding of the relative impacts of these practices on nutrient loading to surface waters.

Export of land-applied nutrients to surface waters, whether originating from municipal, commercial, or animal facility is enhanced when the field in question has artificial drainage systems like tile drains. The NLEW accounting tool used for agriculture rule compliance does not capture the effects of drain tiles nor does it reflect the research findings cited above regarding nitrogen concentrations under waste-applied fields. Since waste applied fields may represent a nutrient loading source not captured through the agriculture rule accounting process, the reductions reported by the agriculture community as a whole could be over estimated.

While not part of the Neuse agriculture rule, there are other state rules that regulate land application. These include the 15A NCAC 2T rules, which specify requirements for systems that treat, store and dispose of wastes that are not discharged to surface waters of the state. These rules went into effect in 2006 and replaced the ".0200" or non-discharge rules. While these regulations do not contain nutrient reduction requirements and were not developed to specifically address the 30% nitrogen reduction goal, the rules do require management practices such as that could serve to help reduce nutrient inputs to the Neuse Basin from land application operations

In addition, in 2007 the NC General Assembly incorporated the findings of the Smithfield Agreement into Senate Bill 1465 (Session Law 2007, Section 523). Senate Bill 1465 prohibits permitting of a new or expanding swine management system utilizing an anaerobic lagoon and sprayfield as the swine farm's primary method of treatment and land application. Senate Bill 1465 also charged the Environmental Management Commission (EMC) to adopt rules to make the performance standards permanent thus allowing for the construction of innovative swine waste management systems for either new farms or for the expansion of existing farms. The swine waste management system performance standards are to:

- Eliminate swine waste discharge to surface water and groundwater through direct discharge, seepage or runoff

- Substantially eliminate atmospheric emission of ammonia
- Substantially eliminate odor detectable beyond the swine farm property boundaries
- Substantially eliminate disease-transmitting vectors and pathogens
- Substantially eliminate nutrient and heavy metals in soils and groundwater

Senate Bill 1485 also established a grant program called the North Carolina Lagoon Conversion and Methane Capture Pilot Program that will be used in conjunction with the North Carolina Agriculture Cost Share Program to assist farmers interested in voluntarily converting existing lagoons to cleaner technologies that will meet the performance standards. The EMC approved rules to implement the new provisions of Senate Bill 1465 in November 2008. Once approved by the Rules Review Commission the rules could go into effect as early as January 1, 2009.

Other regulatory activity, likely result in additional monitoring requirements for CAFOs with NPDES general permits, is currently underway. While these new monitoring requirements are not directly related to the 30% reduction goal, the information collected under these proposed requirements will provide valuable information that will be useful in identifying high priority areas of nutrient inputs from animal waste land application sites. In 2007 a petition filed by several environmental groups sought to compel the EMC to expand the monitoring requirements for general permits for animal feeding operations to ensure compliance with non-discharge effluent limitations. This petition for rulemaking resulted in a public stakeholder process that generated draft rules requiring CAFO facilities to develop monitoring plans that would serve to track the performance of the permitted system, verify that the system is protective of surface water standards and document water quality parameter concentrations in adjacent surface waters and compliance with permit discharge limitations. The draft rules that resulted from the stakeholder process during the summer of 2008 went before the EMC in November 2008 and were approved to go out for public comment in early 2009. Under the current timeline these rules are may be adopted and go into effect by the summer of 2010.

24.3.5 Nutrient Contributions from On-site Wastewater Systems

In addition to land application of waste as a potential nutrient source, initial evidence suggests that residential on-site wastewater systems may be a source of nutrients to the Basin. A recent study conducted by researchers at the NCSU Department of Soil Science is instructive regarding the nitrogen loading generated by households in the basin that use onsite wastewater systems. It estimates that approximately 39% of households in the Neuse Basin use onsite systems, and the cumulative nitrogen load generated by these systems is 3.9 million lb N/yr (Pradham, 2007). While the study is somewhat limited in that it used 1990 Census data, were this magnitude of loading delivered directly to streams it would rival that delivered to the Neuse estuary by all other sources combined. Of course these disposal systems rely on nitrogen removal through landscape processes, primarily denitrification and plant uptake. These processes are believed to remove the vast majority of nitrogen generated by onsite systems before it reaches surface waters. However, such landscape processes are variable in nature, and a question requiring additional study is quantifying the extent to which such ground absorption systems may increase N loading to streams as compared to centralized collection of wastewater, and under what landscape conditions. A second question, which is discussed in the following section, involves understanding the temporal pattern of nitrogen movement through groundwater to surface water toward better understanding the relationship between population increases and nitrogen delivery to streams.

One study that begins to answer this question is an unpublished study conducted through a joint effort between the North Carolina Division of Public Health and the United States Geological Survey (USGS) compared the effects of onsite and offsite wastewater treatment on the occurrence of nitrogen in the Upper Neuse River Basin. It concluded that onsite systems contribute slightly more nitrogen to the nutrient load in recharging surface water than the load contributions from similar residences served instead by municipal sewer systems (Grimes & Ferrell, 2005). In light of these findings it is evident that additional research in this area is needed to better quantify the role on-site wastewater treatment systems play in contributing nitrogen to the Neuse Basin.

24.3.6 Nutrient Loading from Groundwater

An area of growing interest involves improving our understanding of the role of groundwater in nitrogen loading to the estuary. A study by published by USGS in 2008 estimates groundwater nitrogen flux into the Neuse estuary and this initial research suggests groundwater as a possible loading pathway. The study found nutrient fluxes from groundwater to the estuary account for 6% of the nitrogen inputs derived from all sources and approximately 8% of the nitrogen annual inputs from surface-water inflow to the Neuse River estuary (Spruill et al. 2008). The nitrogen load delivered by groundwater was not identified as part of the Neuse TMDL nor assigned a reduction requirement. This was in part because quantitative knowledge was limited at the time on either direct groundwater flux into the estuary or the makeup of groundwater's contribution to loading into basin streams. In addition, from a management standpoint DWQ views groundwater primarily as a pathway rather than a source, and currently we look to manage inputs to this pathway rather than considering treatment of groundwater itself. Over sufficient time, the groundwater nitrogen flux should respond to reductions in landscape inputs. Research is increasingly showing that deeper groundwater flow paths may take on the order of decades to express themselves as surface discharges. This raises several questions. To what extent have the Neuse nutrient rules and other regulations resulted in reductions to landscape N inputs? Can we characterize the temporal pattern of groundwater nitrogen delivery to streams? Can we reliably monitor changes to both stream and estuary nitrogen inputs over time?

To begin answering these questions, we recognize that the set of landscape activities that add nitrogen to groundwater are primarily the variety of human and animal waste disposal and crop fertilization activities mentioned in sections above. An additional contribution is the overlay of atmospheric deposition of nitrogen across the landscape, as described in the following section. Much of these groundwater additions occur under the practice of agriculture. The agriculture rule focuses on surface water and does not require reduction of groundwater N inputs by 30%. Certain practices used to meet the agriculture rule, primarily decreasing N fertilization rates, should decrease groundwater N concentrations. Applying the 30% goal to N application would be problematic since the business of growing crops relies on certain application rates, and crops have inherent N use efficiencies that result in the loss of a fraction of that N, often on the order of half, to groundwater. But we believe that actions taken by producers to comply with the Neuse agriculture rule should yield decreases in cropland N contributions to groundwater. Similarly, as detailed in the previous section, other regulations should result in decreased groundwater N inputs. The state CAFO regulations initiated in the mid-1990's have yielded significant decreases in waste N land application rates. Changes to residuals application included in the 2T rules should yield similar reductions to application rates for this activity.

The other questions will require us to pursue knowledge improvements by seeking additional monitoring and research into groundwater-to-surface water N dynamics. It will be important to assess the magnitude of contributions through this pathway over years and decades.

24.3.7 Nutrient Loading From Atmospheric Deposition

Atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_3) is a significant source of nitrogen input into the Neuse Estuary (Whitall et al., 2003). However due to lack of available data at the time, contributions through atmospheric deposition were likely vastly underestimated in developing the Neuse TMDL nor was it assigned a reduction requirement. And much like groundwater, this was in part because quantitative knowledge was limited at the time on the magnitude of either direct deposition to the surface of the estuary or its contribution to N loading to basin streams. And much like groundwater, from a management standpoint we view atmospheric deposition primarily as a pathway rather than a source, and currently we look to manage inputs to this pathway rather than considering treatment of atmospheric nitrogen itself. Over sufficient time, atmospheric N deposition rates should respond to reductions by emissions sources. As with groundwater, this raises several questions. To what extent are air quality regulations resulting in reductions to atmospheric N emissions? Can we characterize the relationship between reductions in N emissions and reductions in N deposition? Can we reliably monitor changes to nitrogen deposition over time?

While the scientific understanding of atmospheric deposition continues to evolve, some general observations can be made about atmospheric deposition as a source of nitrogen input into the Neuse Estuary. Atmospheric inputs can be divided into two main types: direct: those that fall directly into the estuary and indirect: those that are deposited on various land surfaces throughout the basin, some portion of which is transported into streams and eventually delivered to the estuary. As the population grows in airshed of the Neuse Basin, an increase in NO_x emissions from increased fossil fuel combustion is likely to occur. Ammonia also contributes to atmospheric nitrogen. The great majority of ammonia volatilizes from confined animal operations, but sewage treatment plants and fertilizers applied to the land also contribute small amounts. In North Carolina, animal agriculture is responsible for over 90 percent of all ammonia emissions; in turn, ammonia comprises more than 40 percent of the total estimated nitrogen emissions from all sources (Aneja et al., 1998).

Studies have been conducted to assess the direct and indirect contribution from wet atmospheric N deposition to the Neuse River Basin. The results of one such study completed in 2003 are provided in Table 75 below. The research indicates that atmospheric contributions of nitrogen vary seasonally and spatially within the watershed but that overall it accounts for approximately 24% of the total nitrogen load to the Neuse Estuary (Whitall & Paerl, 2003). These contributions have risen over the last twenty years.

While some of the land-based portion of this loading is addressed through stormwater rules and adjustments to crop fertilization rates, attaining the 30% reduction in nitrogen load to the Neuse Estuary may be challenging without first quantifying atmospheric contributions to the watershed more accurately, and eventually seeking appropriate management measures on all significant emission sources.

Table 75 Atmospheric Nitrogen Deposition Estimates for the Neuse Basin.

Metric	Nitrogen in (lbs/yr)
Total (from all Sources) N flux to the estuary	16,534,669
Atmospheric* N deposition to land areas in the Neuse Basin	37,258,122
Direct atmospheric* N deposition to the estuary	881,849
Estimated estuarine flux of indirect & direct atmospheric* N deposition	2,425,084 – 9,033,952

Note: * = Wet atmospheric N deposition only
Source: (Whitall et al., 2003)

There is very little data available on the concentrations of dry nitrogen deposition in the Neuse Basin. As with wet deposition, dry deposition rates are expected to vary across the basin depending on the proximity to the source. Initial research by the NC DAQ and EPA suggest that the amount of nitrogen contributed to an area from dry deposition is likely to be at least comparable to if not greater than that contributed through wet deposition.

Figures 57 and 58 below provide emission estimates from 2002 through 2018 that generated by the NCDAQ during a recent modeling effort to project emission of NO_x and NH_3 in North Carolina. The emission sources are broken down into four main categories in the graphs. Point sources are the large stationary sources that have permits and are required to submit emissions inventories periodically. Mobile source are the vehicle emissions that can use the highway networks, like cars and trucks. Nonroad mobile sources are sources that move but do not use the highway systems, like airplanes, railroad locomotives, construction equipment, lawn mowers, agricultural tractors, golf carts, etc. Area sources are small stationary sources that generally are too small to have permits, but combined could have substantial emissions. Emissions from CAFOs fall under the “Area” category for projected NH_3 emissions. The projections in Figure 57 show total NO_x emissions decreasing over time while Figure 58 shows total NH_3 emissions slightly increasing over time. The projections are not surprising considering that NO_x emissions are addressed through various current and planned regulations while NH_3 emissions go largely unregulated.

Figure 57 NOx Emission Trend

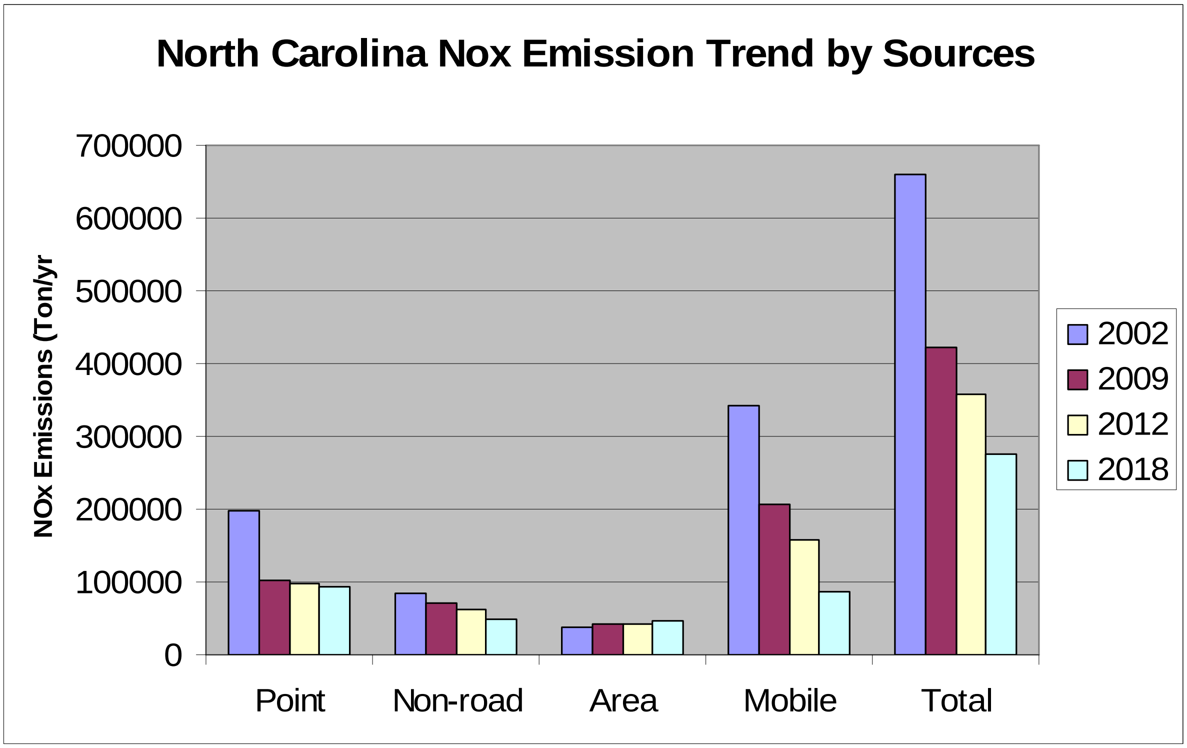
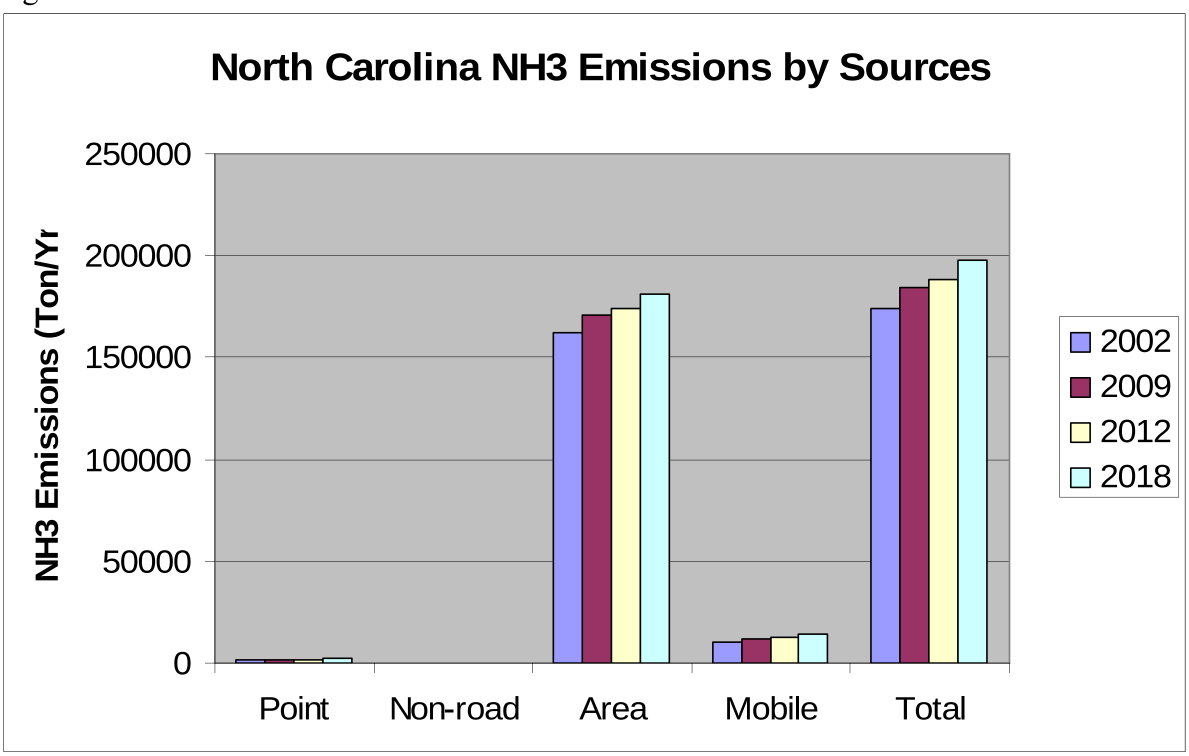


Figure 58 NH3 Emissions



In terms of regulating emissions, recent state and federal regulatory actions are projected to have a positive, reducing effect on NO_x in the coming years while NH_3 emissions remain largely unregulated. NO_x emissions are regulated federally, by USEPA, and in the state by the EMC through the Division of Air Quality. Both have enacted major new requirements on NO_x emissions from two key source types - stationary and mobile - in the last few years. These measures are expected to substantially reduce NO_x emissions in the coming years. Specifically, the laws adopted by the General Assembly in 2002, the Clean Smokestacks Act, and by EPA in 2005, and the pending temporary NO_x SIP Call Rule may combine to reduce NO_x emissions from stationary sources in the southeast by as much as 60% overall by 2014. For mobile sources, the EPA recently adopted "Tier 2" vehicle emissions and fuel standards that are projected to reduce vehicle NO_x emissions by up to 80% over the next 30 years as the current fleet of private and commercial vehicles phases out. Uncertainties associated with these improvements include the extent to which federal regulations in particular will be fully executed, and the relationship between reductions in NO_x emissions and correlated reductions in deposition.

Emissions from concentrated animal operations comprise the great majority of atmospheric ammonia emissions (Aneja et al., 1998). These outputs are not directly regulated currently. One recent improvement addresses new and expanding operations. In 2007 the legislature enacted a new law and the EMC is currently considering rule amendments to require animal waste systems that serve new and expanding swine farms to meet or exceed five performance standards. One of the standards requires such farms to "substantially eliminate atmospheric emission of ammonia." This performance standard specifically requires that "Swine waste management system ammonia emissions from the swine farm must not exceed an annual average of 1.0 kg NH_3 /wk/1,000 kg of steady state live weight." This new regulation may be expected to substantially cap NH_3 emissions from swine farms at current levels. However, it does not require reductions from existing operations, nor does it apply to other types of CAFOs, such as cattle and poultry operations. Thus NH_3 emissions from existing CAFOs remain the largest unregulated source of atmospheric nitrogen emissions.

Additional research and monitoring is needed to obtain a complete understanding of the magnitude and variability of all atmospheric nitrogen inputs into the Neuse Estuary. Due to the dynamic nature of the airshed, it is also necessary to develop a better understanding of the relationship between emission levels and deposition rates of atmospheric nitrogen. DWQ is working with DAQ staff to identify research opportunities. One such opportunity comes from DAQ modeling work using Community Multi-scale Air Quality modeling system (CMAQ) to conduct emissions modeling. The CMAQ modeling system simulates various chemical and physical processes that are thought to be important for understanding atmospheric trace gas transformations and distributions. The modeling system contains three types of modeling components: a meteorological modeling system for the description of atmospheric states and motions, emission models for man-made and natural emissions that are injected into the atmosphere, and a chemistry-transport modeling system for simulation of the chemical transformation and fate. It is possible that the use of an add-on tool to this model in the future may make it possible to use the output of this model to develop estimates of projected atmospheric nitrogen deposition rates.

24.3.8 Summary & Next Steps

Since full implementation of the nutrient reduction strategy was reached in 2003, nitrogen loads from point sources have been reduced by 65% and the agriculture community has reduced their estimated nitrogen loss from cropland and pastureland by approximately 45%. Over 1,850 fertilizer applicators have received nutrient management training and the fifteen local governments covered under the Neuse Stormwater Rule have all adopted and implemented local stormwater programs to limit nitrogen inputs from stormwater runoff resulting from new development. Despite this successful implementation, the goal of a 30 percent reduction in nitrogen loading does not appear to have been met, and the Neuse River Estuary impairment has increased in acreage.

The estuary is a very complex and dynamic system. Climatic variability plays an important role in the mobilization, processing, and delivery of nutrients to the Neuse estuary. The estuarine water quality response is affected by climatic events and this variability obscures clear trends in nutrient loading and the estuary's response to these loads, despite efforts to reduce point and non-point source loads. It is important to note that the data window for this basin plan cycle ends in 2006 and the assessment of progress under the strategy is based on just four years of post implementation water quality data (2003-2006) at this time. Due to the decades of chronic overloading, the time lag required for nonpoint source input reductions to be fully expressed, and the likelihood of nutrient cycling within the estuary, it may be some time before current reductions in nutrient loading will reflect in improved water quality, and before a definitive assessment of the effect of the strategy on the estuary can be made.

In light of the fact that trend evaluations suggest that the 30% reduction has not been met, and recognizing that certain sources are not addressed or not fully addressed under the current strategy, staff have begun an evaluation of the limitations of the current strategy and identified opportunities for developing a better understanding of the nutrient dynamics of this complex system. While we believe that further analysis of existing data and additional years of data collection will provide greater certainty as to the effect of the strategy on the estuary, we also recognize the limitations of the existing strategy and other basin factors that may contribute to the lack of improvement in the estuary. Listed below are the more overarching recommendations and research needs identified in this chapter which will be pursued during this next basin plan cycle. The action plan and time frames for implementing these recommendations is included in Table v of the basin plan summary.

Source Assessment and Trends

- Coordinate efforts with the Division of Air Quality to assess atmospheric nitrogen contributions to the watershed and develop recommendations on better ongoing characterization of atmospheric nitrogen deposition and emission source regulatory considerations.
  - Specifically address better characterization of the contribution of ammonia emissions from CAFO operations.

- Identify the need for additional monitoring locations and parameters to better characterize basin nutrient sources and relative contributions.

- Develop a more detailed analysis of current and historic data in order to better quantify the status of nutrient loading to the estuary; conduct additional trend and loading analysis upstream of the Neuse estuary focusing on smaller watersheds with dominant land use types; this will allow staff to better gauge the effectiveness and progress of strategy implementation.

- Lead in the development of the Falls of the Neuse Reservoir Nutrient Management Strategy per legislative timeline.

- Complete the CAFO monitoring plan rulemaking process.

- Review Neuse Buffer compliance assessment.

Stormwater Needs

- Develop a full assessment and recommendations on stormwater programmatic coverage gaps and need to meet nutrient strategy goals on new development activities. Include recommendations on most appropriate regulatory approach.
    - Designate new Phase II stormwater communities where criteria are appropriate.

    - Review Phase II stormwater permit holders to evaluate nutrient controls upon permit renewal or designation as Phase II if appropriate.

    - Assessment of stormwater Phase II and Neuse Stormwater permitting programs. Make recommendations on how to strengthen the current program to be more environmentally protective. Need to address hydrologic, sediment and nutrient issues.

    - Audit local stormwater programs for effectiveness and work with local governments to strengthen their implementation.

- Evaluate the magnitude of nitrogen loading in runoff from existing development areas and develop recommendations on the need to address this source under the strategy.

- Review stormwater and sediment and erosion control compliance activities; assess need for additional staff for inspection and enforcement needs.

Additional Issues

- Lead the interagency workgroup established to improve accounting of land use changes and net progress toward strategy goals.

- Evaluate regulatory issues associated with nutrient loading potential from high rate infiltration wastewater systems in the basin.

- Work with the Division of Coastal Management and the Clean Marina Program to assess the cumulative impacts of marinas and their impact on nutrient related water quality.

Research needs identified

- Develop monitoring to better characterize the nature, magnitude and trends in atmospheric and groundwater derived nutrient contributions to the Neuse estuary.

- Characterize the location, geographic extent and functionality of tile drains under agricultural fields.

- Quantify the potential magnitude of nutrient loading from spray fields, directly from animal housing and holding, and waste storage facilities on confined animal feeding operations (CAFOs).

- Characterize the geographic extent and quantify the potential magnitude of nutrient loading from dry litter poultry facilities, animal housing and waste storage.

- Characterize the potential for groundwater contamination and transport of nutrients from biosolids and wastewater land application fields to the surface waters of the Neuse Basin.

- Quantify the nitrogen contributions from conventional on-site wastewater treatment systems to surface waters of the Neuse Basin.

- Better quantification of BMP effectiveness (agricultural and stormwater BMPs); improve accounting tools.

- Characterize nutrient loading from various pasture management practices which leads to a better understanding of pasture's nutrient contributions and the value of different management options.

Voluntary Actions

- Require stormwater best management practices for existing and new development.

- Develop, strengthen and enforce riparian buffer ordinances.

- Develop and enforce local erosion control ordinances.

- Implement pet waste and residential fertilizer reduction ordinances.

- Work with local resource agencies to install appropriate BMPs in order to reduce the contribution of nutrient, sediment, bacteria and toxicants as well as addresses stormwater volume and velocity issues.
    - Community Conservation Assistance Program
    - Agriculture Cost Share Program
    - Conservation Reserve Enhancement Program

- Cultivate local champions in impaired watersheds toward initiating voluntary watershed projects.

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