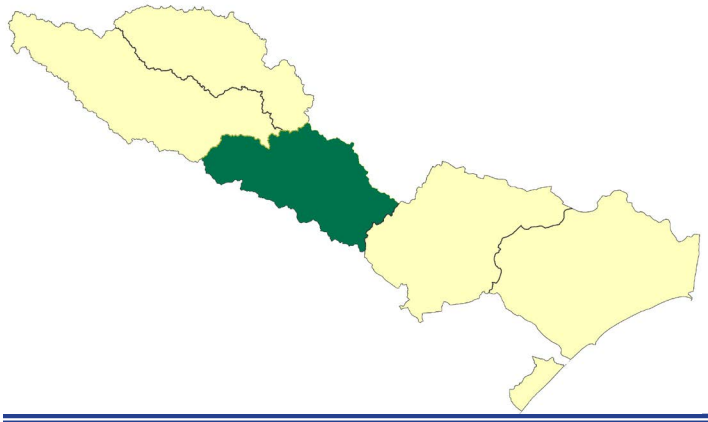


Overview

Lower Tar River Subbasin 03020103

General Subbasin Information

The Lower Tar River Subbasin, hydrologic unit code (HUC) 03020103, contains the mainstem Tar River from Tarboro downstream to Washington covering ~960 square miles; this area was previously delineated as DWQ subbasins 03-03-03, 03-03-05 and 03-03-06.

The western section of the Lower Tar River Subbasin lies within the Southeastern Plains ecoregion while the eastern portion is contained in the Middle Atlantic Coastal Plain ecoregion.

The middle section of the subbasin includes approximately 40 river miles of the Tar River from the confluence of Swift Creek in Edgecombe County to the confluence of Conetoe Creek in Pitt County. It also includes the catchments of Cokey Swamp, Ballahack Canal, and Bynums Mill, Conetoe, Crisp, Otter, and Town creeks. Land use is primarily forest and agriculture. Many streams in this area were channelized 35 or more years ago. The two areas with the greatest potential for impacts from agricultural nonpoint source pollution are the Cokey Swamp and Conetoe Creek catchments. Cokey Swamp also receives urban runoff from Rocky Mount.

The lower section of the subbasin includes approximately 35 river miles of the Tar River from the confluence of Conetoe Creek in Pitt County to just upstream of Washington, NC and the most downstream freshwater reach of the Tar River. It is located within the Mid-Atlantic Flatwoods and the Mid-Atlantic Floodplains and Low Terraces ecoregions. The mainstem of the Tar River here is deep, slow flowing and tidally influenced. Chicod Creek is the major tributary with the greatest potential for nonpoint source pollution. While runoff from crop and forage lands were historic problems in this watershed, an influx of intensive poultry and hog operations during the early 1990s has become the largest nonpoint concern. Tranters Creek is another major tributary, entering the lower Tar River just above Washington (at which point HUC 03020104 begins). Subwatersheds within the lower Tar River section of this subbasin include:

Subbasin at a Glance

Counties:

Nash, Edgecombe, Wilson, Martin, Pitt, Beaufort

Municipalities:

Rocky Mount, Sharpsburg, Elm City, Pinetops, Macclesfield, Tarboro, Princeville, Conetoe, Bethel, Parmele, Robersonville, Everetts, Bear Grass, Falkland, Fountain, Greenville, Simpson, Grimesland, Washington

Population:

2010 Census:..... 163,198

Drainage Area:

Lower Tar River:.....960 sq mi.

Impervious Surface:

Estimate:.....18 sq mi.

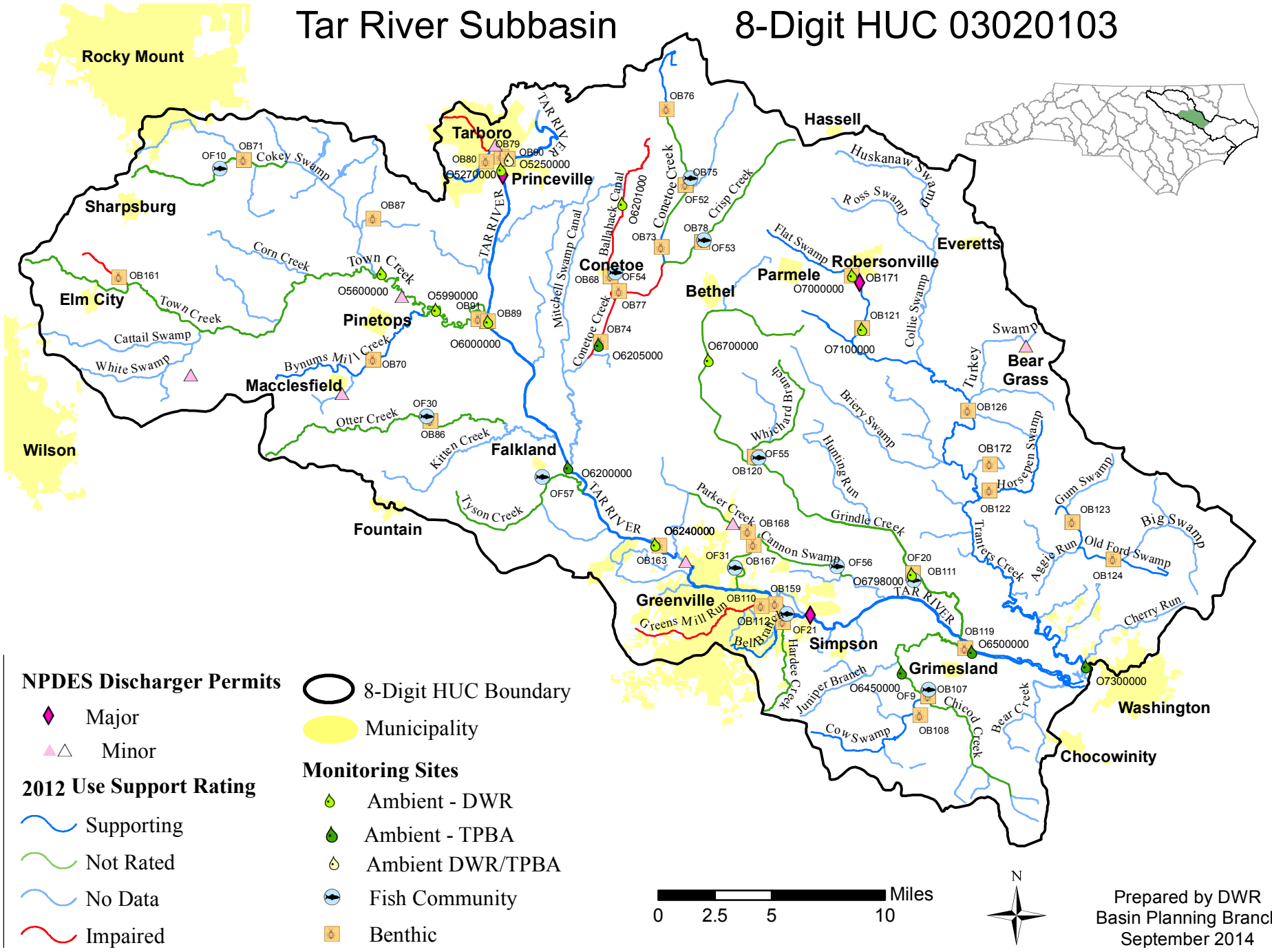
Classifications:

Freshwater Miles.....~612

Supplemental Classifications (miles):

B;NSW	10
C;NSW	397
C;Sw,NSW	154
WS-IV;NSW	50
WS-IV;NSW,CA	1

Classification descriptions are found at: http://portal.ncdenr.org/web/wq/ps/csu



NPDES Discharger Permits

- Major
- Minor

2012 Use Support Rating

- Supporting
- Not Rated
- No Data
- Impaired

- 8-Digit HUC Boundary
- Municipality

Monitoring Sites

- Ambient - DWR
- Ambient - TPBA
- Ambient DWR/TPBA
- Fish Community
- Benthic

Prepared by DWR
Basin Planning Branch
September 2014

Green Mill Run, Cannon, Flat, Old Ford and Horsepen swamps, Whichard Branch, Chicod, Grindle, Hardee, Parker, Tranters and Tyson creeks.

Due to the rural nature of the subbasin many of the water supply needs are provided by private groundwater wells; however, most of the incorporated towns in the subbasin maintain individually operated public water supply systems. These water systems obtain their water from both surface and groundwater sources. The primary source of surface water in the Lower Tar River subbasin for water supply systems is the Tar River {[(the Town of Tarboro)(2.956 MGD average in 2012)]and [(Greenville Utilities Commission (GUC))(12.846 MGD average in 2012)]}. Other public water supply systems in the subbasin are served by municipal groundwater wells and/or the Town of Tarboro or GUC. The other major withdrawers of surface waters within the subbasin are limited to mining, golf courses and agricultural operations.

Use Support History

Table 1: 03020103 - Subbasin Impairment Totals Based on 2008, 2010, 2012 and 2014 Integrated Reports

Impaired Parameter	2008 IR*		2010 IR*		2012 IR*		2014 IR*		Impairment Type
	# of AU's	Miles/ Acres	# of AU's	Miles/ Acres	# of AU's	Miles/ Acres	# of AU's	Miles/ Acres	
Low Dissolved Oxygen			1	13.9 m			1	13.9 m	Aquatic Life
Turbidity			1	8.4 m	1	8.4 m			Aquatic Life
Chlorophyll a							1	338 F a	Aquatic Life
Fecal Coliform	1	14.1 m							Recreational
Enterrococcus									Recreational
Copper									Aquatic Life
Zinc									Aquatic Life
Water Column Mercury									Aquatic Life
Biological Integrity - Macroinvertebrate	9	68.6 m	5	29.0 m	5	29.0 m	5	29.0 m	Aquatic Life
Mercury	All waters of the state are Impaired and fall under the Statewide TMDL: http://portal.ncdenr.org/web/wq/ps/mtu/tmdl/tmdls/mercury								Fish Consumption

*Note: There is not a direct comparison between the IR assessment periods. There could be methodology assessment changes (based on EPA guidance), splits in an assessment units (AU's) due to changes in the watershed or extent of an identified problem or corrections made.
m = miles; a = acres;

Population

The 2010 census estimated population for this subbasin is 163,198. As population increases so does our demand for clean water from aquifer and surface water sources and for the land and water to assimilate wastes. Population estimates for each watershed within this subbasin are listed in Table 2 below.

Table 2: Population Estimates of the Lower Tar Subbasin

10-Digit HUC	1990 Population	2000 Population	2010 Population	2010 Population Density (per sq mi)	2020 Estimated Population	2030 Estimated Population
0302010301	23,520	25,355	26,954	924	24,750	24,423
0302010302	17,764	15,709	17,680	599	13,402	12,284
0302010303	3,559	4,043	3,923	165	4,364	4,529
0302010304	43,822	50,117	57,252	3,302	69,813	79,587
0302010305	13,077	13,729	14,806	462	13,700	13,614
0302010306	23,500	32,692	42,582	1,240	44,940	50,984
03020103	125,243	141,646	163,198	6,692	170,969	185,420

*NC Office of State Budget and Management: http://www.osbm.state.nc.us/

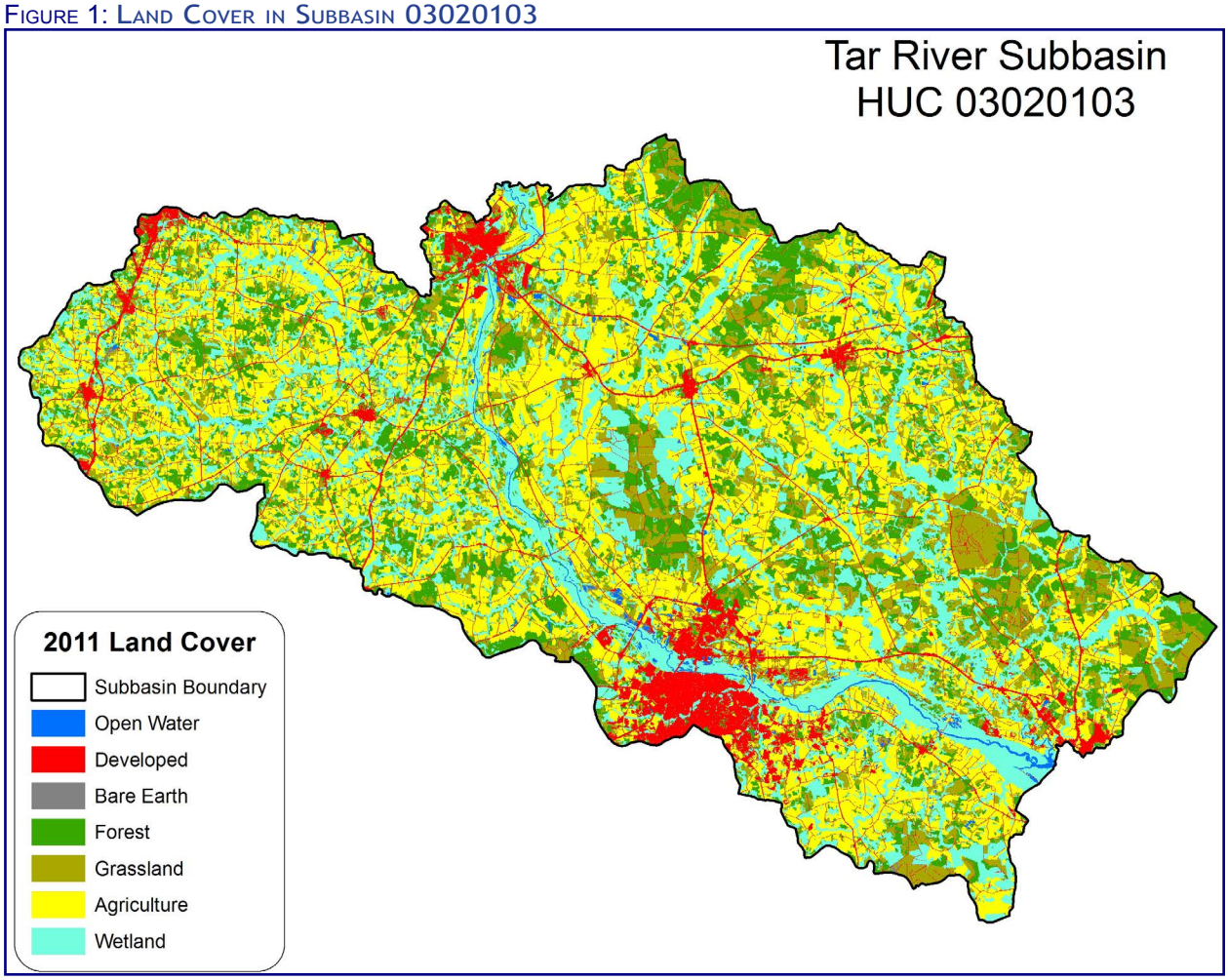
Land Use

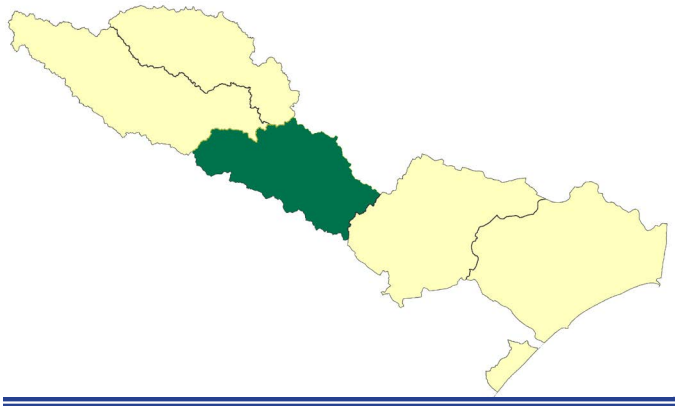
Waterfront development and agriculture continue to place increasing demands for achieving water quality and quantity. Data from the 2001 National Land Cover Database for this subbasin is presented in Table 3 and Figure 2.

Table 3: 2011 Land Cover Percentages

Land Cover Type	Percent
Developed Open Space	5.96
Developed Low Intensity	2.07
Developed Medium Intensity	0.92
Developed High Intensity	0.27
Total Developed	9.22
Bare Earth Transition	0.14
Deciduous Forest	1.79
Evergreen Forest	12.66
Mixed Forest	1.66
Total non-Wetland Forest	16.25
Scrub Shrub	10.69
Grassland Herbaceous	4.16
Pasture Hay	1.25
Cultivated Crops	36.86
Total Agriculture	52.96
Woody Wetlands	19.57
Emergent Herbaceous Wetland	2.01
Total Wetlands	21.58

Figure 1: Land Cover in Subbasin 03020103





Water Demand Projections

Lower Tar River Subbasin 03020103

OVERVIEW

Spurred in part by the Central Coastal Plain Capacity Use Area (CCPCUA) rules, the recent approval of the IBT Certificate for Greenville Utilities (GUC) to serve the Town of Farmville and Greene County has enabled GUC to become a more significant regional water supply provider. This increase in service area has compelled GUC to evaluate a myriad of water supply options to deal with the anticipated regional growth. According to the 2012 Local Water Supply Plan, GUC has determined that it needs to increase its water supply in the near-term (2019) an additional 13.5 million gallons per day (MGD) above the existing 22.5 MGD and long-term (2037) to a total water supply of 56.7 MGD. Evaluations to determine the best sources of these needed water supplies are ongoing. Based upon the current water supplies, the 2030 and 2060 OASIS hydrologic model scenarios estimate small water supply shortfalls for GUC.

Tar River Basin OASIS Hydrologic Model

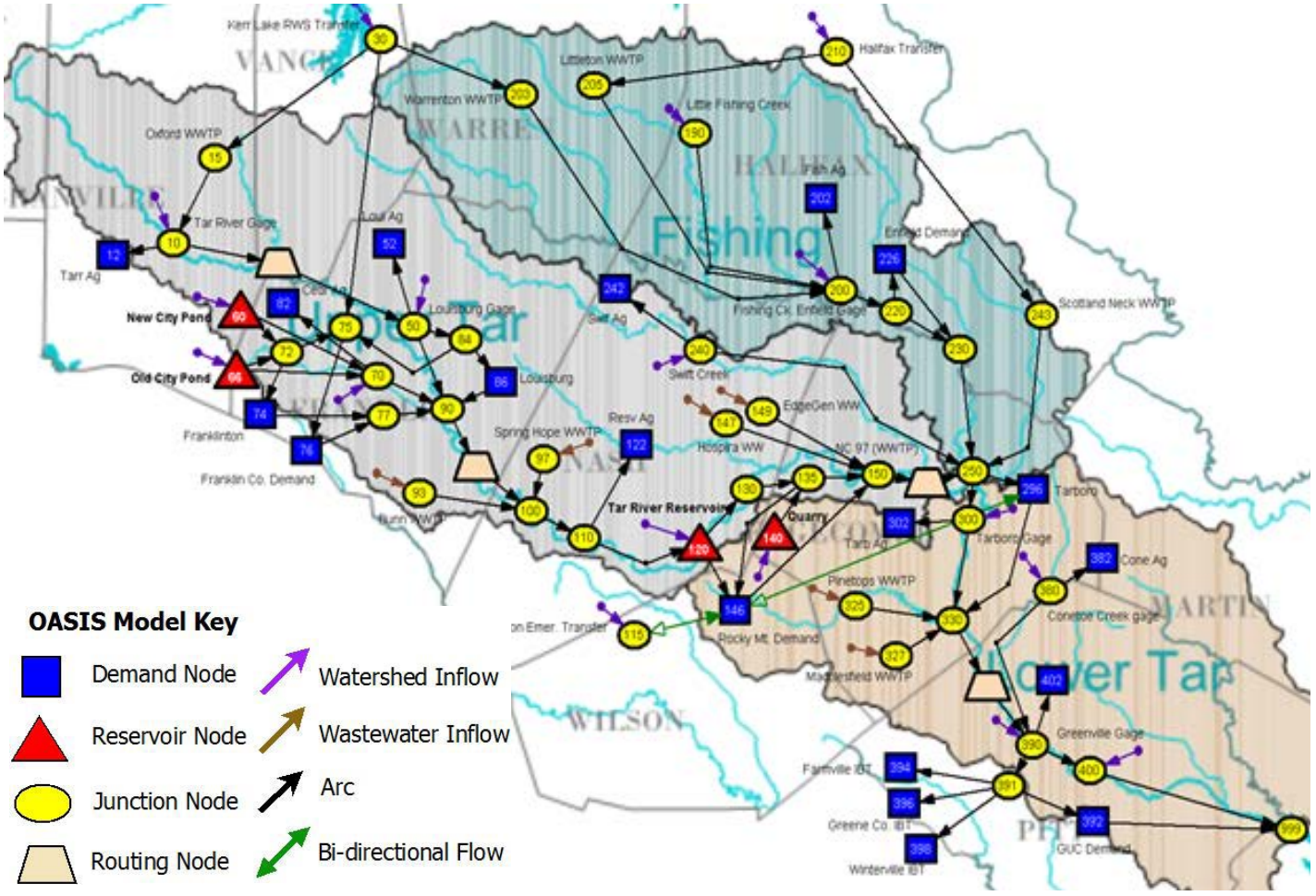
The model used for this analysis, the Tar River Basin Hydrologic Model, uses Operational Analysis and Simulation of Integrated Systems, or OASIS, developed by HydroLogics, Inc. The Tar River Basin Hydrologic Model is a computer- based mathematical model that simulates surface water flows in the Tar River Basin. It can be used to evaluate changes in water availability with changing water demands and operational protocols.

The geographic scope of the model extends from the headwaters of the upper Tar River and Fishing Creek, in eastern Person and Vance Counties, respectively, down to Greenville in lower Tar River, where the river becomes tidally influenced. The schematic map (figure 1) of the basin shows the geographic coverage of the model and the relative location of the various model nodes.

The model uses a set of estimated daily natural inflows to characterize the water entering the river system. The inflow dataset was developed using 80 years of flow records adjusted for known withdrawals, discharges, and reservoir operations. The portion of the Tar River basin covered by the model was subdivided into smaller drainage areas. An average daily inflow was estimated for each drainage area and for each of the more than 29,000 days in the 80 years of flow data.

Water is removed from the system at discrete withdrawal nodes shown as blue boxes on the model schematic. Withdrawals include water supply systems, industrial water users, or agricultural water usage. Public water supply withdrawals are based on local water supply plan data submitted to DWR by local water utilities. Self-supplied industrial water withdrawals were derived from data submitted under DWR's water withdrawal registration program.

Figure 1: Model Node Map



Model Schematic Definitions

1. Demand Nodes (blue square): Demand nodes are nodes to which water is delivered. Delivery to a demand node is a basic, built-in operating goal. The delivery may meet, but never exceed, a specified target value referred to simply as the demand. The deficit between delivery and demand is called shortage.

2. Reservoir Nodes (red triangle): Reservoir nodes are nodes at which water can be stored. OASIS computes the storage at the end of every time step, which is the storage at the beginning of the next time step. Maintaining storage at a reservoir node is a basic, built-in operating goal. OASIS has built-in features to model many types of rules associated with a reservoir node.

3. Junction Nodes (yellow ellipse): Junction nodes are the simplest type of nodes. Unlike demand or reservoir nodes, junction nodes are not automatically associated with any special operating rules. Therefore, there are no special input tables for junction nodes.

4. Routing Node (beige trapezoid): An innovative feature that simulates the routing of water by solving a linear program. Operating rules are expressed as operating goals or operating constraints.

5. Watershed Inflow (purple arrow): These denote water inflow such as streams and river tributaries entering into the system.

6. Wastewater Inflow (brown arrow): Captures inflow from a Wastewater Treatment Plant (WWTP) that gets water from a groundwater system or water sources outside of the model.

7. Arc (black arrow): Arcs represent conveyance from one node to another. In OASIS, every node must have at least one arc connecting to it.

8. Bi-directional Flow (green, two-ended arrow): Water can move in two directions

For modeling and analysis purposes the following definitions are used:

- Water demand **without** water shortage response plans (WSRP) considered in the model run is defined as the water use that is needed to meet demands when no water use restrictions are being required by a water shortage response plan.

- Water demand **with** water shortage response plans considered in the model run is defined as the water use that is needed to meet demands during the periods when the water shortage response plans are at the most severe mandatory level of restrictions measures.

In the model, 2010 conditions are used as the base case against which the scenarios of future demands and return flows are compared. Using the model to compare future demand conditions with the base case conditions, provides information to identify the possible impacts on reservoir water levels and stream flows at points of interest around the basin due to increasing surface water withdrawals. For this analysis, three different projected demand scenarios were modeled: a characterization of current conditions (2010) and two scenarios of future withdrawals based on withdrawals needed to meet estimated 2030 and 2060 demands.

A scenario based on water demands anticipated for the year 2030 was constructed using local water supply plan data and any updated projections received from water systems. While the levels of withdrawals included in this scenario are based on the estimated demands for 2030, this volume of withdrawals could occur before then, or in some year after 2030. Demands are assumed to follow future water use projections provided to the division by water withdrawers and the water systems that depend on them.

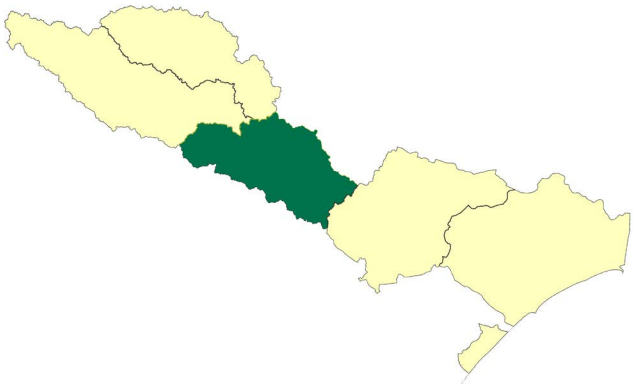
To project water use 50 years into the future, a scenario based on anticipated demands in 2060 was also evaluated. It is similar to the 2030 scenario, except that the water withdrawals are those expected to be needed to meet customers' water demands in the year 2060. Demand projections are based on information supplied to DWR in the local water supply plans and other registered water withdrawals. As with the 2030 scenario, the projected values are based on current understanding of the number of customers expected to be served and their expected demands for water in 2060.

Model Results

Table 1: Yield Summary for Available supplies

Model Scenario		All Water Needs Without WSRP				Essential Water Needs With WSRP			
Model Node	Water Systems	Avg Demand (mgd)	Avg Deficit (% of Demand)	Longest Deficit (Days)	No of Years Demand Not Met Out of 80	Avg Demand (mgd)	Avg Deficit (% of Demand)	Longest Deficit (Days)	No of Years Demand Not Met Out of 80
		2010				2010			
296	Tarboro	2.8	0.0%	0	0	2.8	0.00%	0	0
392	GUC	11.4	0.0%	0	0	11.4	0.00%	0	0
394	Farmville IBT	0.0	0.0%	0	0	0.0	0.00%	0	0
396	Greenville IBT	0.0	0.0%	0	0	0.0	0.00%	0	0
398	Winterville IBT	0.2	0.0%	0	0	0.2	0.00%	0	0
		2030				2030			
296	Tarboro	3.6	0.0%	0	0	3.6	0.0%	0	0
392	GUC	18.1	0.0%	10	1	18.1	0.0%	0	0
394	Farmville IBT	1.7	0.0%	11	1	1.7	0.0%	0	0
396	Greenville IBT	2.7	0.0%	10	1	2.7	0.0%	0	0
398	Winterville IBT	1.8	0.0%	11	1	1.8	0.0%	0	0
		2060				2060			
296	Tarboro	4.9	0.0%	0	0	4.9	0.00%	0	0
392	GUC	42.2	0.0%	12	3	42.2	0.02%	21	3
394	Farmville IBT	3.1	0.0%	21	3	3.1	0.00%	25	3
396	Greenville IBT	4.5	**0.2%**	**25**	**3**	4.5	**0.22%**	**25**	**3**
398	Winterville IBT	2.5	0.0%	15	3	2.5	**0.40%**	**27**	**7**

Note: average deficit <0.1% of demand is shown as 0.0%
Pink Highlighted= - Inadequate
Yellow Highlighted = Adequate with manageable deficits
WSRP= Water Shortage Response Plan (i.e., drought plan)



Monitoring Data

Lower Tar River Subbasin 03020103

Use Support Assessment Summary

All surface waters in the state are assigned a classification reflecting the best-intended use of that water. To determine how well waterbodies are meeting their best-intended uses chemical, physical, and biological parameters are regularly assessed by DWR. These data are used to develop use support ratings every two years as reported to EPA; a collected list of all monitored waterbodies and their water quality rating is called the Integrated Report (IR) and Impaired waters are also reported on the 303(d) list. Water quality evaluation levels and how a waterbody earns a rating of Supporting or Impaired is explained in detail in the IR methodology.

In this subbasin, use support was assigned for aquatic life, recreation, fish consumption and water supply categories. Waters are Supporting, Not Rated, or No Data in the aquatic life and recreation categories on a monitored or evaluated basis. All waters are Supporting in the water supply category on an evaluated basis based on reports from regional water treatment plant consultants. The Integrated Report provides a list of waterbodies in this subbasin and their most recent use support rating if monitored.

Ambient Data

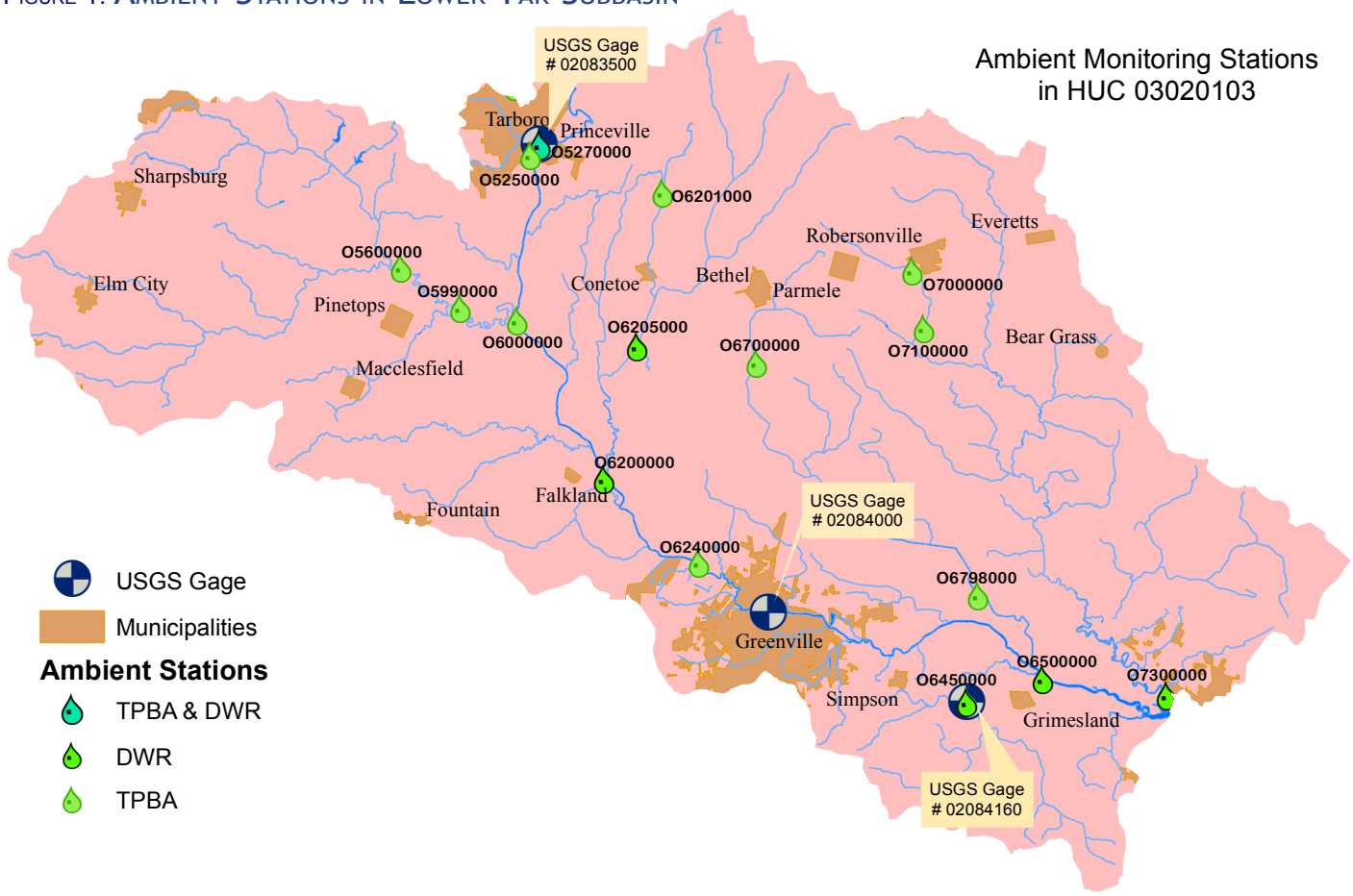
Subbasinwide, monthly chemical and physical samples are taken by DWR (6 stations) (note- due to limited personnel resources some DWR stations were reduced to quarterly monitoring) and by the Tar Pamlico Basin Association (10 stations) starting in 2007. A majority of the ambient stations are associated with waterbody locations where potential pollution could occur from known land use activities. There are also portions of the subbasin where no water quality data are collected; therefore, we cannot evaluate the condition of the water quality in those areas. Parameters collected depend on the waterbody classification, but typically include conductivity, dissolved oxygen, pH, temperature, turbidity, nutrient measurements, metals, and fecal coliform. Each classification has an associated set of standards the parameters must meet in order to be considered supporting the waterbody's designated uses. Ten sample results are required within the five year data collection window in order to evaluate the water quality parameter and compare it to the water quality standards. Stressors are either chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use. Ambient stations are listed in Table 1, and their locations are found in Figure 1.

Table 1: Ambient Stations in HUC 03020103

Station ID	Agency	Active Since	Waterbody	AU#	Station Location	Stressors
O5250000	Both	8/6/73	Tar River	28-(80)	NC 33 And US 64 Bus at Tarboro	Fecal Coliform Bacteria
O5600000	TPBA	3/1/07	Town Creek	28-83	NC 111 SR 1202 near Wiggins Crossroads	Low DO, Low pH
O5990000	TPBA	3/1/07	Town Creek	28-83	US 258 near Cobbs Crossroads	Low DO
O6000000	TPBA	3/1/07	Tar River	28-(80)	NC 42 at Old Sparta	Fecal Coliform Bacteria
O6200000	NCAMBNT	10/10/73	Tar River	28-(84)a	NC 222 near Falkland	-
O6201000	TPBA	3/1/07	Ballahack Canal	28-87-1.2	SR 1526 near Conetoe	Low DO, Low pH, Turbidity, Fecal Coliform Bacteria
O6205000	NCAMBNT	8/1/84	Conetoe Creek	28-87-(0.5)d	SR 1409 near Bethel	Low DO, Low pH
O6240000	TPBA	11/16/05	Tar River	28-(84)b	US 264 Byp near Greenville	-
O6450000	NCAMBNT	8/1/84	Chicod Creek	28-101	SR 1760 near Simpson	Low DO, Low pH, Fecal Coliform Bacteria
O6500000	NCAMBNT	7/5/68	Tar River	28-(99.5)	SR 1565 near Grimesland	
O6700000	TPBA	3/1/07	Grindle Creek	28-100a	SR 1427 near Bethel	Low pH, Fecal Coliform Bacteria
O6798000	TPBA	3/1/07	Grindle Creek	28-100b	US 264 at Pactolus	Low pH, Fecal Coliform Bacteria
O7000000	TPBA	3/1/07	Flat Swamp	28-103-2a	SR 1159 Third St at Robersonville	Fecal Coliform Bacteria
O7100000	TPBA	3/1/07	Flat Swamp	28-103-2b	SR 1157 near Robersonville	Fecal Coliform Bacteria
O7300000	NCAMBNT	10/10/73	Tranters Creek	28-103a	SR 1403 near Washington	-

TPBA= Tar Pamlico Basin Association, NCAMBNT= DWR
"-" indicates no stressors identified

Figure 1: Ambient Stations in Lower Tar Subbasin



USGS= United States Geological Survey, TPBA= Tar Pamlico Basin Association, DWR= Division of Water Resources

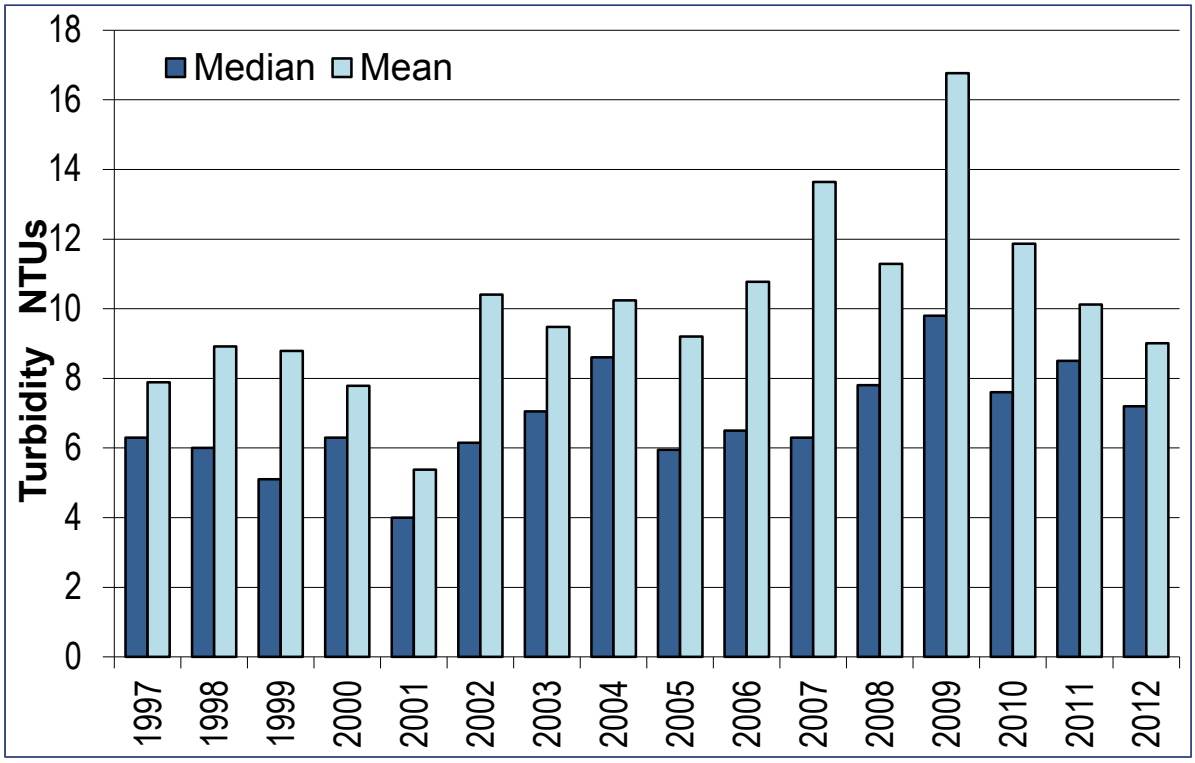
Water Quality Monitoring Parameters

The following discussion of ambient monitoring parameters includes graphs showing the median and mean concentration values for all ambient stations (n=16) in this subbasin for a specific parameter over each year (note: sample size increased with the addition of Tar Pamlico Basin Association sampling in 2007). These graphs are not intended to provide statistically significant trend information or loading numbers, but rather provide an idea of how changes in land use conditions, natural fluctuations, or climate changes effect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the dataset

Turbidity

The turbidity standard for freshwater streams is 50 NTUs. Turbidity is a measure of cloudiness in water and is often accompanied with excessive sediment deposits in the streambed. Excessive sediments deposited on stream and lake bottoms can choke spawning beds (reducing fish survival and growth rates), harm fish food sources, fill in pools (reducing cover from prey and high temperature refuges), and reduce habitat complexity in stream channels. Excessive suspended sediments can make it more difficult for fish to find prey and at high levels can cause direct physical harm, such as clogged gills. Sediments can cause taste and odor problems, block water supply intakes, foul treatment systems, and fill reservoirs.

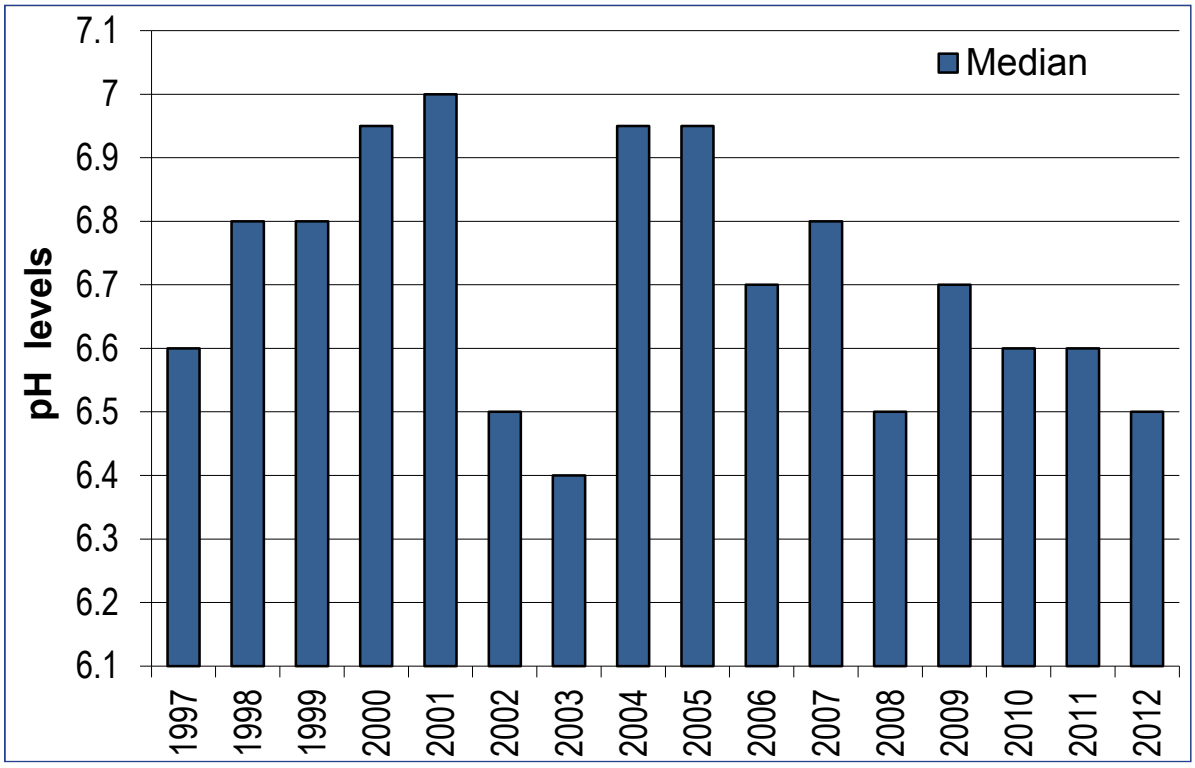
Figure 2: Summarized Turbidity values for all data collected at Ambient Stations in HUC 03020103



pH

The water quality standard for pH in surface freshwater is 6.0 to 9.0 standard units. Swamp water (supplement Class Sw) may have a pH as low as 4.3 if it is the result of natural conditions. pH is a measure of hydrogen ion concentration that is used to express whether a solution is acidic or alkaline (basic). Low values (< 7.0) can be found in waters rich in dissolved organic matter, such as swamp lands, whereas high values (> 7.0) may be found during algal blooms. Lower values can have chronic effects on the community structure of macroinvertebrates, fish and phytoplankton.

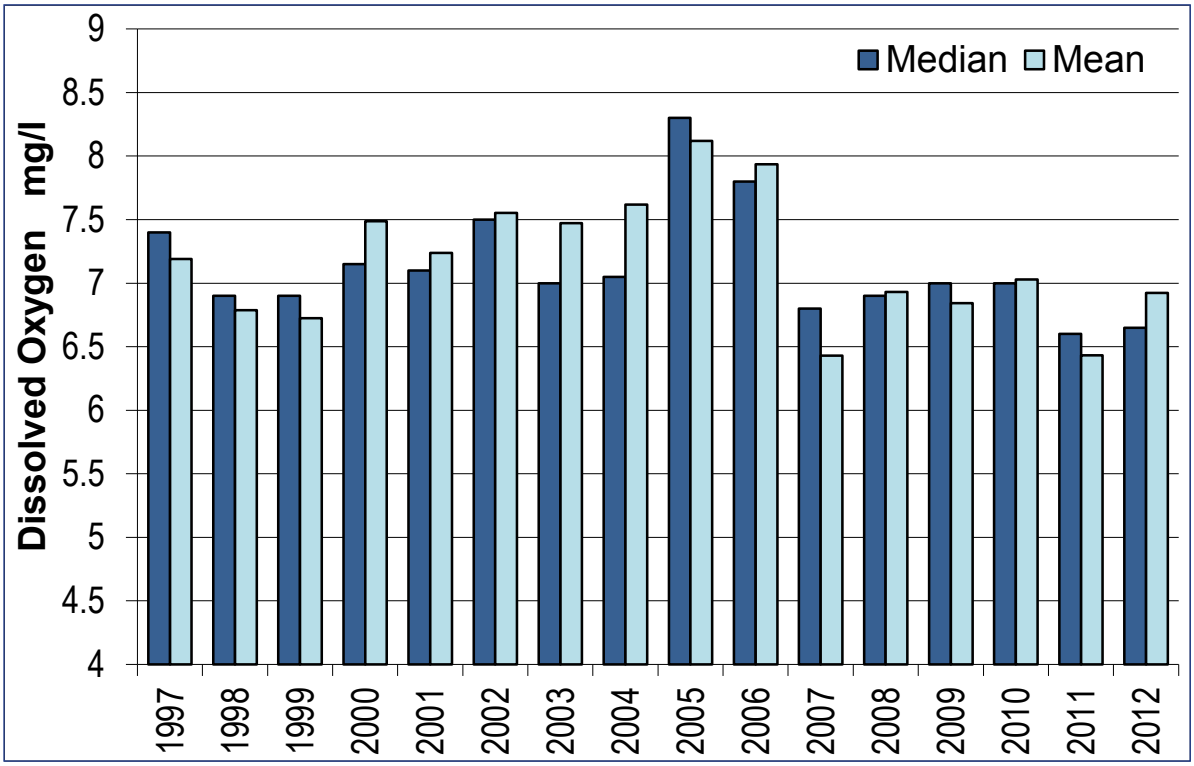
Figure 3: Summarized pH values for all data collected at Ambient Stations in HUC 03020103



Dissolved Oxygen

The dissolved oxygen (DO) water quality standard for freshwater is not less than a daily average of 5 mg/l or a minimum instantaneous value of not less than 4 mg/L. Swamp waters may have lower values if the low DO level is caused by natural conditions. Dissolved oxygen can be produced by wind or wave action that mix air into the water or through aquatic plant photosynthesis. During the day, DO levels are higher when photosynthesis occurs and they drop at night when respiration occurs by aquatic organisms. High levels are found mostly in cool, swift moving waters and low levels are found in warm, slow moving waters. In slow moving waters, such as reservoirs or estuaries, depth is also a factor. Wind action and plants can cause these waters to have a higher dissolved oxygen concentration near the surface, while biochemical reactions lower in the water column may result in concentration as low as zero at the bottom.

Figure 4: Summarized Dissolved Oxygen Levels for all data collected at Ambient Stations in HUC 03020103

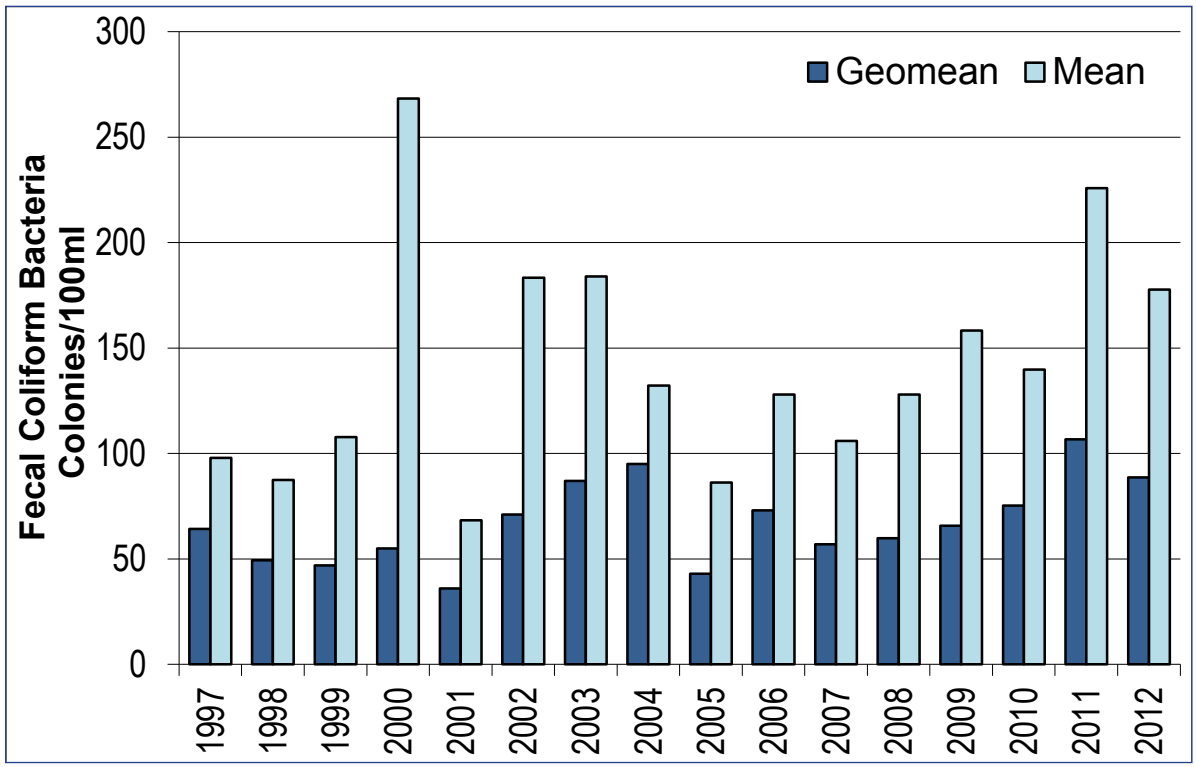


Fecal Coliform Bacteria

The fecal coliform bacteria standard for freshwater streams is not to exceed the geomean of 200 colonies/100ml or 400 colonies/100ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are to be used to indicate whether the stream is Impaired or Supporting. Waters with a classification of B (primary recreation water) will receive priority for 5-in-30 studies. Other waterbodies will be studied as resources permit.

The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of humans or other warm-blooded animals. At the time this occurred, the source water might have been contaminated by pathogens or disease producing bacteria or viruses that can also exist in fecal material. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

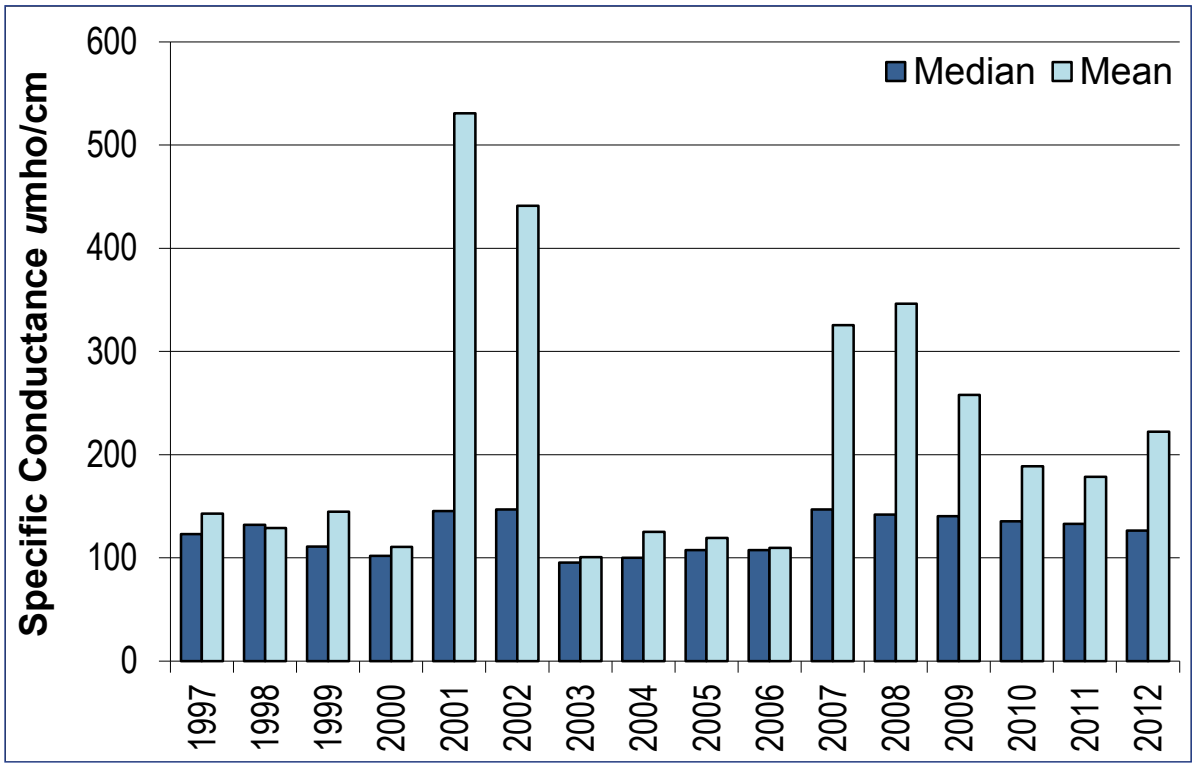
Figure 5: Summarized Fecal Coliform Bacteria for Data collected at Ambient Stations in HUC 03020103



Specific Conductance

Specific conductivity is a measure of the ability of water to pass an electrical current. Higher conductivity concentrations can be an indicator of pollutants associated with discharge of chlorides, phosphates, nitrates and other inorganic dissolved solids. There is no standard for specific conductance in NC.

Figure 6: Summarized Specific Conductance Levels for Data collected at Ambient Stations in HUC 03020103



Nutrient Enrichment

Compounds of nitrogen and phosphorus are major components of living organisms and thus are essential to maintain life. These compounds are collectively referred to as “nutrients”. Nitrogen compounds include ammonia as nitrogen (NH_3), Total Kjeldahl Nitrogen (TKN) and nitrite+nitrate nitrogen (NO_2+NO_3). Total nitrogen (TN) is the sum of TKN and NO_2+NO_3. Phosphorus is measured as total phosphorus (TP) by DWR. When nutrients are introduced to an aquatic ecosystem from municipal and industrial treatment processes or runoff from urban or agricultural land, the growth of algae and other plants may be accelerated. In addition to the possibility of causing algal blooms, ammonia-nitrogen may combine with high pH water to form ammonium hydroxide (NH_4OH), a form toxic to fish and other aquatic organisms.

Due to excessive levels of nutrients resulting in massive algal blooms and fish kills, the entire Tar-Pamlico River Basin was designated as Nutrient Sensitive Water (NSW) in 1989. This designation resulted in the development and implementation of a nutrient management strategy to achieve a decrease in TN by 30% and no increase in TP loads compared to 1991 conditions. Even though implementation of the strategy has occurred by wastewater treatment plant (WWTP) dischargers, municipal stormwater programs, and agriculture, nutrient enrichment continues to be cumulatively impacting the Pamlico Estuary.

Basin trend analyses were completed for nutrient concentration and flow-normalized loads to evaluate progress towards meeting TMDL reduction goals, as discussed in detail in the NSW report. The analyses at the AMS station O5250000 (Tarboro) detected a statistically significant increase in TKN concentration and a decrease in NH_3 and NO_2+NO_3. There were no detected trends for TN or TP concentrations at this site. Downstream at AMS site O6500000 (Grimesland) the analysis detected a statistically significant increase in TKN and TN concentrations and a decrease in NH_3 and NO_2+NO_3. There were no detected trends TP concentrations at the Grimesland site. TKN is defined as total organic nitrogen and NH_3. An increase in organic nitrogen is the likely source for the increase in TKN concentrations since NH_3 concentrations have decreased basinwide.

Figure 7: Summarized Total Phosphorus values for all data collected at Ambient Stations in HUC 03020103

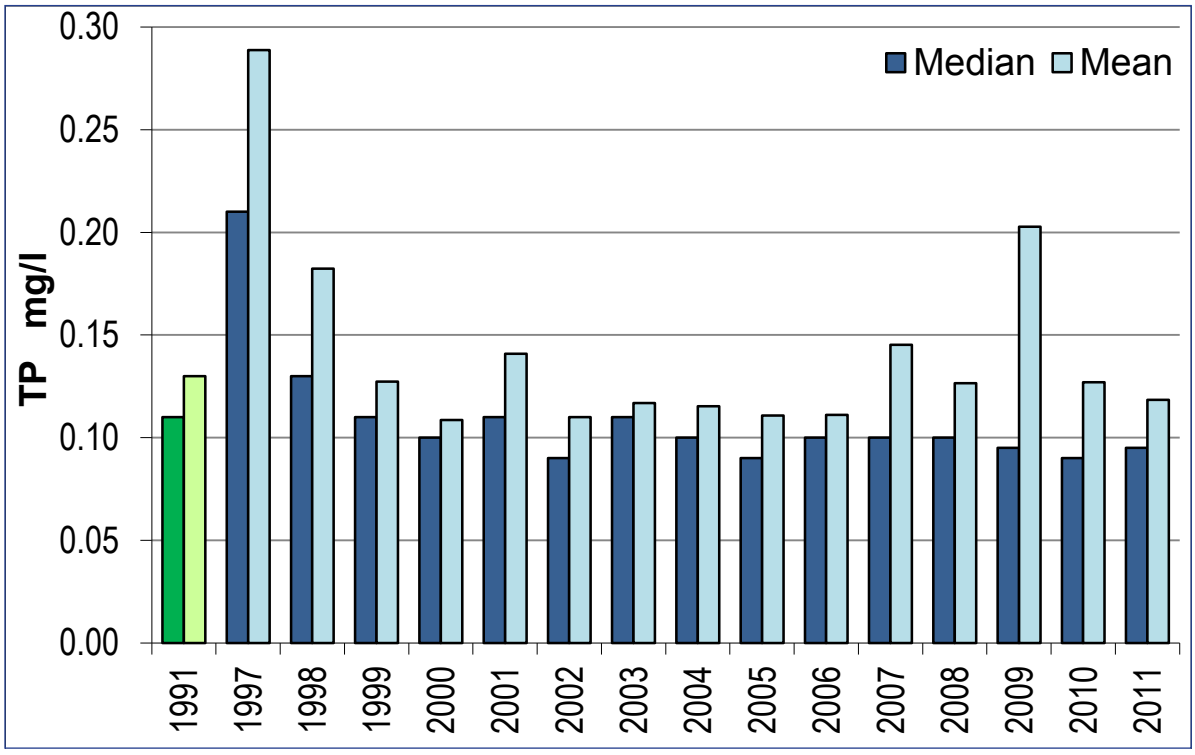


Figure 8: Summarized Total Nitrogen values for all data collected at Ambient Stations in HUC 03020103

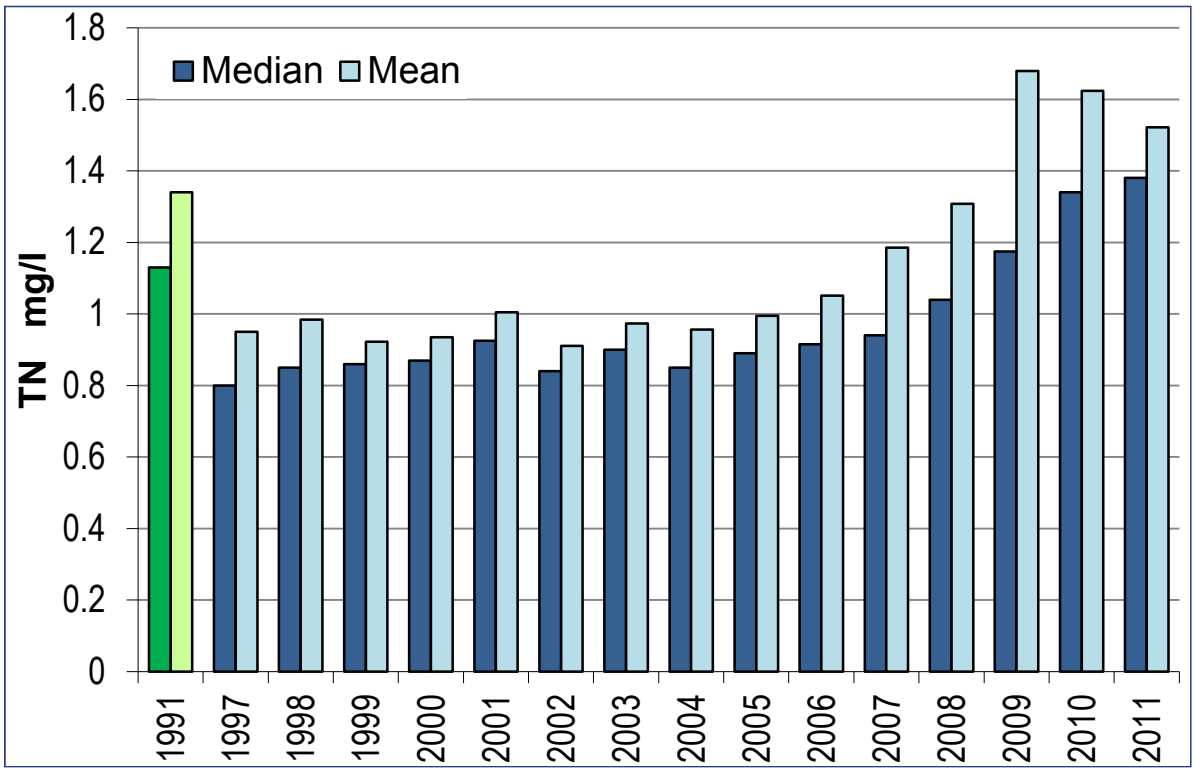
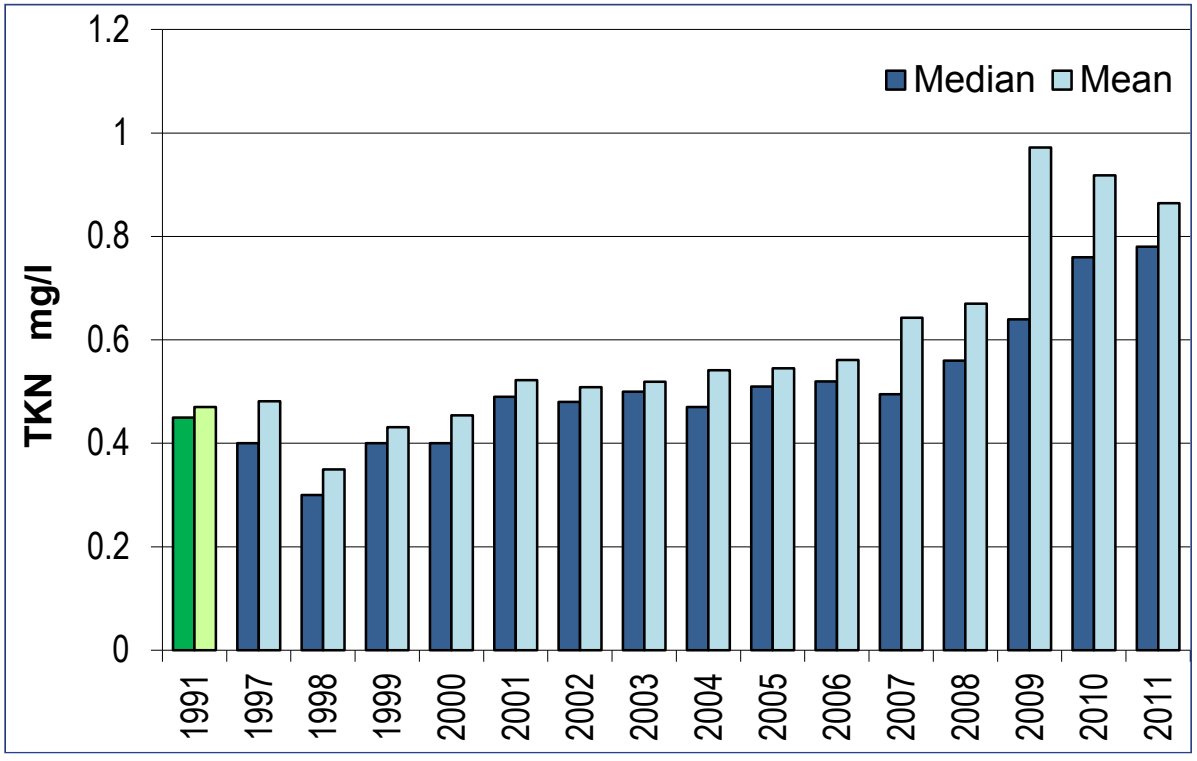


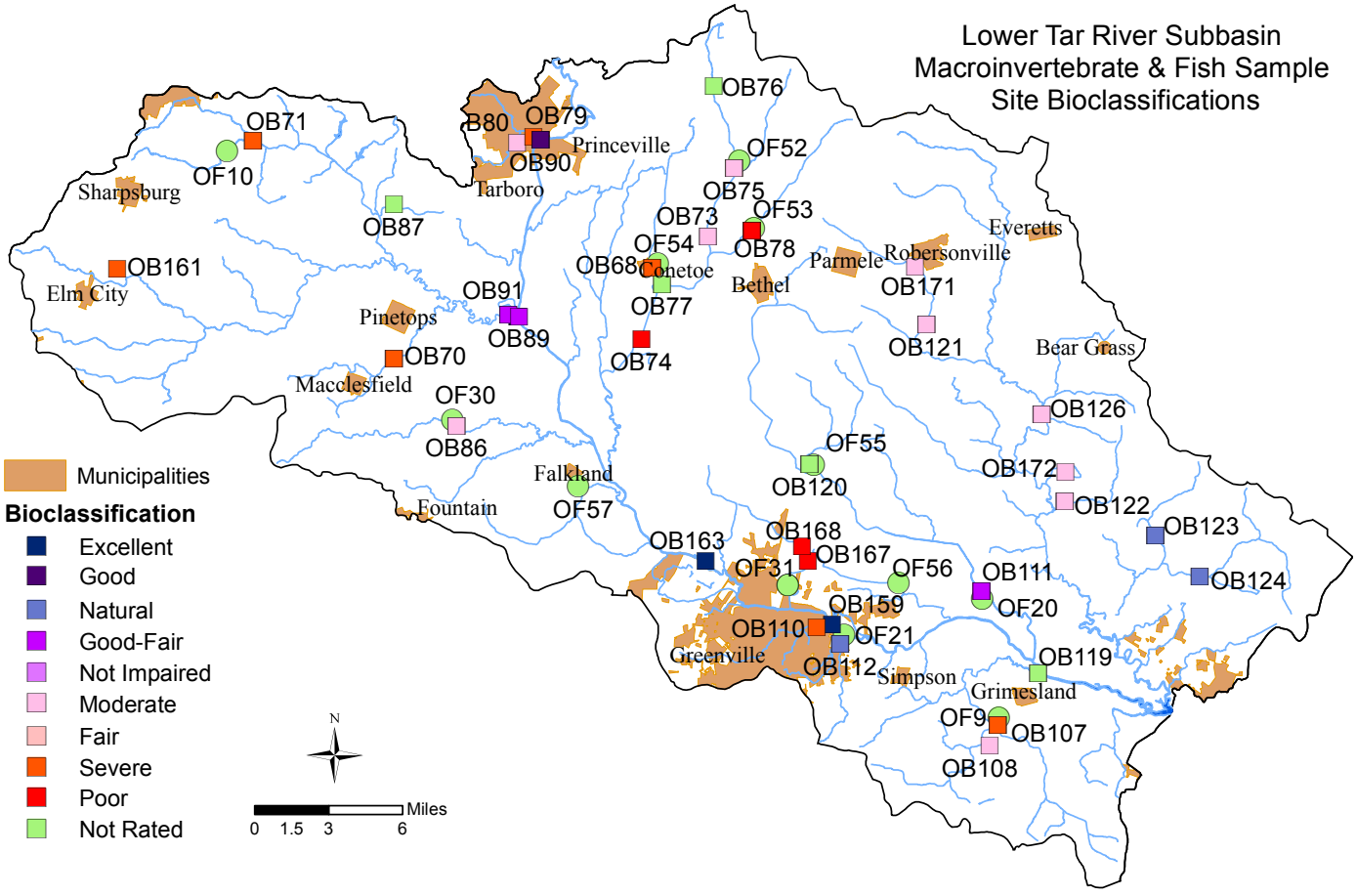
Figure 9: Summarized TKN concentrations for all Data collected in HUC 03020103



Biological Data

Biological samples were collected during the spring and summer months of 2012 as part of the basinwide sampling five year cycle. Fifteen benthic macroinvertebrate sites and no fish community sites were sampled as part of the basinwide sampling cycle. The 2012 basin sampling efforts were greatly reduced compared to previous years primarily because of the lack of personnel resources. The limited data shows four sites with improvements and four sites with declining bioclassifications since the 2007 sample period. Tables 2 and 3 provide summaries of most recent sample results and a description of the stream location corresponding to Figure 10.

Figure 10: HUC 03020103 Macroinvertebrate & Fish Sites Sampled between 2000-2012



Benthos Community Sampling Summary

Table 2: Benthos Biological Sample Results in HUC 03020103

Site ID*	Waterbody	Description	Location	County	AU#.	Date	BioClass
OB87	Sasnet Mill Br	From source to Cokey Swamp	SR 1222	Edgecombe	28-83-3-3	2/7/01	NotRated
OB161 Special Study	UT Town Cr	From source to Town Creek	SR1400	Wilson	28-83ut8	2/7/07	Severe

Site ID*	Waterbody	Description	Location	County	AU#.	Date	BioClass
OB91	Town Cr	From source to Tar River	SR 1601	Edgecombe	28-83	2/26/12 6/27/07	Good-Fair Good
OB80	Holly Cr	From source to Hendricks Creek	US 64A	Edgecombe	28-81-1	3/1/04	Moderate
OB79	Hendricks Cr	From source to Tar River	St James St	Edgecombe	28-81	3/1/04	Severe
OB90	Tar R	From Tarboro Raw Water Supply Intake to Suggs Creek	US 64 BUS	Edgecombe	28-(80)	6/26/12 6/27/07	Good Good
OB89	Tar R	From Tarboro Raw Water Supply Intake to Suggs Creek	NC 42	Edgecombe	28-(80)	6/26/12 6/28/07	Good-Fair Excellent
OB163 Special Study	Tar R	From 030303/030305 boundary to Johnsons Mill Creek	US 264	Pitt	28-(84)b	6/25/07	Excellent
OB159	Tar R	From Greenville Raw Water Supply Intake to 1.2 miles downstream of the mouth of Broad Run	US 264A	Pitt	28-(94)	6/25/07	Excellent
OB119	Tar R	From a point 1.2 miles downstream of the mouth of Broad Run to the upstream side of the mouth of Tranters Creek	SR 1565	Pitt	28-(99.5)	6/26/07	Good-Fair
OB91	Town Cr	From source to Tar River	SR 1601	Edgecombe	28-83	6/27/07	Good
OB71	Cokey Swp	From source to Dickson Branch	NC 43	Edgecombe	28-83-3a	1/6/12 2/8/07	Severe Moderate
OB70	Bynums Mill Cr	From source to Town Creek	SR 1120	Edgecombe	28-83-4	2/6/12 2/7/07	Moderate Moderate
OB86	Otter Cr	From source to a point 0.7 mile upstream of Kitten Creek	SR 1614	Edgecombe	28-86-(0.3)	2/6/12 2/7/07	Moderate Moderate
OB76	Conetoe Cr	From source to SR 1516	SR 1516	Edgecombe	28-87-(0.5)a	2/6/01	NotRated
OB75	Conetoe Cr	From SR 1516 to 1350 meters North of NC 42	SR 1510	Edgecombe	28-87-(0.5)b	2/7/12 2/6/07	Moderate Moderate
OB73	Conetoe Cr	From 1350 meters North of NC 42 to Crisp Creek	NC 42	Edgecombe	28-87-(0.5)c	2/6/07	Moderate
OB77	Conetoe Cr	From Crisp Creek to Pitt County SR 1404	US 64A	Pitt	28-87-(0.5)d	2/7/12 2/6/01	NotRated Fair

Revised 11/26/14

Site ID*	Waterbody	Description	Location	County	AU#.	Date	BioClass
OB74 special study	Conetoe Cr	From Crisp Creek to Pitt County SR 1404	SR 1409	Pitt	28-87-(0.5) d	11/2/00	Poor
OB78	Crisp Cr	From source to Conetoe Creek	SR 1527	Edgecombe	28-87-1	2/7/12 2/6/07	Severe Moderate
OB68	Ballahack Canal	From source to Conetoe Creek	NC 42	Edgecombe	28-87-1.2	2/6/07	Severe
OB168	Parker Cr	From source to Tar River	SR 1579	Pitt	28-95	6/25/09	Poor
OB167	Parker Cr	From source to Tar River	SR 1591	Pitt	28-95	6/25/09	Poor
OB110	Greens Mill Run	From source to Tar River	Greensprings Park	Pitt	28-96	3/2/04	Severe
OB112	Hardee Cr	From source to Tar River	NC 33	Pitt	28-97	2/27/12 2/14/07	Moderate Natural
OB111	Grindle Cr	From Whichard Branch to Tar River	US 264	Pitt	28-100b	6/27/12 6/25/07	Good-Fair Good-Fair
OB120	Whichard Br	From source to Grindle Creek	SR 1521	Pitt	28-100-2	2/13/07	Moderate
OB107	Chicod Cr	From source to Tar River	SR 1777	Pitt	28-101	2/27/12 2/14/07	Moderate Natural
OB108	Cow Swp	From source to Chicod Creek	SR 1756	Pitt	28-101-5	3/2/04	Moderate
OB126	Tranters Cr	From source to subbasin 030305/030306 boundary	SR 1552	Edgecombe	28-103a	2/29/12 2/13/07	Moderate Moderate
OB121	Flat Swp	From 1.5 miles downstream of Robersonville WWTP discharge to Tranters Creek	SR 1157	Martin	28-103-2b	2/13/07	Moderate
OB124	Old Ford Swp	From source to Aggie Run	US 17	Beaufort	28-103-14-1	2/12/07	Moderate
OB123	Lathams Cr	From source to Aggie Run	SR 1410	Beaufort	28-103-14-2	2/28/12 2/12/07	Moderate Natural
OB122	Horsepen Swp	From source to Tranters Creek	SR 1001	Beaufort	28-103-10	2/28/12 2/13/07	Moderate Moderate

Bioclassification of Excellent, Good, Natural, Good-Fair, Not Impaired or Moderate Stress = Supporting
Fair, Severe, Severe Stress or Poor = Impaired

Fish Community Sampling Summary

Table 3: Fish Community Sample Results in HUC 03020103

Site ID*	Waterbody	Description	Location	County	AU#	Date	NCIBI Rating
OF9	Chicod Cr	From source to Tar River	SR 1777	Pitt	28-101	4/16/02	Not Rated
OF10	Cokey Swp	From source to Dickson Branch	SR 1135	Edgecombe	28-83-3a	5/09/07	Not Rated
OF20	Grindle Cr	From Whichard Branch to Tar R	US 264	Pitt	28-100b	4/16/02	Not Rated
OF21	Hardee Cr	From source to Tar River	NC33	Pitt	28-97	4/16/02	Not Rated
OF30	Otter Cr	From source to a point 0.7 mile upstream of Kitten Cr.	SR 1614	Edgecombe	28-86-(0.3)	4/17/02	Not Rated
OF52	Conetoe Cr	From SR 1516 to 1350 meters North of NC 42	SR 1510	Edgecombe	28-87-(0.5) b	5/09/07	Not Rated
OF53	Crisp Cr	From source to Conetoe Creek	SR 1527	Edgecombe	28-87-1	5/09/07	Not Rated
OF54	Ballahack Canal	From source to Conetoe Creek	NC 42	Edgecombe	28-87-1.2	5/09/07	Not Rated
OF57	Tyson Cr	From source to Tar River	SR 1255	Pitt	28-88	5/10/07	Not Rated
OF31	Parker Cr	From source to Tar River	NC 33	Pitt	28-95	5/10/07	Not Rated
OF56	Cannon Swp	From source to Moyes Run	US 264	Pitt	28-99-1-1	5/10/07	Not Rated
OF55	Whichard Br	From source to Grindle Creek	SR 1521	Pitt	28-100-2	5/10/07	Not Rated

Not Rated = Fish community metrics and criteria have yet to be developed for Coastal Plain streams

Tar-Pamlico River Basin 10-digit Watershed 0302010301 Town Creek

> AU Number	Name	Description	Length or Area	Units	Classification	Category

Category	Rating	Use	Reason for Rating	Parameter	Year

Tar-Pamlico River Basin **8-digit Subbasin** 03020103 Tar River

Tar-Pamlico River Basin 10-digit Watershed 0302010301 Town Creek

12-digit Subwatershed 030201030107 Lower Town Creek

>								
>	**28-(80)**	**TAR RIVER**	**From Tarboro Raw Water Supply Intake to Suggs Creek**	**14.8**	**FW Miles**	**C;NSW**	**2**

1	Supporting	Aquatic Life	Excellent Bioclassificatio	Ecological/biological Integrity Benthos
1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)

>								
>	**28-83-4**	**Bynums Mill Creek**	**From source to Town Creek**	**9.7**	**FW Miles**	**C;NSW**	**2**

1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos

12-digit Subwatershed 030201030104 Outlet Cokey Swamp

>								
>	**28-83-3a**	**Cokey Swamp**	**From source to Dickson Branch**	**8.6**	**FW Miles**	**C;NSW**	**3**

3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity FishCom
1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos

12-digit Subwatershed 030201030102 Upper Town Creek

>								
>	**28-83**	**Town Creek**	**From source to Tar River**	**36.2**	**FW Miles**	**C;NSW**	**3**

3a	Not Rated	Aquatic Life	Data Inconclusive	Low Dissolved Oxygen
3a	Not Rated	Aquatic Life	Data Inconclusive	Low pH
1	Supporting	Aquatic Life	Good Bioclassification	Ecological/biological Integrity Benthos
1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)

>								
>	**28-83ut8**	**UT to Town Creek**	**From source to Town Creek**	**2.6**	**FW Miles**		**5**

5	Impaired	Aquatic Life	Severe Bioclassification	Ecological/biological Integrity Benthos	2010

Tar-Pamlico River Basin 10-digit Watershed 0302010302 Otter Creek-Tar River

Tar-Pamlico River Basin | 10-digit Watershed | 0302010302 | Otter Creek-Tar River

>	AU Number	Name	Description	Length or Area	Units	Classification	Category
	Category	Rating	Use	Reason for Rating	Parameter	Year	
			12-digit Subwatershed	030201030201			City of Tarboro-Tar River
>	**28-(74)b**	**TAR RIVER**	**From subbasin 030302/030303 boundary to a point 0.5 mile upstream of Tarboro Water Supply Intake**	**21.0**	**FW Miles**	**WS-IV;NSW**	**2**
	1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)		
>	**28-79-(30.5)**	**Fishing Creek**	**From a point 1.7 miles downstream of Beech Swamp to Tar River**	**17.1**	**FW Miles**	**WS-IV;NSW**	**2**
	1	Supporting	Aquatic Life	Excellent Bioclassificatio	Ecological/biological Integrity Benthos		
	1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)		
			12-digit Subwatershed	030201030203			Otter Creek
>	**28-86-(0.3)**	**Otter Creek**	**From source to a point 0.7 mile upstream of Kitten Creek**	**13.9**	**FW Miles**	**C;NSW**	**3**
	3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity FishCom		
	1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos		
			12-digit Subwatershed	030201030202			Town Creek-Tar River
>	**28-81**	**Hendricks Creek**	**From source to Tar River**	**3.9**	**FW Miles**	**C;NSW**	**5**
	5	Impaired	Aquatic Life	Severe Bioclassification	Ecological/biological Integrity Benthos	2008	
>	**28-81-1**	**Holly Creek**	**From source to Hendricks Creek**	**3.2**	**FW Miles**	**C;NSW**	**2**
	1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos		

Tar-Pamlico River Basin | 10-digit Watershed | 0302010303 | Conetoe Creek

			12-digit Subwatershed	030201030303			Fountain Fork Creek-Middle Conetoe Creek
>	**28-87-(0.5)b**	**Conetoe Creek**	**From SR 1516 to 1350 meters North of NC 42**	**5.9**	**FW Miles**	**C;NSW**	**3**
	3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity FishCom		
	1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos		

Tar-Pamlico River Basin | 10-digit Watershed | 0302010303 | Conetoe Creek

>	AU Number	Name	Description	Length or Area	Units	Classification	Category
	Category	Rating	Use	Reason for Rating	Parameter	Year	
>	28-87-(0.5)c	**Conetoe Creek**	From 1350 meters North of NC 42 to Crisp Creek	1.5	FW Miles	C;NSW	2
	1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos		
>	28-87-(0.5)d	**Conetoe Creek**	From Crisp Creek to Pitt County SR 1404	6.7	FW Miles	C;NSW	5
	3a	Not Rated	Aquatic Life	Data Inconclusive	Low Dissolved Oxygen		
	3a	Not Rated	Aquatic Life	Data Inconclusive	Low pH		
	5	Impaired	Aquatic Life	Fair Bioclassification	Ecological/biological Integrity Benthos	1998	
	1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)		
>	28-87-1	**Crisp Creek**	From source to Conetoe Creek	8.7	FW Miles	C;NSW	3
	3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity FishCom		
	1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos		

12-digit Subwatershed 030201030305 Lower Conetoe Creek

>							
>	28-87-1.2	**Ballahack Canal**	From source to Conetoe Creek	8.4	FW Miles	C;NSW	5
	5	Impaired	Aquatic Life	Standard Violation	Turbidity	2006	
	3a	Not Rated	Aquatic Life	Data Inconclusive	Low Dissolved Oxygen		
	3a	Not Rated	Aquatic Life	Data Inconclusive	Low pH		
	3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity FishCom		
	5	Impaired	Aquatic Life	Severe Bioclassification	Ecological/biological Integrity Benthos	2006	
	3a	Not Rated	Recreation	Potential Standards Viol	Fecal Coliform (recreation)		

12-digit Subwatershed 030201030301 Upper Conetoe Creek

>							
>	28-87-(0.5)a	**Conetoe Creek**	From source to SR 1516	3.9	FW Miles	C;NSW	2
	1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos		

Tar-Pamlico River Basin	10-digit Watershed	0302010304	City of Greenville-Tar River

> AU Number	Name	Description	Length or Area	Units	Classification	Category
Category	Rating	Use	Reason for Rating	Parameter	Year	

Tar-Pamlico River Basin	10-digit Watershed	0302010304	City of Greenville-Tar River
	12-digit Subwatershed	030201030404	City of Greenville-Tar River

>	AU Number	Name	Description	Length or Area	Units	Classification	Category
>	**28-(94)**	**TAR RIVER**	**From Greenville Raw Water Supply Intake to a point 1.2 miles downstream of the mouth of Broad Run**	**13.1**	**FW Miles**	**C;NSW**	**2**
	1	Supporting	Aquatic Life	Excellent Bioclassificatio	Ecological/biological Integrity Benthos		
>	**28-95**	**Parker Creek**	**From source to Tar River**	**7.3**	**FW Miles**	**C;NSW**	**3**
	3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity FishCom		
	3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity Benthos		
>	**28-96**	**Greens Mill Run**	**From source to Tar River**	**7.3**	**FW Miles**	**C;NSW**	**5**
	5	Impaired	Aquatic Life	Severe Bioclassification	Ecological/biological Integrity Benthos	2008	

	12-digit Subwatershed	030201030401	Tyson Creek-Tar River

>	AU Number	Name	Description	Length or Area	Units	Classification	Category
>	**28-(84)a**	**TAR RIVER**	**From Suggs Creek to Subbasin 030303/030305 boundary**	**6.3**	**FW Miles**	**WS-IV;NSW**	**2**
	1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)		
>	**28-(84)b**	**TAR RIVER**	**From 030303/030305 boundary to Johnsons Mill Creek**	**7.4**	**FW Miles**	**WS-IV;NSW**	**2**
	1	Supporting	Aquatic Life	Excellent Bioclassificatio	Ecological/biological Integrity Benthos		
	1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)		
>	**28-88**	**Tyson Creek (King Creek) (Harris Mill Pond)**	**From source to Tar River**	**8.7**	**FW Miles**	**WS-IV;NSW**	**3**
	3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity FishCom		

Tar-Pamlico River Basin	10-digit Watershed	0302010305	Tranters Creek
	12-digit Subwatershed	030201030506	Aggie Run

Tar-Pamlico River Basin | 10-digit Watershed 0302010305 | Tranters Creek

>	AU Number	Name	Description	Length or Area	Units	Classification	Category
	Category	Rating	Use	Reason for Rating	Parameter	Year	
>	28-103-14-1	**Old Ford Swamp**	From source to Aggie Run	5.1	FW Miles	C;Sw,NSW	2
	1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos		
>	28-103-14-2	**Latham Creek**	From source to Aggie Run	2.7	FW Miles	C;Sw,NSW	2
	1	Supporting	Aquatic Life	Natural Bioclassification	Ecological/biological Integrity Benthos		
			12-digit Subwatershed 030201030507			Cherry Run-Lower Tranters Creek	
>	28-(102.5)	**TAR RIVER (River Segment)**	From the upstream side of the mouth of Tranters Creek to mouth at U.S. Hwy. 17 bridge at Washington	338.0	FW Acres	C;NSW	2
	1t	Supporting	Aquatic Life	No Criteria Exceeded	Chlorophyll a	2006	
	1	Supporting	Aquatic Life	No Criteria Exceeded	Water Quality Standards Aquatic Life		
>	28-(99.5)	**TAR RIVER**	From a point 1.2 miles downstream of the mouth of Broad Run to the upstream side of the mouth of Tranters Creek	10.3	FW Miles	B;NSW	2
	1	Supporting	Aquatic Life	Good-Fair Bioclassificati	Ecological/biological Integrity Benthos		
	1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)		
>	28-103a	**Tranters Creek**	From source to subbasin 030305/030306 boundary	37.8	FW Miles	C;Sw,NSW	2
	1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos		
	1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)		
			12-digit Subwatershed 030201030502			Headwaters Tranters Creek	
>	28-103-2a	**Flat Swamp**	From source to 1.5 miles downstream of Robersonville WWTP discharge	8.1	FW Miles	C;Sw,NSW	2
	1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)		

Tar-Pamlico River Basin | 10-digit Watershed 0302010305 | Tranters Creek

> AU Number	Name	Description	Length or Area	Units	Classification	Category
28-103-2b	**Flat Swamp**	**From 1.5 miles downstream of Robersonville WWTP discharge to Tranters Creek**	**1.5**	**FW Miles**	**C;Sw,NSW**	**2**

Category	Rating	Use	Reason for Rating	Parameter	Year
1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos	
1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)	

12-digit Subwatershed 030201030505 Middle Tranters Creek

> AU Number	Name	Description	Length or Area	Units	Classification	Category
28-103-10	**Horsepen Swamp**	**From source to Tranters Creek**	**6.0**	**FW Miles**	**C;Sw,NSW**	**2**

Category	Rating	Use	Reason for Rating	Parameter	Year
1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos	

Tar-Pamlico River Basin | 10-digit Watershed 0302010306 | Tar River

12-digit Subwatershed 030201030601 Headwaters Grindle Creek

> AU Number	Name	Description	Length or Area	Units	Classification	Category
28-100-2	**Whichard Branch**	**From source to Grindle Creek**	**6.6**	**FW Miles**	**C;NSW**	**3**

Category	Rating	Use	Reason for Rating	Parameter	Year
3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity FishCom	
1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos	

> AU Number	Name	Description	Length or Area	Units	Classification	Category
28-100a	**Grindle Creek**	**From source to Whichard Branch**	**13.6**	**FW Miles**	**C;NSW**	**3**

Category	Rating	Use	Reason for Rating	Parameter	Year
3a	Not Rated	Aquatic Life	Data Inconclusive	Low pH	
1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)	

12-digit Subwatershed 030201030604 Outlet Chicod Creek

> AU Number	Name	Description	Length or Area	Units	Classification	Category
28-101-5	**Cow Swamp**	**From source to Chicod Creek**	**7.3**	**FW Miles**	**C;NSW**	**2**

Category	Rating	Use	Reason for Rating	Parameter	Year
1	Supporting	Aquatic Life	Moderate Bioclassificati	Ecological/biological Integrity Benthos	

12-digit Subwatershed 030201030605 Town of Grimesland-Tar River

Tar-Pamlico River Basin | 10-digit Watershed | 0302010306 | Tar River

> AU Number	Name	Description	Length or Area	Units	Classification	Category
28-100b	Grindle Creek	From Whichard Branch to Tar River	14.2	FW Miles	C;NSW	3

Category	Rating	Use	Reason for Rating	Parameter	Year
3a	Not Rated	Aquatic Life	Data Inconclusive	Low pH	
3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity FishCom	
1	Supporting	Aquatic Life	Good-Fair Bioclassificati	Ecological/biological Integrity Benthos	
1	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)	

> AU Number	Name	Description	Length or Area	Units	Classification	Category
28-101	Chicod Creek	From source to Tar River	14.1	FW Miles	C;NSW	3

Category	Rating	Use	Reason for Rating	Parameter	Year
3a	Not Rated	Aquatic Life	Potential Standards Viol	Low Dissolved Oxygen	
3a	Not Rated	Aquatic Life	Data Inconclusive	Low pH	
1	Supporting	Aquatic Life	Natural Bioclassification	Ecological/biological Integrity Benthos	
1t	Supporting	Recreation	No Criteria Exceeded	Fecal Coliform (recreation)	

> AU Number	Name	Description	Length or Area	Units	Classification	Category
28-97	Hardee Creek	From source to Tar River	5.6	FW Miles	C;NSW	3

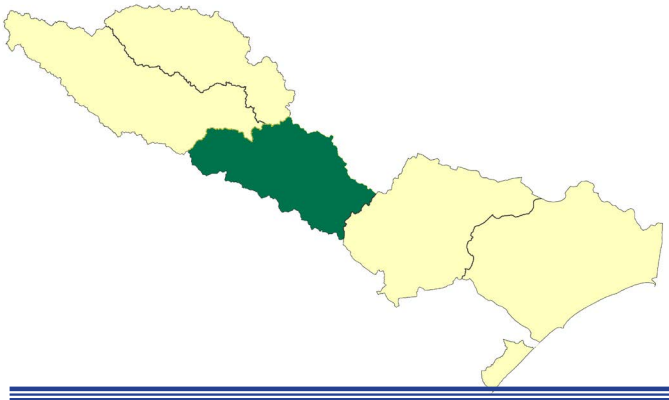
Category	Rating	Use	Reason for Rating	Parameter	Year
3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity FishCom	
1	Supporting	Aquatic Life	Natural Bioclassification	Ecological/biological Integrity Benthos	

> AU Number	Name	Description	Length or Area	Units	Classification	Category
28-97-1	Meeting House Branch	From source to Hardee Creek	3.8	FW Miles	C;NSW	2

Category	Rating	Use	Reason for Rating	Parameter	Year
1	Supporting	Aquatic Life	Natural Bioclassification	Ecological/biological Integrity Benthos	

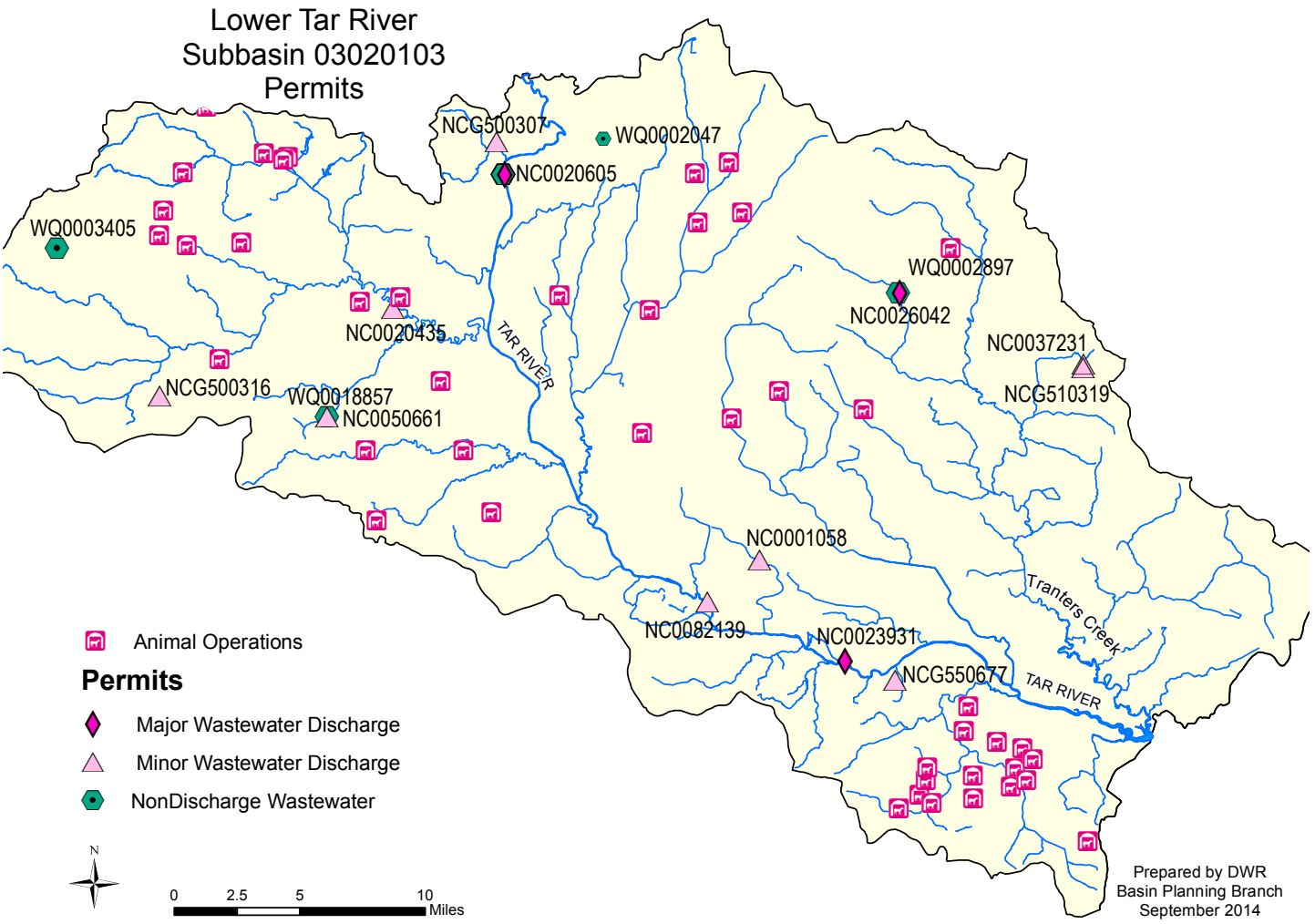
> AU Number	Name	Description	Length or Area	Units	Classification	Category
28-99-1-1	Cannon Swamp	From source to Moyes Run	4.7	FW Miles	C;NSW	3

Category	Rating	Use	Reason for Rating	Parameter	Year
3a	Not Rated	Aquatic Life	Not Rated Bioclassificati	Ecological/biological Integrity FishCom	



Permitted & Registered Activities

Lower Tar River Subbasin 03020103



Wastewater Dischargers

The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States, as authorized by the Clean Water Act. Non-compliance with permit limits on wastewater flow and constituents can lead to discharge of pollutants that degrade surface waters making them unsafe for drinking, fishing, swimming, and other activities. The NPDES Permitting and Compliance Programs of DWR are responsible for administering the program for the state. These permits are reviewed and are potentially renewed every 5 years. A list of NPDES permits are listed in Table

1 and a map of major facilities are located here: http://portal.ncdenr.org/web/wq/npdes-major-facility-map and minor facilities here: http://portal.ncdenr.org/web/wq/npdes-minor-facility-map.

The Federal and State Pretreatment Program gives regulatory authority for EPA, states, and municipal governments to control the discharge of industrial wastewater into municipal Wastewater Treatment Plants (WWTPs) or Publicly Owned Treatment Works (POTWs). The objectives of the Pretreatment Program are to prevent pass-through, interference, or other adverse impacts to the POTW, its workers, or the environment; to promote the beneficial reuse of biosolids; and to assure all categorical pretreatment standards are met. There are currently around 700 Significant Industrial Users (SIUs) who discharge industrial wastewater to over 120 POTWs throughout the state of North Carolina. The WWTPs covered by POTW Pretreatment Programs in this subbasin are Tarboro, Greenville Utilities Commission (GUC) and Robersonville.

Table 1: NPDES Discharge Permits in HUC 03020103

Permit #	Owner Name	Facility Name	Owner Type	Permit Type	Class	Receiving Stream	Permit Flow MGD
NC0001058	DSM Pharmaceuticals	DSM Pharm.	Non-Government	Industrial Process & Commercial Wastewater	Minor	Parker Creek	0
NC0020435*	Town of Pinetops	Pinetops WWTP	Government - Municipal	MWD < 1MGD	Minor	Town Creek	0.3
NC0020605*	Town of Tarboro	Tarboro WWTP	Government - Municipal	MWD, Large	Major	Tar River	5.0
NC0023931*	Greenville Utilities Commission	GUC WWTP	Government - Municipal	MWD, Large	Major	Tar River	17.5
NC0026042*	Town of Robersonville	Robersonville WWTP	Government - Municipal	MWD, Large	Major	Flat Swamp	1.8
NC0037231	Martin County Schools	Bear Grass Elementary School WWTP	Government - County	Discharging 100% Domestic < 1MGD	Minor	Turkey Swamp	0.005
NC0050661	Town of Macclesfield	Macclesfield WWTP	Government - Municipal	MWD < 1MGD	Minor	Bynums Mill Creek	0.175
NC0082139	Greenville Utilities Commission	Greenville WTP	Government - Municipal	Water Plants and Water Conditioning	Minor	Tar River	0

* Indicates Tar-Pamlico Basin Association Permittee Member

MWD = Municipal Wastewater Discharge

On-Site Wastewater Treatment Systems (Septic Systems)

Wastewater from many households is treated on-site through the use of permitted septic systems instead of being sent to a wastewater treatment facility. Poorly planned and/or maintained systems can fail and contribute to nonpoint source pollution. Wastewater from failing septic systems can contaminate groundwater and surface water. Failing septic systems are health hazards and are considered illegal discharges of wastewater if surface waters are impacted. Information about the proper installation and maintenance of septic tanks can be obtained

by contacting the Department of Environmental Health and Human Services and local county health departments. Local health departments are responsible for ensuring that new systems are sited and constructed properly and an adequate repair area is available. County, town and city planners need to understand the economic and human health ramifications caused by failing septic systems and plan for long-term septic system sustainability.

In 2007, North Carolina Agricultural Research Service completed a report concerning nitrogen contributions from on-site wastewater systems for each river basin. The results for this subbasin based on 1990 census data indicate a population of 49,784 people using 19,583 septic systems resulting in a nitrogen loading of 497,841 lbs/yr and nitrogen loading rate of 519 lbs/mi^2/yr. These numbers reflect the TN discharged to the soil from the septic system and does not account for nitrogen used because of soil processes and plant uptake. (Pradhan et al. 2007).

Wastewater Residuals (Biosolids)

Residuals, biosolids or treated sludge, are by-products of the wastewater treatment process. After pathogen reduction, vector attraction reductions, and metal limits are met, these residuals are disposed in a manner to protect public health and the environment. Disposal sites include landfills, dedicated and non-dedicated residual disposal sites, agricultural land for crops not for human consumption, and distribution to the public for home use. When applied to the land, steps must be taken to assure that residuals are applied at or below agronomic rates based on the soil and crop types present at the disposal site. If these criteria cannot be met, permitted disposal must take place at a dedicated residual disposal site or landfill.

In this subbasin, five facilities that produce wastewater residuals (Class B) apply their treated sludge on an available 86 fields covering 1,431 acres (not all fields are used every year). A rough estimate of 100,170 lbs/yr of nitrogen and 128,790 lbs/yr of phosphorus are applied to these fields. This estimate does not include Class A residuals which are not monitored by DWR. Of these permitted facilities, two are located in the Tar-Pamlico River Basin, the other three permit holders are facilities outside the basin but apply their residuals within the basin. Additional research would be necessary to determine if organic nitrogen from biosolids are contributing to the basinwide increase in organic nitrogen.

Non-Discharge

Non-discharge systems have been the preferred alternative to discharge to surface waters for some NSW waterbodies and DWR requires all new and expanding NPDES permit applicants to provide documentation that considers alternatives to surface waters. Non-discharge wastewater options include spray irrigation, rapid infiltration basins, and drip irrigation systems. Although these systems are operated without a discharge to surface waters, they still require a DWR permit. The permit insures that treated wastewater is applied to the land at a rate that is protective of groundwater resources, and does not produce ponding or runoff into a waterbody. More information about land application and non-discharge requirements can be found on the DWR Non-Discharge Permitting Unit's website: http://portal.ncdenr.org/web/wq/aps/lau. Non-discharge permits in this subbasin are listed in Table 2 and a map of facilities is located here: http://portal.ncdenr.org/web/wq/aps/lau/map.

Table 2: Non-Discharge Permits in HUC 03020103

Facility Name	Permit Type	Permit #	Size
Elm City Spray Irrigation WWTP	Surface Irrigation	WQ0003405	Major
General Foam Plastics	Groundwater Remediation, Non-discharge	WQ0005620	Minor
Comer Oil Co-Williams & Lamm	Groundwater Remediation, Non-discharge	WQ0014508	Minor
GUC Residuals Land Application Program (D)	Land Application of Residual Solids (503)	WQ0003781	Minor
Macclesfield Reclaimed Water Field	Reuse	WQ0018857	Minor
Town of Robersonville Residuals Land Application Program	Land Application of Residual Solids (503)	WQ0002897	Minor

Run-off and spills are not common at non-discharge facilities. In general, maintaining compliance with permit conditions largely falls back to having a properly managed facility. Aging sewer systems may lead to increased flows from inflow and infiltration or a facility may not be properly prepared to expand as flows increase and the upper limits of a plant's capacity are reached. Non-discharge facilities, just like any other, must properly plan for any elevated flows and take action to ensure that the facility is capable of managing the wastewater.

Groundwater moving into surface water is a mechanism to introduce nutrients into the surface water system in the absence of direct discharges and in NSW systems it is important to be able to better quantify these potential nutrient loads. Some facilities have a groundwater monitoring program to measure compliance with groundwater quality standards. However, it should be noted that a facility can be compliant with groundwater quality requirements while still contributing to the overall nutrient loading of a surface water system. A better understanding of the groundwater/surface water interaction process at non-discharge facilities may help to identify and quantify nutrient loading from these locations.

Riparian Buffers

Riparian buffers in the basin are to be protected and maintained on both sides of intermittent and perennial streams, lakes, ponds, and estuarine waters. Tar-Pamlico River Basin Buffer Rules (15A NCAC 2B.0259) do not establish new buffers unless the existing use in the buffer area changes. The footprints of existing uses such as agriculture, buildings, commercial and other facilities, maintained lawns, utility lines, and on-site wastewater systems are exempt. A total of 50 feet of riparian area is required on each side of waterbodies; within this 50 feet, the first 30 feet is to remain undisturbed and the outer 20 feet must be vegetated. Activities that disturb this buffer require a buffer authorization from DWR or may require a major variance approval from the Environmental Management Commission. Pitt County is the only county that is a delegated authority to implement the Tar-Pamlico River Basin buffer rules. Therefore, buffer authorizations and minor variances would be reviewed by Pitt County in non-incorporated areas in that county. More information about the buffer rules are available at: http://portal.ncdenr.org/web/wq/swp/ws/401/riparianbuffers.

Wetland Or Surface Water Disturbance (401 Certification)

The "401" refers to Section 401 of the Clean Water Act. The North Carolina DWR is the state agency responsible for issuing 401 water quality certifications (WQC). When the state issues a 401 certification this certifies that a given project will not degrade waters of the state or violate state water quality standards. A 401 WQC is required for any federally permitted or licensed activity that may result in a discharge to waters of the U.S. Typically, if the United States Army Corps of Engineers determines that a 404 Permit or Section 10 Permit is required because a proposed project involves impacts to wetlands or surface waters, then a 401 WQC is also required. A map of 401 WQCs is found here: http://portal.ncdenr.org/web/wq/401-buffer-permit-tracker. Examples of activities that may require permits include:

- Any disturbance to the stream bed or banks,
- Any disturbance to a wetland,
- The damming of a stream channel to create a pond or lake,
- Placement of any material within a stream, wetland, or open water, including material that is necessary for construction, culvert installation, causeways, road fills, dams, dikes, or artificial islands, property protection, reclamation devices and fill for pipes or utility lines, and
- Temporary impacts including dewatering of dredged material prior to final disposal and temporary fill for access roads, cofferdams, storage, and work areas.

Animal Operations

The Animal Feeding Operations Unit is responsible for the permitting and compliance activities of animal feeding operations across the state. A map of permitted animal facilities is available here: http://portal.ncdenr.org/web/wq/animal-facility-map.

Animal waste is often stored in lagoons before it is applied to fields. Numerous environmental hazards exist from these lagoons including: ammonia emissions, overflows into surface waters, and groundwater contamination. A better understanding of groundwater quality in relation to animal feeding operation locations is needed. Most animal operations are located immediately adjacent to surface water bodies. Groundwater that is moving from beneath a facility into the surface water system may transport significant levels of nutrients. However, lack of groundwater quality data at animal operations hampers quantifying their impacts.

Water Withdrawals

Agricultural water users that withdraw one million gallons of water a day or more and non-agricultural water users that withdraw one hundred thousand gallons of water a day are required to register with DWR. Registrants must also report their water usage annually; annual reports can be found at: http://www.ncwater.org/Permits_and_Registration/Water_Withdrawal_and_Transfer_Registration/report

Central Coastal Plain Capacity Use Area

In August 2002, the North Carolina EMC enacted the Central Coastal Plain Capacity Use Area (CCPCUA) rules. These regulations were developed to control groundwater use in the Cretaceous Aquifers in response to decreasing groundwater levels and increasing saltwater intrusion. The CCPCUA rules require groundwater users in the impacted areas to reduce their consumption in three phases between 2008 and 2018. In this subbasin, Beaufort, Edgecombe, Martin, Pitt and Wilson counties are within the CCPCUA and are required to obtain a water withdrawal permit. In order to stay in compliance with the permit, the permit holder must report accurate daily water withdrawals, monthly water levels and annual chloride results from each of their wells. More information about the CCPUA is available from the DWR website: http://www.ncwater.org/CCPCUA. Table 3 lists the CCPCUA permit holders within this subbasin.

Table 3: CCPCUA Permits

Permit	Permittee	Maximum Daily Withdrawal (mgd)	Cretaceous Well Annual Base Rate (mgy)	Non Cretaceous Aquifer	Number of Non Cretaceous Wells	Cretaceous Aquifer	Number of Cretaceous wells
CU3053	Town of Pinetops	0	0.327694932		0	Upper Cape Fear	4
CU3089	Conetoe Community Water Assoc., Inc.	0	0.100001		0	Upper Cape Fear	2
CU3128	Town of Macclesfield	0	0.100001		0	Upper Cape Fear, Lower Cape Fear	2
CU3135	Anderson & Co., Inc. - Anderson Sand Pit	2.88	0	Surficial	1		0
CU1129	Martin Co. Water and Sewer Dist. No. 2	0	0.504		0	Black Creek, Upper Cape Fear	2
CU3016	Town of Robersonville	0	1.285093151		0	Upper Cape Fear	7
CU3045	Patten Seed Company -Super Sod East Carolinas	0	0.100001		0	Upper Cape Fear	2
CU3004	Greenville Utilities Commission	0	1.20456		0	Black Creek, Upper Cape Fear	10
CU3070	Town of Bethel	0	0.159816438		0	Black Creek, Upper Cape Fear	2
CU3074	Patheon Manufacturing Services, LLC	0	0.142611156		0	Black Creek, Upper Cape Fear	2
CU3077	Bell Arthur Water Corporation	0	1.409482192		0	Upper Cape Fear	5
CU3088	Stokes Regional Water Corporation	0	0.192846575		0	Upper Cape Fear	2

Table 3: CCPCUA Permits

Permit	Permittee	Maximum Daily Withdrawal (mgd)	Cretaceous Well Annual Base Rate (mgy)	Non Cretaceous Aquifer	Number of Non Cretaceous Wells	Cretaceous Aquifer	Number of Cretaceous wells
CU3102	Eastern Pines Water Corporation	0.72	2.033	Peedee	2	Peedee, Black Creek, Upper Cape Fear	9
CU3117	American Materials Co., LLC (Pinner Pit)	1.4	0	Surficial	1		0
CU3132	East Carolina University - Health Sciences Campus	0.10512	0.16056	Peedee	1	Upper Cape Fear	2
CU3133	East Carolina University - Main Campus	0.09936	0.108	Peedee	1	Black Creek, Upper Cape Fear	2
CU3147	ECU - North Recreational Complex	0.4	0	Yorktown	5		0
CU3173	Grimesland Plantation, LLC	0.4464	0	Peedee	2		0
CU3238	American Materials Company LLC (Dupree Pit)	1.44	0	Surficial	1		0
CU3246	Barnhill Contracting Company (Harris Pit)	0.936	0	Surficial	1		0
CU3067	Town of Elm City	0.53568	0	Bedrock	5		0
CU3078	Hanson Agg. SE (Elm City Quarry)	2.16	0	Bedrock	1		0

To meet the requirements of the CCPCUA, Greenville Utilities Commission (GUC) initiated a flow study to estimate the amount of surface water that will be available for withdrawal from the Tar River in the future, and to assist in developing a long-term plan for providing a reliable and sustainable water supply. The goal of the Tar River Flow Study was to identify the environmental issues and potential constraints associated with water withdrawals in the Tar River and provide the basis for evaluating the potential effects of increased withdrawals on instream habitat, water quality, and aquatic resources and values. The study results also helped identify saltwater encroachment upriver during periods of low inflow or drought.

Additional water withdrawal registrations in this subbasin are listed in Table 4.

Table 4: Water Withdrawals

Registration #	County	Facility Name
CU3065	Pitt	American Materials Co., LLC (Buck Pit)
CU3095	Edgecombe	HASSELL THIGPEN
CU3097	Pitt	E.R. Lewis Construction (Gaylord Mine)
CU3104	Pitt	Greenville Country Club
CU3136	Pitt	E.R. Lewis Const. (Joyner Mine No. 1)
CU3144	Beaufort	S.T. Wooten Corporation (Briley Pit)
CU3159	Pitt	Pitt County Memorial Hospital
CU3163	Pitt	E.R. Lewis Construction (Hart Mine)
CU3165	Pitt	Bradford Creek Golf Course
CU4014	Pitt	NCDOT (PITT CO. MAINTENANCE)
CUR0003	Pitt	Town of Grimesland
CUR0015	Edgecombe	Town of Tarboro Water Treatment Plant
CUR0018	Pitt	JP Davenport & Son
CUR0020	Pitt	Laughinghouse Farms, Inc.
CUR0064	Pitt	Greenville Utilities Commission WTP
CUR0071	Edgecombe	Linwood Allen Webb Farms
CUR0085	Pitt	Brook Valley Country Club

Local Water Suppliers

Local governments and other large community water systems that provide water to the public are required to prepare local water supply plans (LWSP). The LWSPs describe current and projected water sources and demands. Customer demands can be met by withdrawing surface water or groundwater and by purchasing water from a neighboring community. LWSPs with service within this subbasin are listed in Table 5. Details about each LWSP can be found at: http://www.ncwater.org/Water_Supply_Planning/Local_Water_Supply_Plan/search.php

Table 5: LSWPs for Water Supplies with Service Area in the Lower Tar Subbasin

PWS ID	Name	Ownership
0474045	BELL ARTHUR WATER CORP	BELL ARTHUR WATER CORP
0474030	BETHEL, TOWN OF	BETHEL, TOWN OF
0433030	CONETOE COMMUNITY WATER SYSTEM	CONETOE COMM WATER ASSN
0474015	EASTERN PINES WATER CORP	EASTERN PINES WATER CORP
0498020	ELM CITY, TOWN OF	ELM CITY TOWN OF
0474010	GREENVILLE UTILITIES COMM	GREENVILLE UTILITIES COMMISSIO
0474055	GRIMESLAND, TOWN OF	GRIMESLAND TOWN OF
0433020	MACCLESFIELD, TOWN OF	MACCLESFIELD TOWN OF
6059009	MARTIN CO WATER & SEWER DIST 2	MARTIN COUNTY
0433015	PINETOPS, TOWN OF	PINETOPS, TOWN OF
0459015	ROBERSONVILLE, TOWN OF	ROBERSONVILLE, TOWN OF
0474060	STOKES REGIONAL WATER CORP	STOKES REGIONAL WATER CORP
0433010	TARBORO, TOWN OF	TARBORO, TOWN OF

Public Water Systems

In addition to the local water supplies, public water systems found within this subbasin are listed in Table 6. Public water systems are those that provide piped drinking water to at least 15 connections or 25 or more people, 60 or more days per year. These water systems must report their status to the Public Water Supply Section of DWR. Community systems are those that supplies water to the same population year-round, a transient non-community system provides water in a place such as a gas station or campground where people do not remain for long periods of time and non-transient non-community systems regularly supply water to at least 25 permanent residents at least six months per year, but not year-round.

Table 6: Public Water Systems in Subbasin 03020105

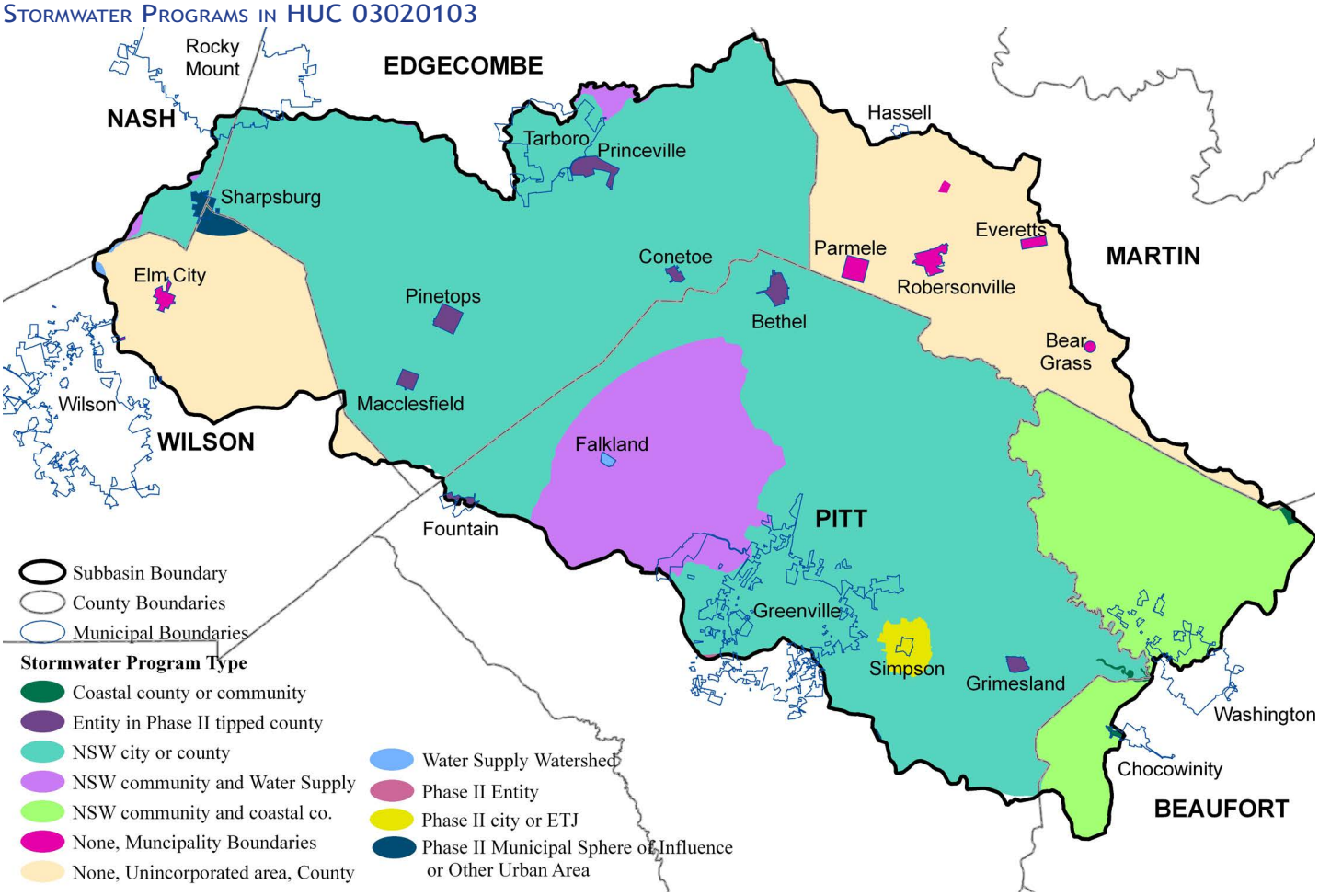
PWS ID	Name	Type
0407597	ASMO WAREHOUSE-SHEPHARD MILL ROAD	Non-Transient Non-Community
0433421	TAYLOR`S GROCERY AND GRILL	Transient Non-Community
0433441	UNITED CHURCH OF JESUS CHRIST	Transient Non-Community
0433443	MAYO CHAPEL MISSIONARY BAPTIST	Transient Non-Community
0459431	ROBERSONVILLE C0UNTRY CLUB	Transient Non-Community
0464460	ROSE MOTEL	Transient Non-Community
0464461	HOLIDAY MOTEL	Transient Non-Community
0464462	GRA BAR MOTEL	Transient Non-Community
0464498	CAROLINA INN	Transient Non-Community
0474110	HOMESTEAD MHP	Community
0474118	SMITH`S TRAILER PARK	Community
0474140	THOMAS MOBILE PARK	Community
0498115	OAK VIEW ESTATES MHP	Community
0498417	NOBLES CHAPEL BAPTIST CHURCH	Transient Non-Community
0498489	AENON BAPTIST CHURCH	Transient Non-Community
0498532	MT ZION UNITED METH CHURCH	Transient Non-Community
0498588	BATCHELOR FARMS	Transient Non-Community
0498617	OUTREACH CENTER CHURCH OF GOD	Transient Non-Community
6059012	WHISPERING PINES MHP	Community

Stormwater

The NC Division of Energy Minerals and Land Resources (DEMLR) administers several different stormwater programs. The goal of the DEMLR stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff control. These stormwater control programs include Phase II NPDES and state post-construction, coastal stormwater, HQW/ORW stormwater, Tar-Pamlico River Basin NSW stormwater, and associated with the Water Supply Watershed Program requirements. The figure below indicates the different stormwater programs in this subbasin.

Greenville, Tarboro, and Washington and Nash, Edgecombe, and Pitt counties are required to implement actions to prevent and treat stormwater runoff required by the Tar-Pamlico NSW stormwater rules. These local programs are to include new development controls to reduce nitrogen runoff by 30 percent compared to pre-development levels and to keep phosphorus inputs from increasing over those pre-development levels. Local programs must also identify and remove illicit discharges; educate developers, businesses, and homeowners; and make efforts toward treating runoff from existing developed areas.

Stormwater Programs in HUC 03020103



References:

Pradhan, S.S., Hoover, M.T., Austin, R.E. and H. A. Devine. 2007. Potential Nitrogen Contributions from On-site Wastewater Treatment Systems to North Carolina's River Basins and Sub-basins Technical Bulletin 324. North Carolina Agricultural Research Service North Carolina State University Raleigh, NC.

Town Creek Watershed (0302010301)

Watershed Monitoring Sites	
Type	Site ID
Ambient	O5600000 O5990000
Benthos	OB70 OB71 OB87 OB91 OB161
Fish	OF10 OF45

Recommendations

Currently, there is not a sample site that can quantify nutrients draining from this watershed. Nutrient data should be collected at ambient site O5990000 to help target areas within the basin for further nutrient reductions.

Restoration Opportunities & Protection Priorities

Cokey Swamp (HUCs 030201030103 & 030201030104) is a tributary to Town Creek and drains eastern Nash and western Edgecombe counties. Cokey Swamp is currently classified as C; NSW even though physically and biologically it appears to be Swamp Waters. NC Natural Heritage Program has designated part of the subwatershed as Significant Natural Heritage Area. Since 2002 the upper 8.6 miles of the stream (AU# 28-83-3a) have been Impaired based on a Severe Stress swamp bioclassification at site OB71. Urban runoff from Rocky Mount and Sharpsburg and agriculture nonpoint source pollution potentially impact the stream. There are also several waste residual application sites located within the lower subwatershed. The potential runoff impact from these areas is unknown, but should be minimal if applied appropriately.

In 2005, the Upper Coastal Plain Council of Government and the Pamlico-Tar River Foundation received a 205j grant to identify nonpoint source pollution through a land use assessment of property within 100-300 feet from the stream. Their land use assessment identified potential problem areas including: tilled cropland or pastures draining to the stream or ditch networks, CAFO's, spray fields, and one lagoon located within the 100-yr floodplain. Junk and abandoned cars were found within the riparian areas within Cokey Swamp headwaters.

Upper Town Creek Subwatershed (HUC 030201030102)

Excess runoff from Elm City's WWTP spray fields prompted DWR's Raleigh Regional Office to request samples be taken in Town Creek in 2007. This spray system consistently exceeded its limits on a weekly basis (calculated ~1.1 million gallons of runoff occurred during 2006) and was under a Special Order by Consent. The town is currently under a sewer moratorium due to severe compliance problems that have resulted in the discharge of partially treated municipal waste directly to surface waters in the Basin. The town's wastewater system could be contributing factor in the impairment of a stream that drains the wastewater application fields. Sampling results in 2007 resulted in a Severe bioclassification rating indicating degraded water quality in an unnamed tributary (UT) to Town Creek at SR 1400.This UT to Town Creek (AU# 28-83ut8 2.6 mi) is Impaired on the 2010 303(d) list.

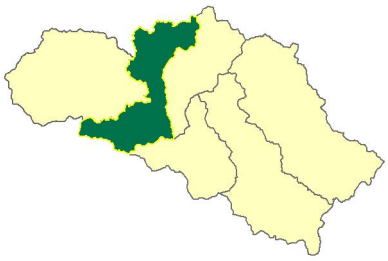
The special sample results noted that UT to Town Creek appeared to be in the process of transforming into a wetland from the documented increased volume of water from the upstream spray field. Furthermore, the riparian habitat along this reach of stream and within the channel

was degraded. Water chemistry parameters such as pH and temperature indicated warmer waters and higher pH levels characteristic of upstream point sources. The special study results concluded this waterbody did not support a diversity of aquatic macroinvertebrates. The benthic community that persisted here was made up of a smaller number of highly tolerant organisms. The Deformity Analysis revealed a slightly higher rate of deformities than the natural background rate, but that those deformities did not appear to be caused by highly toxic conditions. DWR inspections in 2008 indicate improved management of the wastewater collection system, with reduced inflow and infiltration (I&I) maintenance of adequate lagoon freeboard and the possibility of acquiring new lagoons and spray fields locations. Additional benthic surveys will be required to indicate if the WWTP's improved management has allowed stream conditions to restore to full use.

The lower reach of Town Creek [AU# 28-83b] received a Good-Fair benthic bioclassification rating in 2012; this is a decline from the previous two samples. Although the 2012 bioclassification decline was most likely the result of unfavorable habitat conditions and low flow conditions relative to previous samples

Bynums Mill Creek (HUC 030201030106), AU# 28-83-4-1, is no longer Impaired. The 2007 and 2012 samples resulted in Moderate Stress swamp bioclassifications, although water quality issues seem to be the main concern versus habitat conditions. Macclesfield WWTP discharges into Bynums Mill Creek; the NPDES permitted flow is 0.175 million gallons/day (MGD) and the median annual daily flow is 0.0655 MGD. There have been no limit violations since 2012. Parameters that have exceeded the permit limits in the past include: pH, fecal coliform bacteria, chlorine, total suspended solids, ammonia, and BOD. The facility is receiving technical assistance from DWR's Raleigh Regional Office to better address ammonia.

Otter Creek- Tar River Watershed (0302010302)



Watershed Monitoring Sites	
Type	Site ID
Ambient	O6200000 O6205000 O6201000
Benthos	OB86 OB80 OB79 OB90 OB89 OB86
Fish	OF30

Restoration Opportunities

Hendricks Creek (HUC 030201030202), AU# 28-81, from source to Tar River 3.9 miles is Impaired based on a Severe bioclassification in 2004. Hendricks Creek runs through the middle of Tarboro and habitat conditions represent typical conditions in highly urbanized watersheds with very severe bank erosion and scour. The creek's flashiness is apparent (e.g., high wrack lines, scour, severe bank erosion) and is indicative of highly impervious watersheds. Restoration efforts for Hendricks Creek need to focus on both habitat and water quality improvements to significantly improve benthic bioclassifications. This stream is part of an EEP local watershed plan; more information can be found at: http://www.nceep.net/services/lwps/Tar-Pamlico/Middle_Tar_LWP_Files/Middle_Tar_Rehabilitation_Plans_Appendices/Hendricks_Creek_Rehabilitation_Plan.pdf.

Protection Priorities

Tar River Watershed (HUC 030201030202 & HUC 030201030204)

In 2005, two sites (OB89 & OB90) were sampled along the Tar River, [AU# 28-(80)] from Tarboro Raw Water Supply Intake to Suggs Creek, in Edgecombe County between Tarboro and Greenville. Both sites received Excellent bioclassifications. However in 2007 and 2012, the OB90 site at US Bus.64 received Good bioclassification ratings and site OB89 received a Good-Fair rating in 2012. Water quality conditions are noted as being stable at this location for over 30 years despite the declines in bioclassification. Continued monitoring is necessary to rule out any possible water quality changes. Between 2000 and 2005, Wildlife Resources Commission biologists collected mussel taxa from the Tar River between the two sites and at NC 42. These taxa consisted of *Lampsilis radiata*, *Alasmidonta undulata*, and *Elliptio roanokensis*, which are listed as Threatened by NC and *Lampsilis cariosa*, which is listed as Endangered by NC, and as a Species of Special Concern in the United States. Due to the presence of listed aquatic species and potential water quality from US Bus. 64 to NC 42, this section of the Tar River might qualify for ORW. The presence of these rare, threatened and endangered species dependent on excellent water quality makes this portion of the Tar River and contributing tributaries priorities for restoration and protection activities.

Otter Creek (HUC 030201030203) [AU# 28-86-(0.3)] is noted as having stable water quality conditions. The 2012 winter swamp sample resulted in a Moderate bioclassification which is consistent with previous samples.

Land Cover

To help understand land use changes and potential impacts on water quality an analysis of the change in land cover was also performed for the area draining to AMS O5250000 on the Tar River. Changes in land use between data collected for the 2001 National Land Cover Database and the 2011 dataset indicate that the loss of forest, agriculture, woody wetlands and grassland acres likely resulted in the large gain in scrub acres followed by developed areas and emergent wetlands. (Table 1).

Table 1: NLCD Land Cover changes between 2001-2011

Land Use	2011 % Land Cover	Percent change	Acres Lost/ Gained
Water	0.71	5.4	518.0
Developed	7.9	3.7	3,991.9
Barren	0.16	-23.0	-679.4
Forest	43.62	-4.9	-31,703.9
Scrub	5.74	117.5	44,143.7
Grassland	5.74	-1.4	-1,136.6
Agriculture	26.11	-3.8	-14,728.3
Woody Wetlands	9.23	-2.9	-3,856.8
Emergent Wetlands	0.80	43.7	3,451.6

TRENDS at Ambient Station O5250000

Station O5250000 and USGS gage # 02083500 are co-located on the Tar River in Tarboro. To help understand upstream conditions and their contributions to the nutrient loading to the estuary a trend analysis was performed on the nutrient parameters collected from AMS O5250000.

Flow adjusted concentration

The results of the Seasonal Kendall test for flow-adjusted concentrations of NH3-N, NOx-N, TKN, TN, and TP at O5250000 are provided in the Table 2. Except for TN and TP, there were statistically significant trends for NH3, NOx-N, and TKN. NH3-N and NOx-N showed decreasing trends in concentration, while TKN showed an increasing trend. The average decrease in median concentrations were a 41% for NH3-N and 42% for NOx-N, over the 22 years of study period. Conversely, there was a 44% increase in TKN concentration.

Table 2: Result of Seasonal Kendall Trend Analysis for Nutrient Concentrations at Tarboro (1991-2013).

Water Quality Constituents (mg/L)	Seasonal Sen Trend Slope (mg/L/year)	Significant Trend at 95%	First 12 month Median	Average % Change in Median
NH3-N	-0.00094	Decreasing	0.05	-41.36
NOx-N	-0.00888	Decreasing	0.47	-41.57
TKN	0.00807	Increasing	0.4	44.39
TN	-	No trend	0.96	-
TP	-	No trend	0.13	-

Flow-normalized load

Assessment of trends in annual nutrient loads at AMS O5250000 were performed using flow-normalized concentrations and loads computed for flow intervals representing low, medium, and high flows. Nutrient concentrations were estimated from the mean of available data and flow-weighted average concentrations. The results from a flow-normalized loading analysis indicates an overall 20% decrease in nitrate/nitrite(NOx-N), 2% increase in Total Kjeldahl nitrogen (TKN), 7% decrease in total nitrogen (TN) and 7% increase in total phosphorus (TP).

Flow-Normalized Total Nitrogen Loading at AMS 05250000

Figure 1 shows annual TN loading at Tar River near Tarboro by flow interval. The average TN contributions (1991-2013) from low, middle, and high flow interval were 5, 18 and 77%, respectively. The annual TN loading at this station ranged from 0.74 to 6.2 x 10^6 lbs/year for the 1991–2013 timeframe, with a median value of 2.8 x 10^6 lbs/year for.

Figure 1: Total Nitrogen Load at AMS 05250000

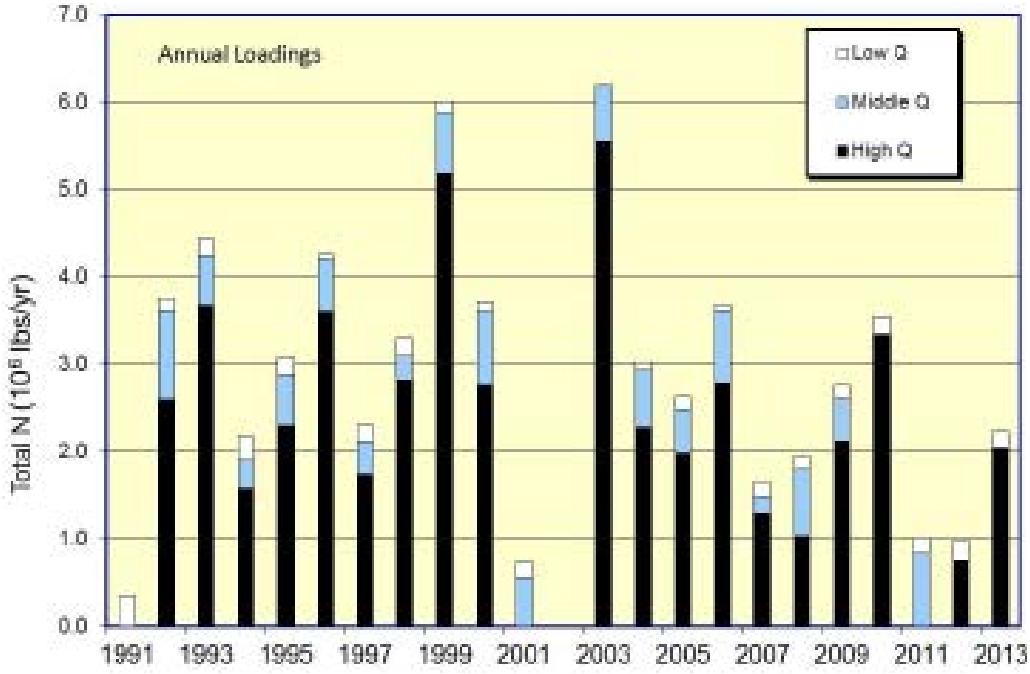
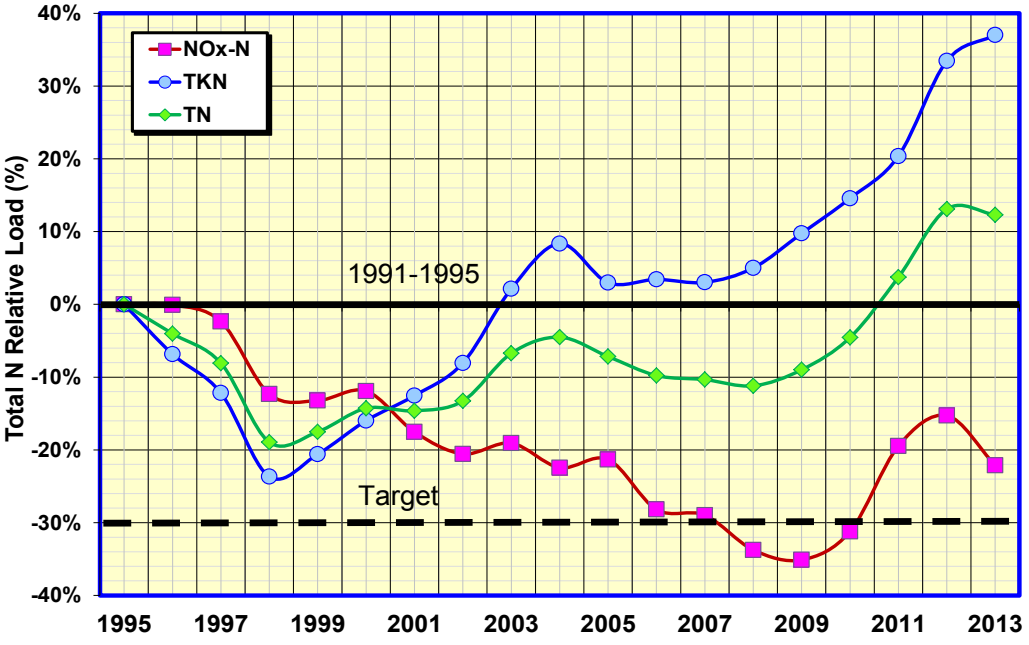


Figure 2 shows the relative N load reduction. The results of the flow-normalized loading analysis indicate reduction in flow-normalized NOx-N loading, but an increase in TKN loading. Flow-normalized TKN loading has been consistently higher than the 1991–1995 baseline period throughout the past 11 five-year periods and reached a maximum values of 37% in the 2009-2013 period. Ammonia loading declined over the same time period and the increase in TKN loading was primarily due to an increase in the Org-N fraction. The recent increase in TKN flow normalized loadings appears to be mainly due to increases for the high flow intervals. The average decrease in flow-normalized TN loading for the periods ending in 2006-2010 was approximately 11% and the average increase for the periods beginning in 2007- 2011 ending in 2009-2013 was about 10%.

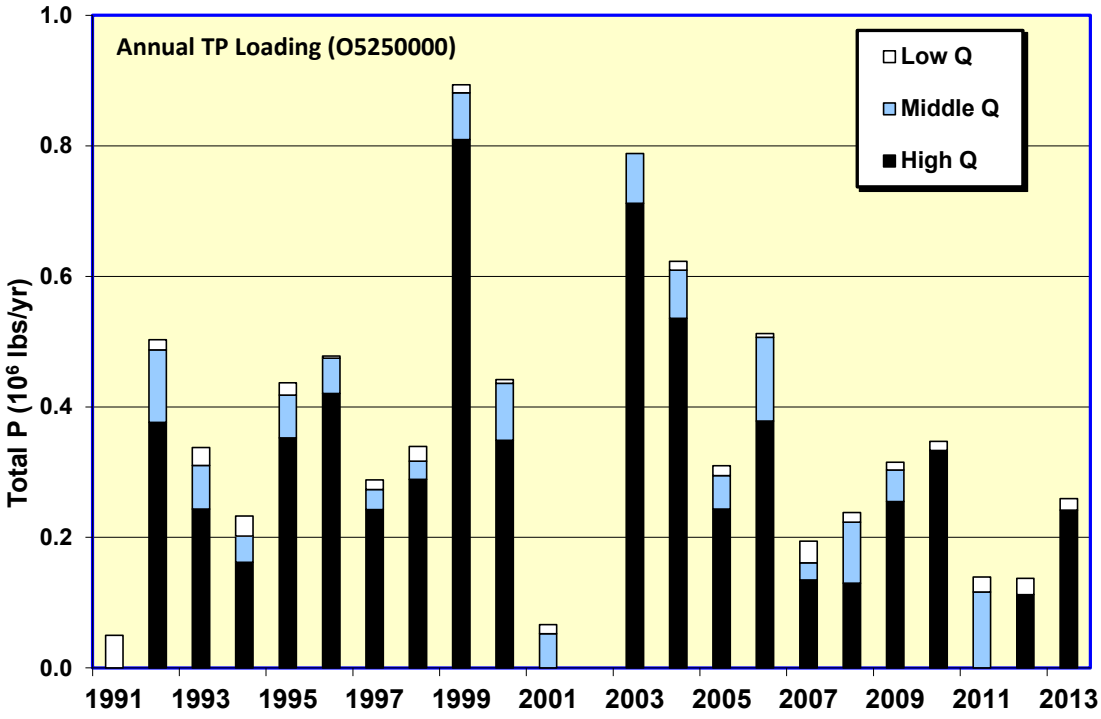
Figure 2: Relative N Load Reduction- Comparison to 1991-1995



Flow-Normalized Total Phosphorus Loading at AMS 05250000

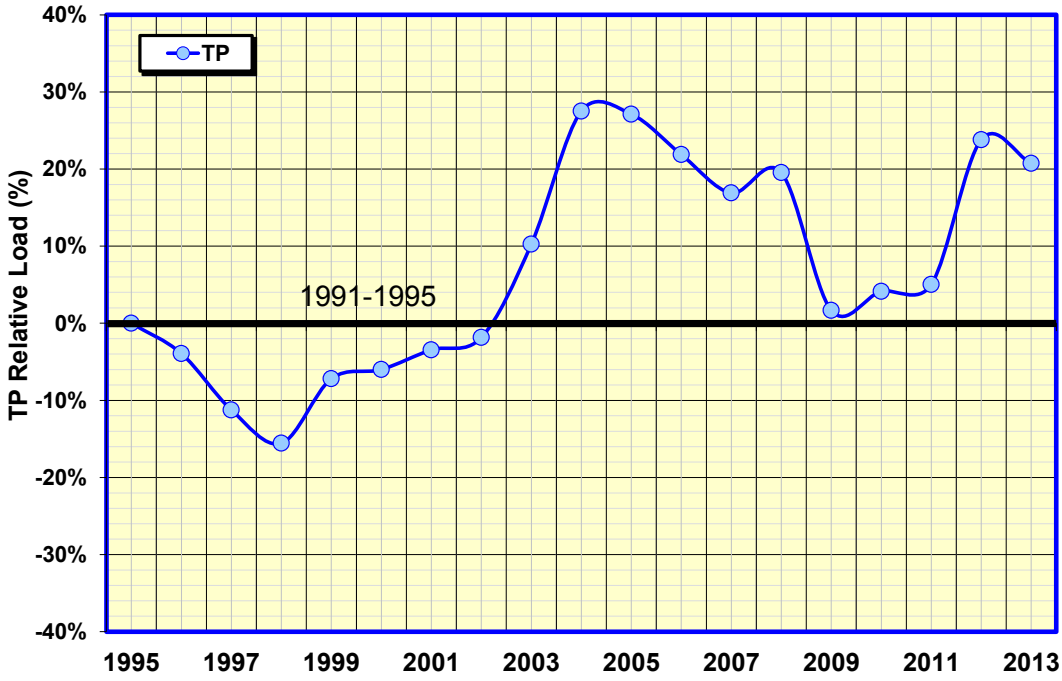
The annual TP loading at Tar River near Tarboro ranged from 0.5 to 8.9 x 10^5 lbs/year, with a median value of 3.3x 10^5 lbs/year. Figure 3 shows annual TP loading at this station by flow interval. The average TP contributions (1991-2013) from low, middle, and high flows were 4.4, 16.2 and 79.4%, respectively. These results show that high flow events contribute large amounts of nutrients to this watershed.

Figure 3: Total Phosphorus Load at AMS 05250000



Flow-normalized TP loading at Tar River Station near Tarboro has been consistently lower than the corresponding 1991-1995 loading until the 1998-2002 period and then gradually increased and became higher than the 1991-1995 loading since the 1999-2003 period. The average increase in flow-normalized TP loading for the periods beginning in 1999-2003 and ending in 2009-2013 was approximately 16.0%. (figure 4).

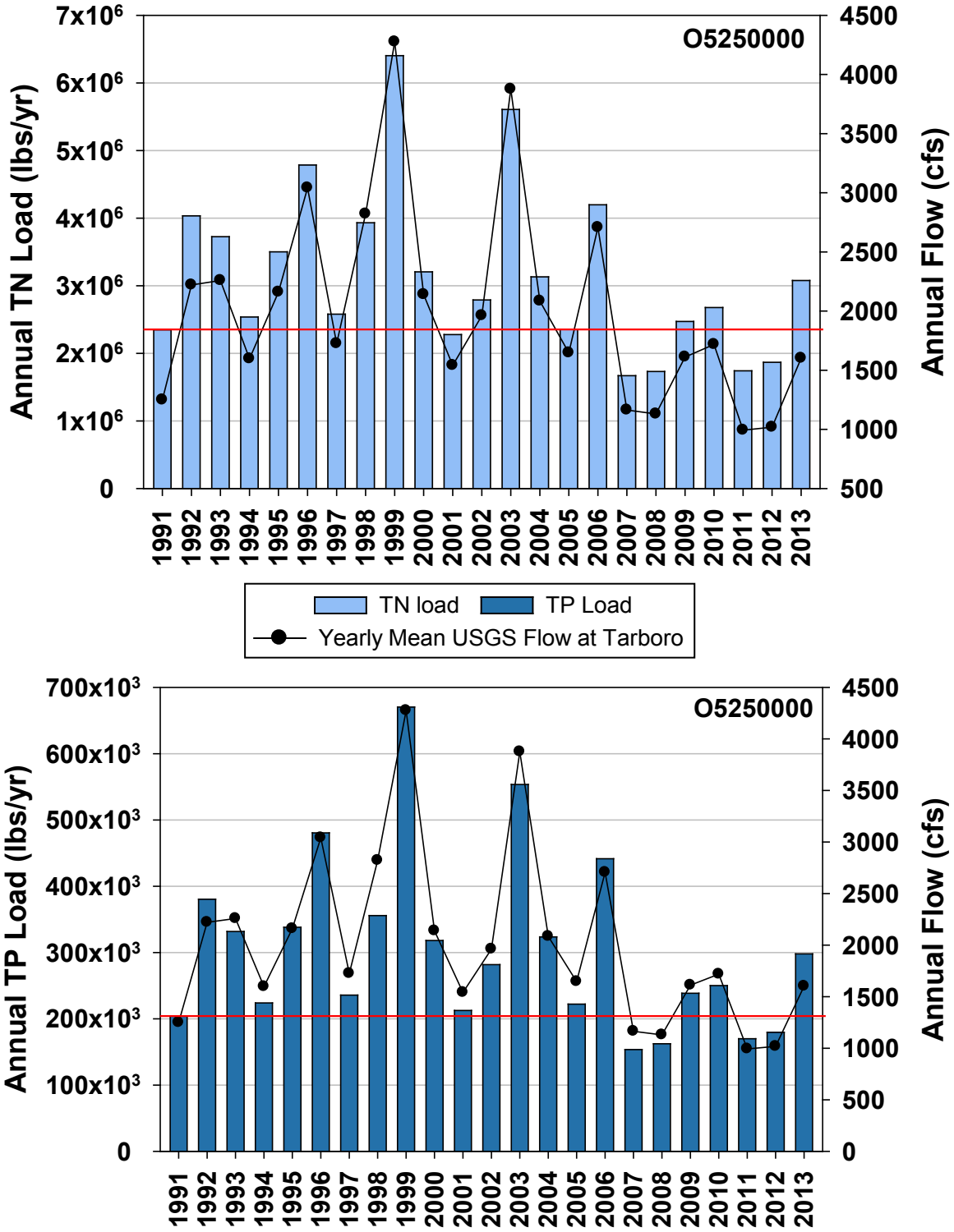
Figure 4: Relative Phosphorus Load Reduction- Comparison to 1991-1995



Annual Load

Annual Load estimates were run using USGS's LOAD ESTimator. Figure 5 shows the annual total nitrogen and total phosphorous load results in comparison to the 1991 baseline year (shown as a red horizontal line). The estimated mean TN loading in Tar River at Tarboro was 3,161,774 lbs/yr. The estimated mean TP loading was 393,712 lbs/yr. The yearly estimated TN and TP loading was lower in 5 and 4 of the 22 years post the 1991 baseline loads, respectively. The loading at this point represents what is coming into this station from the two upstream subbasins.

FIGURE 5: TAR RIVER AT TARBORO (O5250000) WITH FLOW AT TAR RIVER USGS GAGE 02083500



Conetoe Creek Watershed (0302010303)

Watershed Monitoring Sites	
Type	Site ID
Ambient	O6201000 O6205000
Benthos	OB53 OB68 OB73 OB74 OB75 OB76 OB77
Fish	OF54 OF75

Conetoe Creek Watershed, (HUCs 030201030301, 030201030303, 030201030305)

Previously half of this creek was impaired based on a Severe Stress bioclassification; however, 2007 and 2012 benthic samples at site OB75 resulted in a Moderate bioclassification indicating improved conditions. This improvement results in 9.8 miles being removed from the 2010 303(d) Impaired waters list (AU# 28-87-(0.5)a & 28-87-(0.5)b). The lower 6.7 miles of Conetoe Creek remain Impaired (AU# 28-87-(0.5)d) based on a Poor rating from a special study conducted in 2000. The 2012 benthic site (OB77) was moved ~3.8 miles downstream of the NC 42 site (OB73) and is below the confluence of Crisp Creek. More favorable conditions were noted at this downstream site which may be the result of the improved flow associated with the larger drainage area; the site received a Not Rated status. It is recommended this site be sampled during the next basinwide biological sampling period.

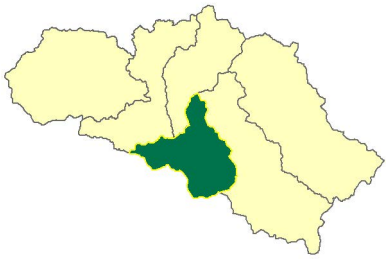
Land use is primarily agricultural in this watershed. Water is controlled through a series of canals that are managed by a drainage district board (consisting of local landowners and a technical advisor). Over 95 miles of stream in the watershed were channelized in the 1960s with intermittent de-snagging and dredging since then. The drainage district levies a tax on landowners to maintain the canals for proper drainage including canal access, mowing, de-snagging, and pipe and crossing repairs. Woody debris were noted as sparse and the habitat is generally poor throughout the watershed. Agricultural chemicals are thought to be the cause of toxicity and channelization the cause of the habitat degradation. Reestablishment of buffers along the intermittent and perennial streams should be encouraged to reduce nutrient inputs and provide habitat for aquatic organisms.

There is one swine animal operation (AWS740120) in this watershed that has been in violation with their DWR permit. The facility has a history of minimal emergency storage volume capacity and the sprayfields are in poor condition and not managed well. DWR will continue to closely monitor this operation.

Ballahack Canal (HUC 030201030305), AU# 28-87-1.2, from source to Conetoe Creek, 8.4 miles had a Severe benthos bioclassification in 2007. Ballahack Canal is a highly channelized tributary of Conetoe Creek. The benthic station is located in the town of Conetoe and it has been rated Severe since 2002. This site had a very low habitat score due to the straight channel, lack of instream habitat, homogenous substrate (sand/silt), lack of pools, eroding banks, open canopy and little riparian buffer zone. In addition to the low habitat score, algal mats were abundant and the conductivity was elevated (179 umhos/cm). Ambient data indicates high turbidity levels, high fecal coliform bacteria levels, and low pH. Water flow has recently been managed by the drainage district through the use of an inflatable fabric dam.

Crisp Creek (HUC 030201030302), AU# 28-87-1, is a tributary to Conetoe Creek. This channelized creek, has stabilized banks with a mature hardwood riparian zone. After two Moderate bioclassifications in 2004 and 2007, the 2012 collection reverted back to Severe which was consistent with the collection obtained at site OB78 in 2002. Further monitoring in this watershed is warranted to confirm that the drop in bioclassification in 2012 was related to low flows versus water quality. This stream is part of a DENR Ecosystem Enhancement Program plan.

Greenville-Tar River Watershed (0302010304)



Watershed Monitoring Sites	
Type	Site ID
Ambient	O6240000
Benthos	OB168 OB167 OB163 OB110
Fish	OF57 OF31

Greens Mill Run (HUC 030201030403), AU# 28-96, from source to Tar River, 7.3 miles is Impaired due to a Severe benthos bioclassification in 2004. Stream habitat conditions represent typical conditions in highly urbanized watersheds with very severe bank erosion and scour. Stream flow flashiness is apparent (e.g., high wrack lines, scour, severe bank erosion) and is indicative of highly impervious watersheds. Restoration efforts for Green Mill Run need to focus on both habitat and water quality improvements to significantly improve benthic bioclassifications. This stream is part of a DENR Ecosystem Enhancement Program local watershed plan; more information can be found at: http://www.nceep.net/services/lwps/Tar-Pamlico/Middle_Tar_LWP_Files/Middle_Tar_Rehabilitation_Plans_Appendices/Green_Mill_Run_Rehabilitation_Plan.pdf.

Parkers Creek (HUC 030201030404), AU# 28-95, from source to Tar River, 7.3 miles are Not Rated based on a 2007 fish community sample (OF31). This site is Not Rated because criteria are still being developed to rate coastal plain streams; when these criteria are finalized this stream can then be back-rated based on the 2007 sample. The sample indicated an improvement in riparian vegetation and bank stability since the 2002 sample; a diverse and abundant fish community was seen for such a small channelized stream.

In the summer of 2009, two benthic samples were taken upstream of OF31 to determine if stormwater from a specific property was contributing to water quality degradation. The samples indicated Poor ratings both upstream (SR 1579) and downstream (SR 1591) of the facility with impacted habitat in-stream and riparian limitations likely caused by historic channelization and extreme fluctuations in hydrology (flashiness). The poor aquatic macroinvertebrate habitat conditions could not be directly linked to the property of interest. Stormwater runoff and altered hydrology are likely the main reason for degraded water quality in this subwatershed. This subwatershed drains the Pitt-Greenville Airport and Greenville's industrial areas. Parkers Creek will likely be listed as impaired on the 2012 303(d) list.

Tranters Creek Watershed (0302010305)

Watershed Monitoring Sites	
Type	Site ID
Ambient	O7000000 O7100000 O7300000
Benthos	OB121 OB126 OB122 OB123 OB124
Fish	N/A

Old Ford Swamp, (030201030506), AU# 28-103-14-1, had the only benthic sample site to decline in bioclassification rating during the 2007 sampling period, going from a natural rating in 2002 to a moderate rating in 2007. The site also had the lowest pH (4.9) recorded at a benthic site in the basin. It is hypothesized that the lack of high pH agricultural runoff during the 2007 drought was supplanted by low pH swamp waters.

Haw Branch (HUC 030201030505)[AU# 28-103-9] was sampled in 2012 at site OB172 as part of a special study. The sample resulted in a Moderate swamp bioclassification.

Horsepen Swamp [AU# 28-103-10] was sampled in 2012 as part of the basinwide samples at site OB122. The sample resulted in a Moderate swamp bioclassification and was noted as being stable.

Latham Creek (HUC 030201030506)[AU# 28-103-14-2] was sampled in 2012 at site OB123 and received a Moderate swamp bioclassification. Nonpoint source pollution along with low water levels, flows, and dissolved oxygen (6.1 mg/L) were noted as possible limitations on some preferred habitats and conditions for macroinvertebrates in this swamp.

Tranters Creek Watershed, AU# 28-103a, runs ~38 miles from its source in Martin County to the Tar River in Beaufort County. Tranters Creek watershed (HUC 0302010305) drains ~243 sq. miles and includes the towns of Parmele, Robersonville, Everetts, and the northwestern parts of Washington. Land use data from 2011 indicates 19% of the watershed is forested, 35% agriculture, 19% wetlands, 20% scrub/grasslands, and 7% developed. There are also several waste residual application fields in the upper watershed. Over the past 10 years one swine animal operation facility has had numerous violations, resulting in minimal emergency volume storage capacity and poor spray field conditions.

The 2012 winter swamp sample (OB126) resulted in a Moderate bioclassification and noted the taxa collected were common with organic pollution or low dissolved oxygen levels. Further benthic and toxicity analyses are recommended at this Tranters Creek station to investigate any new point or nonpoint pollution sources upstream.

Land Cover

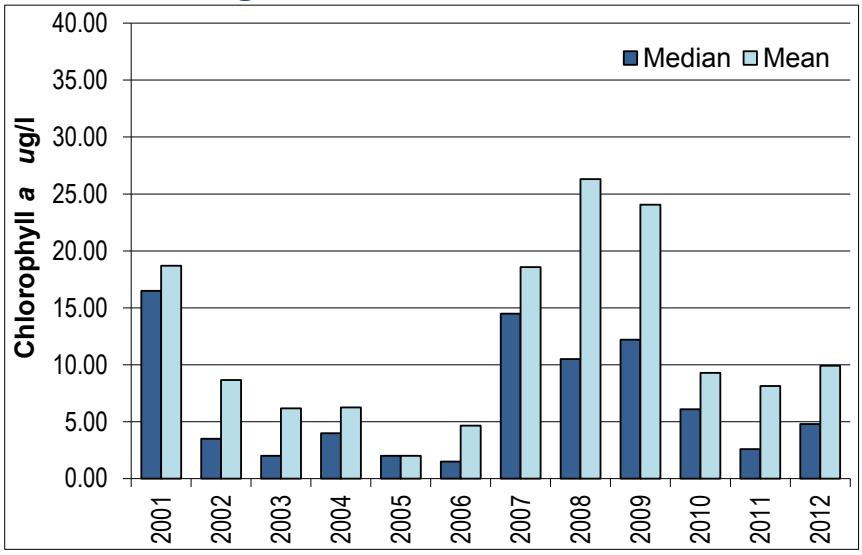
To help understand land use changes and potential impacts on water quality an analysis of the change in land cover was performed for the area draining to AMS 07300000 on Tranters Creek. Changes in land use between data collected for the 2001 National Land Cover Database and the 2011 dataset indicate that the loss of forest, agriculture and woody wetlands acres likely resulted in the large gain in scrub and grassland acres (Table 1).

Table 1: NLCD Land Cover changes between 2001-2011

Land Use	2011 % Land Cover	Percent change	Acres Lost/ Gained
Water	0.21	15.1	51
Developed	6.92	4.0	416
Barren	0.05	89.8	77
Forest	18.85	-22.3	-8,391
Scrub	15.07	32.8	7,661
Grassland	4.96	19.3	1,478
Agriculture	34.7	-2.4	-1,336
Woody Wetlands	17.21	-3.6	-954
Emergent Wetlands	2.02	31.8	998

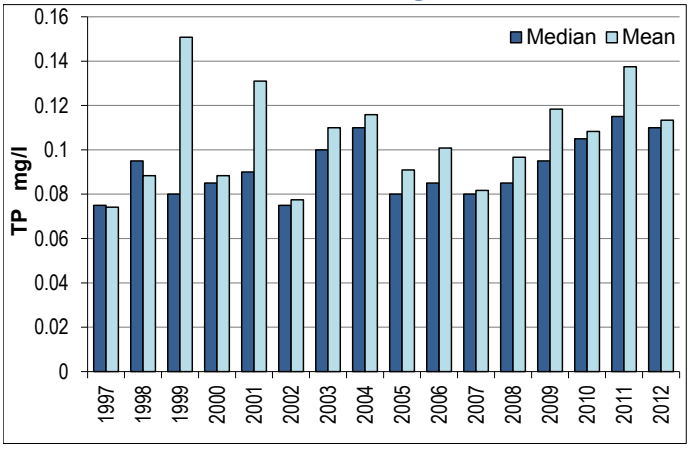
Tranters Creek and its tributaries are nutrient sensitive swamp freshwater systems. Chlorophyll *a*, a constituent of most algae, is a widely used indicator of algal biomass and the is the measured response to nutrient enrichment. The chlorophyll *a* standard is 40 µg/L (micrograms per liter) for lakes, reservoirs, and slow moving waters in North Carolina. The chlorophyll *a* standard is used to detect an algal response to accumulated nutrients to a waterbody. Figure 1 shows chlorophyll *a* data collected at the mouth of Tranters Creek.

Figure 1: Summary Chlorophyll a Concentration @ AMS 07300000

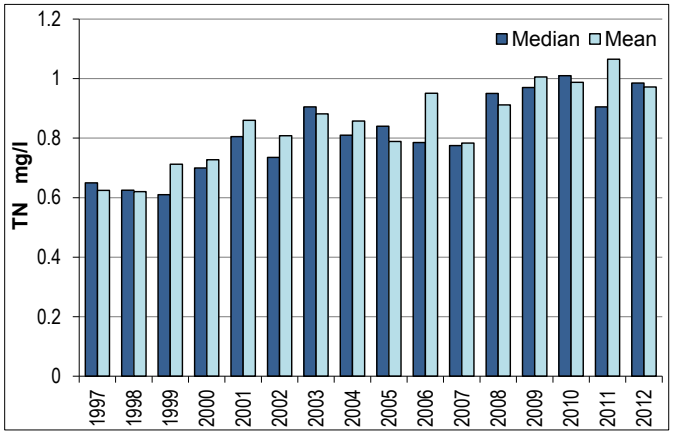


The following graphs show a summary of the nutrient parameters concentrations and ambient data collected at 07300000 over 16+ years.

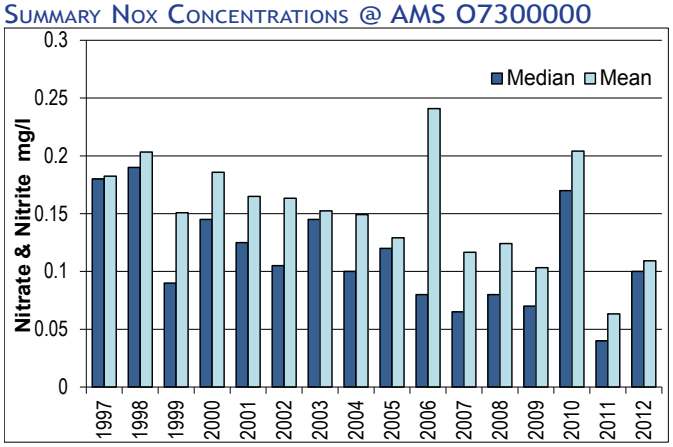
Total Phosphorus Concentration @ AMS 07300000



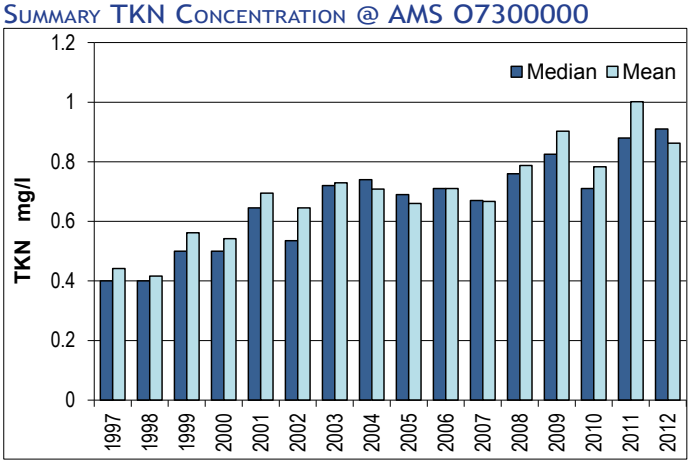
Total Nitrogen Concentration @ AMS 07300000



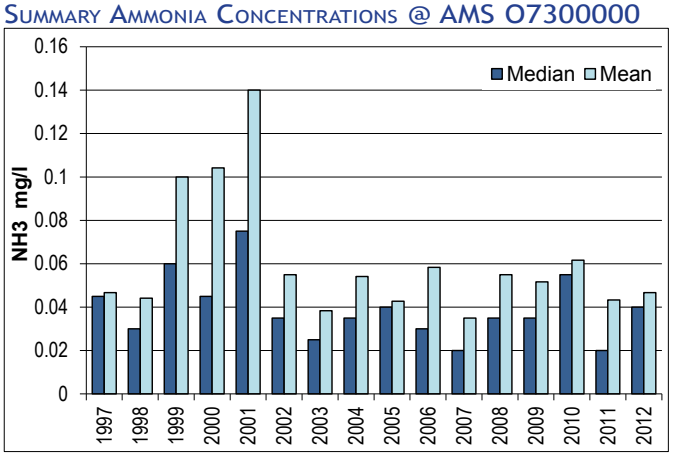
Summary Nox Concentrations @ AMS 07300000



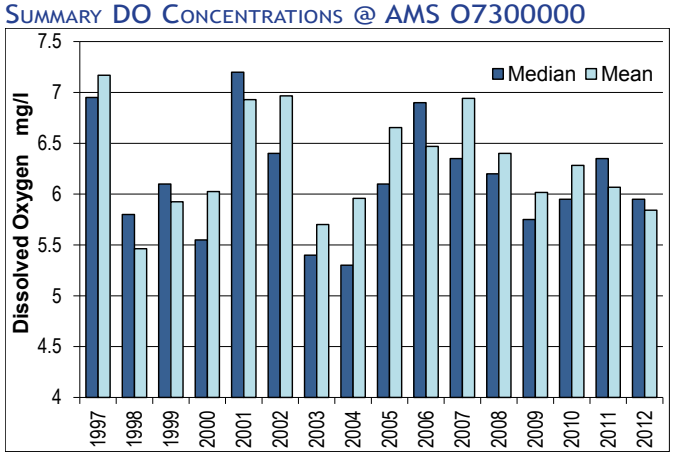
Summary TKN Concentration @ AMS 07300000



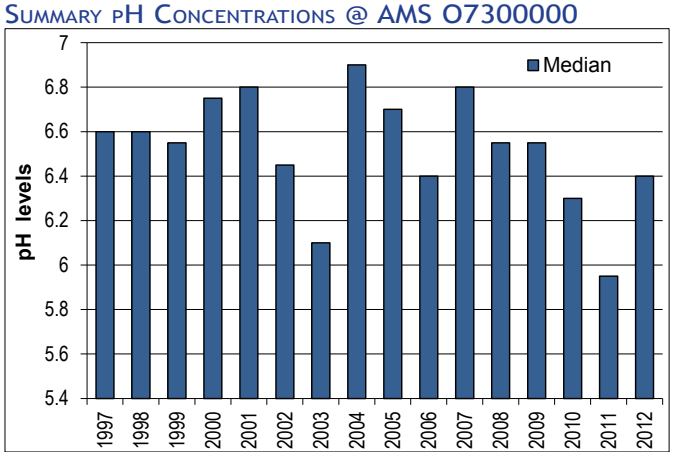
Summary Ammonia Concentrations @ AMS 07300000



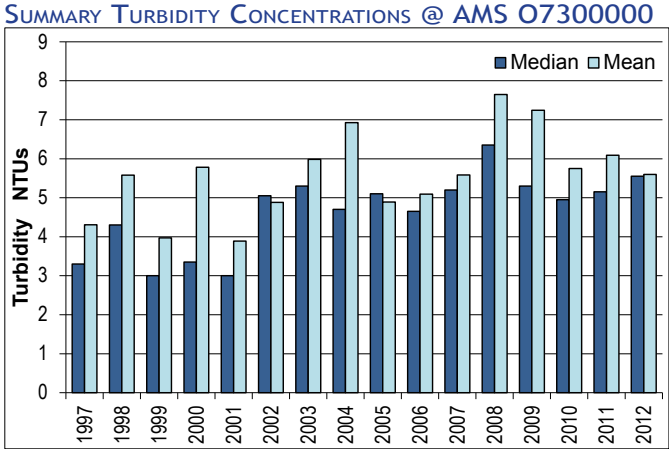
Summary DO Concentrations @ AMS 07300000



Summary pH Concentrations @ AMS 07300000



Summary Turbidity Concentrations @ AMS 07300000



Tar River Chicod Watershed (0302010306)

Watershed Monitoring Sites	
Type	Site ID
Ambient	O6700000 O6798000 O6450000 O6500000
Benthos	OB120 OB111 OB159 OB119 OB107 OB108 OB112
Fish	OF55 OF56 OF21 OF9 OF24

Whichard Branch (HUC 030201030601)[AU# 28-100-2] received at Moderate swamp bioclassification at site OB120 in 2012.

Grindle Creek's (HUC 030201030602) [AU# 28-100a & 28-100b] sample at site OB111 in 2012 resulted in a Good-Fair bioclassification. The benthic macroinvertebrate data suggest that conditions have improved, but specific conductance has risen and the 2012 sample resulted in the fewest EPT collected. Additional monitoring is strongly recommended at this macroinvertebrate site. There are two ambient stations along Grindle Creek, each showing incidences of low pH and high fecal coliform bacteria levels.

Hardee Creek (HUC 030201030605)[AU# 28-97] was sampled at site OB112 in 2012 and received a Moderate swamp bioclassification. Increased precipitation following the recent extended drought conditions in this mostly suburban catchment could be leading to more runoff and nonpoint source pollution inputs to this swamp.

Tar River [AU# 28-(99.5)] is monitored at ambient station O6500000 at Grimesland. The data from 2008-2012 does not indicate any violations that would result in this reach of the River to be Impaired. The data from this station, combined with flow data from the gage in Greenville, is used to assess compliance with the nutrient TMDL. Flow-adjusted trend analysis for nutrient concentration parameters in the Tar River at Grimesland indicate a decline in NH3-N and NOx-N, an increase in TKN and TN and no trend in TP. A detailed review of trend data from this station is available in the **NSW Report.**

Chicod Creek Watershed (HUCs 030201030603, 030201030604, 030201030605) [AU# 28-101], from source to Tar River, has a history of Poor, Fair, and Severe swamp bioclassification ratings that lead to the Impairment of 14.1 miles of the watershed. However, the 2007 benthic macroinvertebrate sample resulted in a Natural bioclassification. The 2012 sample resulted in a decline in bioclassification to Moderate, this is likely do to the increase in precipitation and an increase in nonpoint source pollution runoff in this mostly agricultural watershed.

Chicod Creek has numerous hog farms within its drainage area that could be contributing to nonpoint source pollution if inadequate BMPs are used or if nutrients are traveling via groundwater to the creek. There are five swine animal operations within this subbasin that have been issued NOVs or have come close to being in violation of their permits. These facilities have had various problems including lagoon pump leaking, high freeboard levels, erosion and woody vegetation on lagoon banks, irrigation outside acceptable crop window, poor spray field conditions, and poor record keeping issues. DWR will continue to closely monitor these facilities.

Chicod Creek was also Impaired because of high levels of fecal coliform bacteria concentrations related to agricultural activities. A **TMDL** was completed in 2004 addressing the fecal coliform bacteria. As of 2010 303(d) list of Impaired waters, the creek is no longer Impaired.

TRENDS at Ambient Station O6450000

Land Cover

Chicod Creek is a small 44 square mile agricultural based watershed located in close proximity to Grimesland and the Pamlico estuary. To help understand land use changes and potential impacts on water quality, an analysis of the change in land cover was also performed for the area draining to AMS O6450000 on Chicod Creek. Changes in land use between data collected for the 2001 National Land Cover Database and the 2011 dataset indicate that the loss of forest, agriculture and woody wetland acres likely resulted in the large gain in scrub and grassland acres (Table 1).

Table 1: NLCD Land Cover changes between 2001-2011

Land Use	2011 % Land Cover	Percent change	Acres Lost/ Gained
Water	0.20	25.91	13
Developed	4.56	3.11	38
Barren	0.43	80.13	96
Forest	11.06	-37.76	-1,890
Scrub	10.98	36.38	1,126
Grassland	6.05	43.28	736
Agriculture	40.48	-1.09	-125
Woody Wetlands	24.59	-2.89	-198
Emergent Wetlands	1.66	43.59	205

Nutrient Concentrations and Loads

During the early 1990's, the Chicod Creek watershed received federal funds to support agricultural BMP implementation. A trend analysis was conducted in 1998 to determine if statistically significant changes in nutrient loads and concentrations occurred pre- and post- BMP implementation. The 1990's trend results indicated a significant decrease in total nitrogen (TN) concentration and load and no statistically significant change in total phosphorus (TP).

In 2014, DWR completed trends analyses at five locations throughout the basin including Chicod Creek near Simpson (AMS O6450000) using data through 2013. These analyses compared changing nutrient concentrations to the TMDL baseline year of 1991, except for Chicod Creek, in which the baseline year of 1993 was used. It should be noted that flows were much higher 1993 than in 1991 and therefore meeting reductions goals appears to be more achievable. More details about these trends are available in the **NSW Report**.

Flow adjusted concentration

The results of the Seasonal Kendall test for flow-adjusted concentrations of ammonia (NH3-N), nitrate/nitrite (NOx-N), Total Kjeldahl nitrogen (TKN), TN, and TP at O6450000 are provided in Table 2. Except for NH3-N and NOx-N, there were no statistically significant trends for TKN, TN, and TP. The downward slopes of NH3-N and NOx-N suggest that the average decrease in median concentration is 38% and a 57%, respectively, over the 22 years of the study period.

Table 2: Result of Nutrient Concentrations Seasonal Kendall Trend Analysis (1993-2013).

Water Quality Constituents (mg/L)	Seasonal Sen Trend Slope (mg/L/year)	Significant Trend at 95%	First 12 month Median	Average % Change in Median
NH3-N	-0.00592	Decreasing	0.31	-38.19
NOx-N	-0.02279	Decreasing	0.8	-56.98
TKN	-	No trend	1	-
TN	-	No trend	1.9	-
TP	-	No trend	0.42	-

Flow-normalized load

Data from 1993-2013 was used in a flow-normalized analysis to evaluate loading in 5-year blocks and compare it to baseline years of 1993-1997 5-year block. The overall results from a flow-normalized loading analysis indicates an overall 33% decrease in NOx-N, 24% decrease in TKN, 28% decrease in TN and 22% decrease in TP. Although the results show an overall decline in nutrient loading the assessment of the most recent years show an increase in NOx-N, TKN, and TN starting 2008 as shown in (figure 1) with the majority of the loading occurring during high flows (figure 2).

Figure 1: Relative TN Load Reduction- Comparison to 1993-1997, AMS 06450000

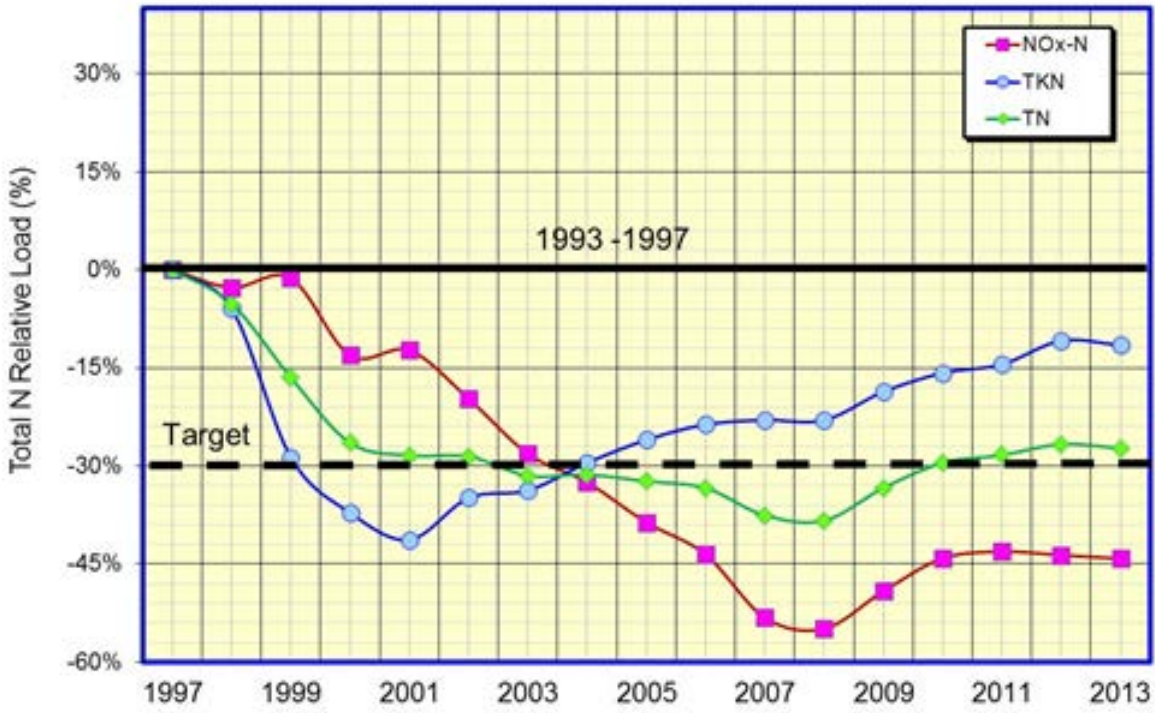
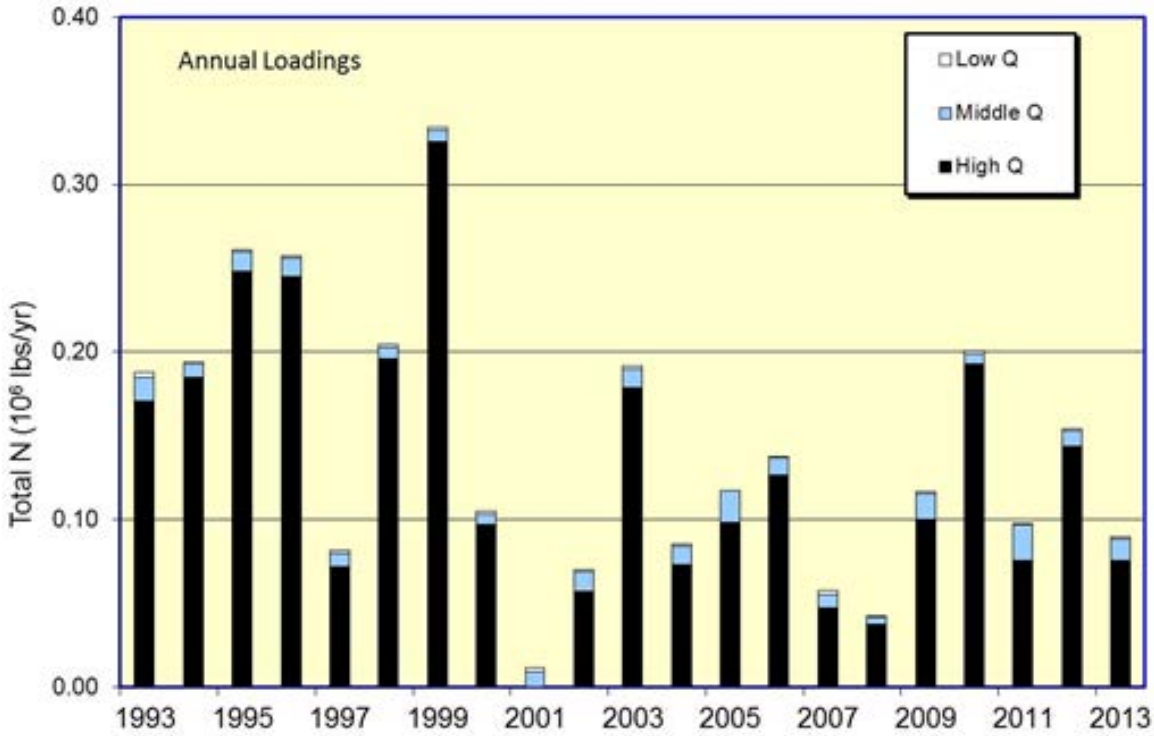


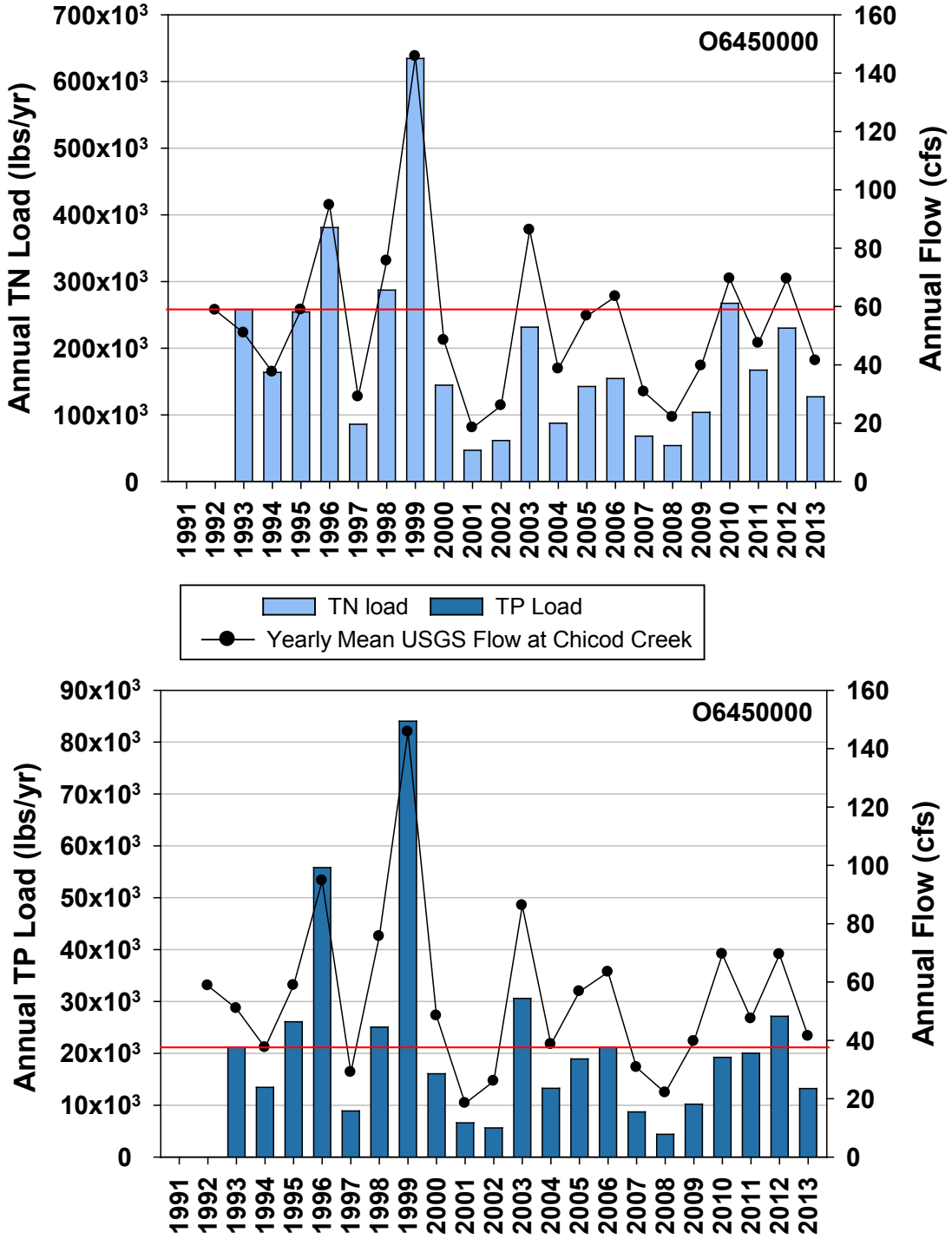
Figure 2: Annual TN Loading at AMS 06450000 by Flow Interval



Annual Load

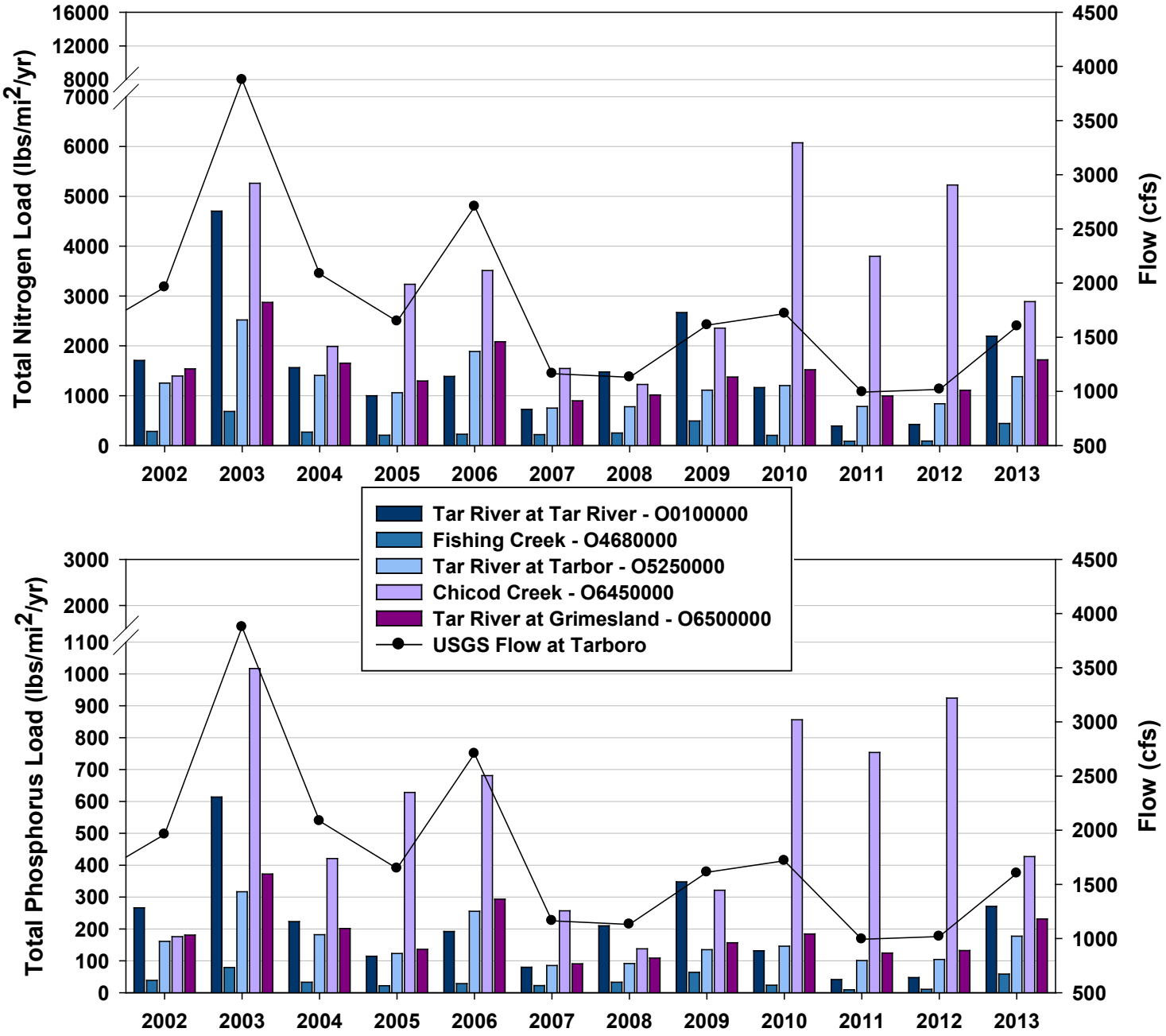
Annual Load estimates were run using USGS's LOAD ESTimator. Figure 3 shows the annual load results in comparison to the 1993 baseline year (shown as a red horizontal line). The yearly estimated TN and TP loading were lower in 15 and 13 of the 20 years post the 1993 baseline loads, respectively. These graphs also indicate that during lower flow conditions the loading is below the baseline and they also show several years of increasing loads post a drought year.

FIGURE 3: LOADEST TOTAL PHOSPHORUS & TOTAL NITROGEN LOAD ESTIMATES AT AMS 06450000



Using the watershed size of each ambient station and the LOADEST results helps understand what level of loading is being delivered per square mile and what amount of loading might be expected from a specific type of land use. Figure 4 shows TN & TP loads for each watershed. The estimated mean TN loading in Chicod Creek was 188,112 lbs/yr with a unit area loading mean of 4,275 lbs/mi^2/yr. The estimated mean TP loading was 32,110 lbs/yr with a unit area loading of 730 lbs/mi^2/yr. The TN and TP area unit loading is 2.7 times and 3.7 times higher from the Chicod Creek watershed than at the Tar River at Grimesland station. The unit area loading from Chicod Creek is substantially higher than all the other watersheds assessed. Chicod Creek watershed only accounts for 1.5% of the overall Grimesland watershed but accounts for 4.1% of the overall estimated mean load. While it appears that the loads are lower than the 1993 baseline load, it is

FIGURE 4: LOADEST TN & TP UNIT AREA LOAD ESTIMATES FOR ALL WATERSHEDS ASSESSED 2002-2013



considerably high and the sources of nutrients in this watershed should be identified. DWR should work closely with the Soil and Water Conservation District to determine what BMP has been utilized and if additional practices are likely to help reduce the high instream concentrations and overall load.

Groundwater monitoring in this watershed would be helpful to understand if and how nutrients are moving from groundwater to surface waters. It is recommended that Chicod Creek watershed be used as a pilot study area to initiate expansion of DWR's groundwater quality monitoring.

Additional Studies

Ecosystem Enhancement Program (EEP) Middle Tar-Pamlico Local Watershed Plan

Assessment of the middle Tar-Pamlico region by EEP began in 2004 with a focus on four waterbodies including: Cow Swamp, Crisp Creek, Green Mills Run, and Hendricks Creek.

All of these subwatersheds have been significantly impacted by development and agricultural practices, resulting in a loss of wetlands and buffers, increased runoff, and a general degradation in water quality. The goal of the EEP plan is to provide a framework for watershed functional rehabilitation and to provide primary supporting information for implementation of the rehabilitation system while taking into consideration development and agriculture. To achieve this, efforts were focused on three investigative methods: 1) land use/land cover trending analysis; 2) watershed system modeling; and 3) riparian reach field investigation. The findings and results from these tasks were tabulated and compared with the concerns of the stakeholder groups. The end result being the location of potential restoration, enhancement, preservation and BMP sites that are best suited to meet the goals of the study. More information about these ongoing restoration opportunities can be found on the EEP website at: http://www.nceep.net/services/lwps/pull_down/by_basin/TarPamlico_RB.html.

Lower Tar River (B-071206)

Special study sampling in the lower Tar River indicated dramatic changes (ranging from Excellent to Fair) in the benthic community between Tarboro and downstream of Greenville. Several factors influenced the benthic community in the lower Tar River including saline waters moving upstream towards Greenville during lower flows and wind tides from Pamlico River/Sound. Periodic saltwater events can stress the predominately freshwater aquatic benthic community in the lower Tar River. These short-term oligosaline conditions also masked the stresses associated with urban runoff from Greenville and the effects of a 17.5 MGD major discharger, the Greenville Utility Commission's WWTP (NC0023931), downstream of the city. Furthermore, the physical character of the Tar River changes in the vicinity of Greenville, from a shallow water body, with moderate current (Coastal A) to a deeper river with little or no current (Coastal B).

This study investigated possible water quality influences (e.g. urban areas of Greenville, WWTP) one potential source at a time, by sampling upstream and downstream of both the city and the WWTP. Tar River sites sampled in 2007 for this study were: NC 42, US 264, US 264A, SR 1565. The habitat scores were similar among all four of the sites suggesting that the differences in the biological communities were related to water quality at each site, or natural, physical changes in

the lower Tar River. Especially in larger rivers, in-channel snags provide an important colonization habitat for aquatic macroinvertebrates. Both downstream sites (US 264A and SR 1565) had abundant snags, in addition to other habitats.

Aquatic macroinvertebrate data do not suggest any water quality problems in the Tar River below Tarboro downstream to Greenville. Sampled aquatic communities were diverse and many were pollution sensitive. From US 264 to US 264A, there was a 35% decrease in the total number of macroinvertebrate taxa collected from the Tar River. Only half the numbers of EPT taxa found at the two sites upstream of Greenville were collected downstream at US 264A. The actual physical change in the Tar River (from Coastal A to Coastal B), as opposed to water quality changes, could account for these decreases.

Water quality degrades from US 264A to SR 1565, below the Greenville WWTP, as indicated by the increase in the Biotic Index and EPT Biotic Index, and the decreases in EPT taxa. Many of the taxa collected below the Greenville WWTP (SR 1565) are pollution tolerant species (but also species tolerant of naturally low levels of dissolved oxygen, oligosaline, and lentic conditions). The combination of the natural, physical changes in the lower Tar River, a moderate urban influence from the City of Greenville and the impacts of the Greenville WWTP, resulted in a decline of over 70% of the EPT fauna at the point where the Tar River flows under SR 1565, when compared with upstream sites. In addition to the Greenville urbanization and the WWTP effects, estuarine and lentic influences, as documented by both water chemistry and the biological community, affected the predominately freshwater benthos in the lower part of the Tar River between Greenville and SR 1565.

Volunteer Water Information Network

The Volunteer Water Information Network (VWIN) is a partnership of groups and individuals dedicated to preserving water quality in North Carolina. In August 2005, the Pamlico-Tar River Foundation initiated a monitoring program in tributaries to the Tar River. The UNC-Asheville Environmental Quality Institute (EQI) provided technical assistance through laboratory analyses of water samples, statistical analyses of water quality results, and written interpretation of the data. Volunteers collected water samples once a month from selected streams in Edgecombe, Nash and Pitt counties. The results of this data collection are similar to DWR's sampling results, but VWIN also collected data on streams that DWR does not monitor. Statistical analyses and interpretation of data from samples gathered from Briery Swamp, Chicod Creek, Cokey Swamp, Conetoe Creek, Green Mill Run, Grindle Creek, Hardee Creek, Hendricks Creek, Meeting House Branch, Moye's Run, Parker Creek, and Town Creek are found in the VWIN report.