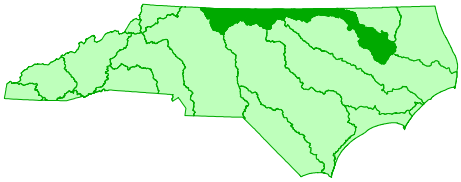
Executive Summary

Roanoke River Basin



River Basin Description

The Roanoke River basin extends from its source in the Blue Ridge Mountains of Virginia to the Albemarle Sound in North Carolina, encompassing mountainous, piedmont, and coastal topography as it flows generally east-southeastward. Its five subbasins (Figure ES-2) constitute approximately 3,500 square miles of drainage area and approximately 2,400 miles of streams and rivers in North Carolina, and contains diversity with classified trout streams in the western portion and swamp classified waters in the eastern portion. Seventeen counties and 42 municipalities are within the NC portion of the basin.

The ecoregions associated with this river basin are the:

- Sauratown Mountains of the Blue Ridge ecoregion;
- Triassic Basins;
- Southern Outer Piedmont;
- Northern Inner Piedmont;
- Carolina Slate Belt;
- Northern Outer Piedmont ecoregions of the Piedmont;
- Rolling Coastal Plain;
- Southeastern Floodplains;
- Low Terraces ecoregions of the Southeastern Plains;
- Mid-Atlantic Flatwoods;
- Mid-Atlantic Floodplains;
- Low Terraces ecoregions of the Middle Atlantic Coastal Plain.

Though some urban and suburban development has occurred in the Roanoke River basin, according to 2006 data, the greatest portion of land cover in the basin has remained forest and, to a lesser extent, agriculture-based. Also characteristic of activities throughout the state, nonpoint source runoff and numerous small point source dischargers associated with development and agricultural activities have potential to affect water quality in the basin.

Basin at a Glance

Counties:

Beaufort, Bertie, Caswell, Forsyth, Granville, Guilford, Halifax, Martin, Northampton, Orange, Person, Rockingham, Stokes, Surry, Vance, Warren, & Washington

Major Municipalities:

Eden, Henderson, Oak City, Reidsville, Roanoke Rapids, & Roxboro

Permitted Facilities:

NPDES Dischargers: 223
- Major 17
- Minor 48
- General 158

NPDES Non-Discharge:.....44
Stormwater: 131
- General 122
- Individual 9

Animal Operations: 84
Aquaculture:.....45

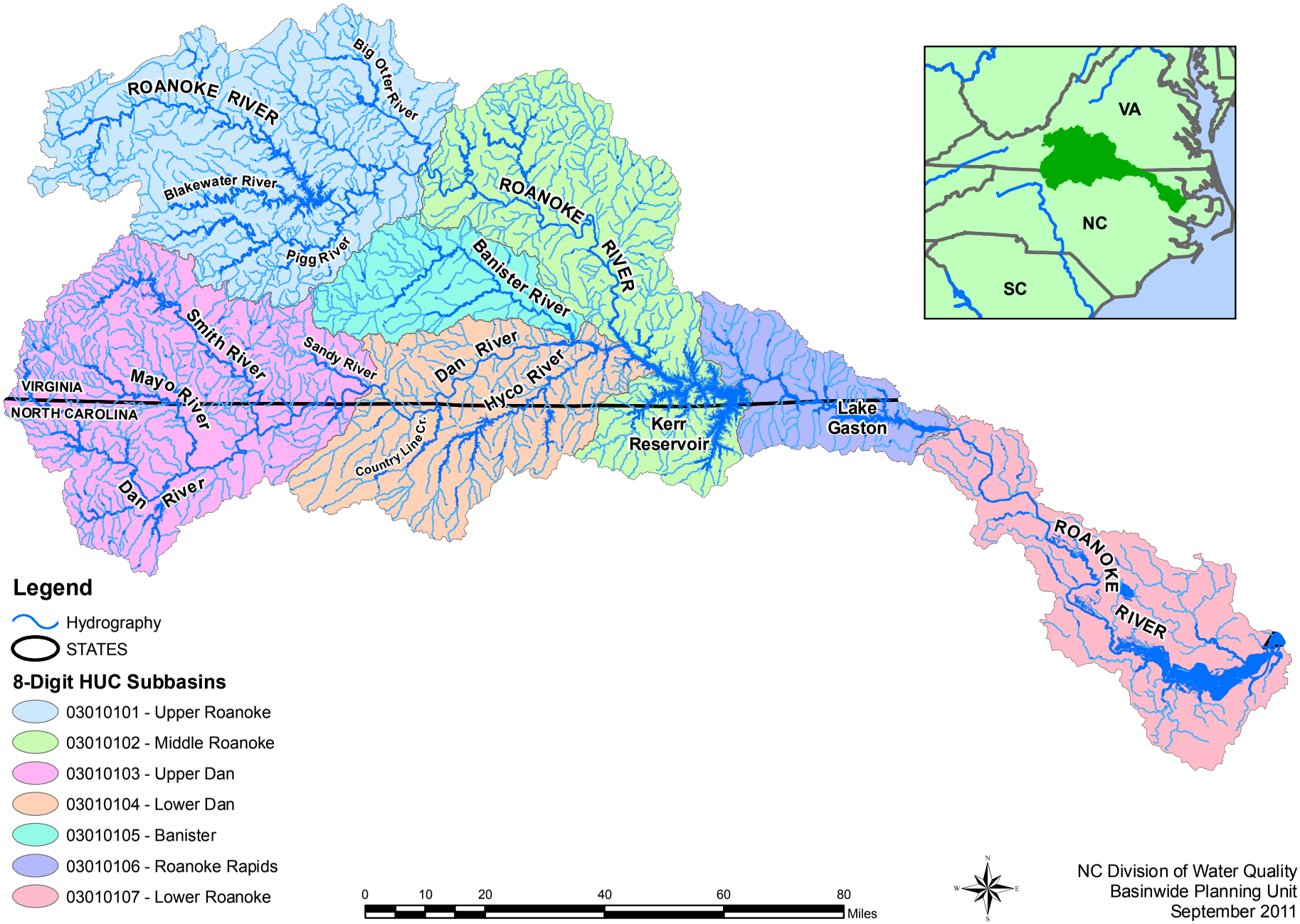
Population:

2000 Census.....285,488
2010 Census.....289,784

2006 Land Cover:

Open Water.....2.6%
Developed.....6.5%
Forest 48.2%
Agriculture.....21.1%
Wetlands.....11.9%
Barren Land 0.1%
Shrub/Grassland 9.6%

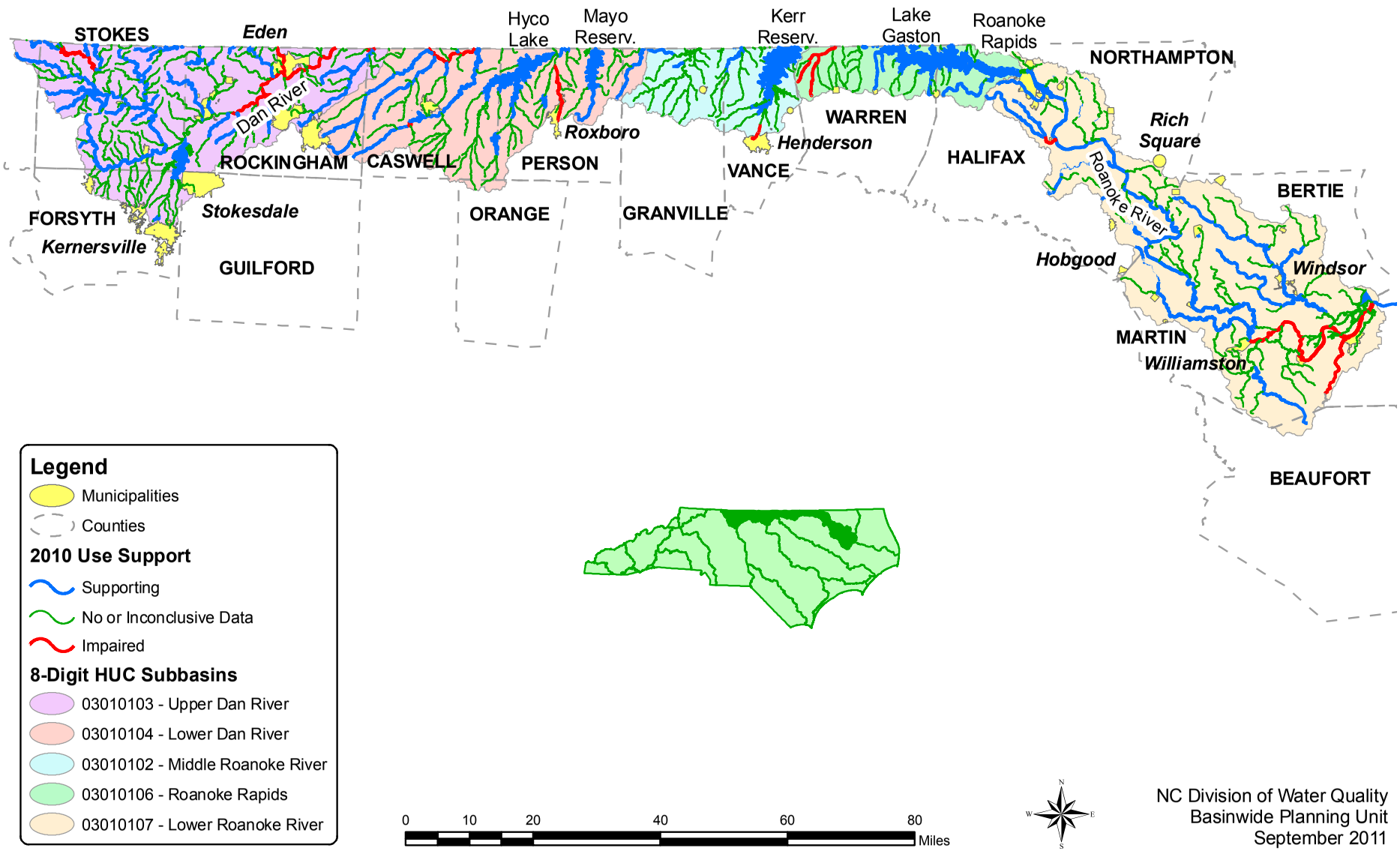
Entire Roanoke River Basin



NC Division of Water Quality
Basinwide Planning Unit
September 2011

FIGURE ES-1: THE ENTIRE ROANOKE RIVER BASIN (HYDROLOGIC UNIT CODE 030101)

NC Portion of the Roanoke River Basin



NC Division of Water Quality
Basinwide Planning Unit
September 2011

FIGURE ES-2: NORTH CAROLINA PORTION OF THE ROANOKE RIVER BASIN

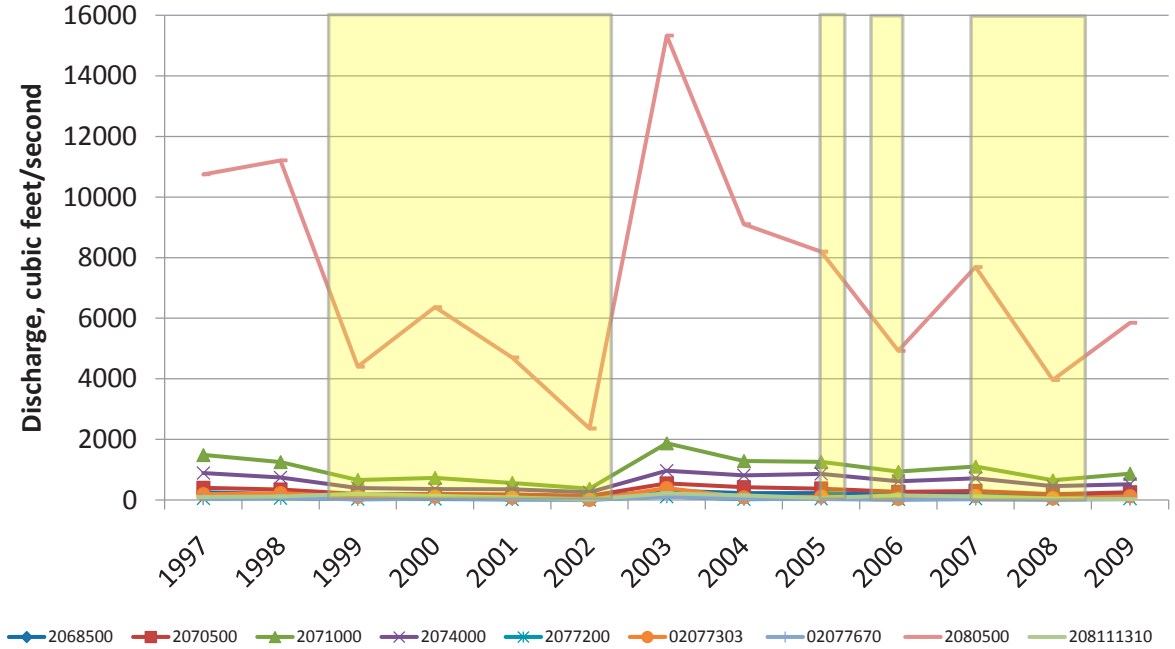
WATER QUALITY DATA OVERVIEW

Stream flow, aquatic biology, and chemical/physical parameters were analyzed as part of the basinwide planning process. Detailed information about the Division of Water Quality (DWQ) monitoring and the effects each parameter has on water quality is discussed in Chapters 2 and 3 of the Supplemental Guide to North Carolina's Basinwide Planning document.

STREAM FLOW

The basin experienced prolonged droughts between 1998-2002 and between 2007-2008, with moderate droughts in 2005 and 2006 (Figure ES-3). Details about flows in the Roanoke River Basin is in the 2010 Roanoke River Basinwide Assessment Report by DWQ-Environmental Sciences Section (ESS).

FIGURE ES-3: YEARLY FLOW RATES (CFS) OF THE USGS GAGE STATIONS IN THE ROANOKE RIVER BASIN BETWEEN 1997 & 2009



Indicates periods of drought in the Roanoke River Basin

From Left to Right:

- 2068500: Dan River (Francisco)
- 2070500: Mayo River
- 2071000: Dan River (Wentworth)
- 2074000: Smith River
- 2077200: Hyco Creek (Leasburg)
- 2077303: Hyco Creek (McGehees)
- 2077670: Mayo Creek
- 2080500: Roanoke River
- 208111310:Cashie River

Biological Data

Biological samples of benthic macroinvertebrate and fish communities were collected mostly during the spring and summer months of 2009 by DWQ-ESS as part of the five-year cycle basinwide sampling efforts. Limited samples were also collected for special studies. Overall, 65 biological sampling sites were monitored and rated within the Roanoke River Basin. Each site's biological rating is used to determine the stream's aquatic life use support category (Figure ES-4) for use on the Integrated Report.

Benthic Macroinvertebrate Sampling

Each benthic station monitored during the current cycle is shown in Figure ES-5 and color coded based on its current rating. Each of the sites are discussed in more detail in the subbasin chapters. Figure ES-7 is a comparison of benthic site ratings sampled during the last two basinwide cycles to indicate if there are any overall shifts in ratings. Benthic ratings from this cycle are overall similar to those received during the previous cycle, indicating a relatively stable benthic macroinvertebrate community.

Figure ES-4: Use Support Categories for Biological Ratings

Biological Ratings	Aquatic Life Use Support
Excellent	Supporting (Categories 1-2)
Good	
Good-Fair	
Not Impaired	
Not Rated	Not Rated (Category 3)
Fair	Impaired (Categories 4-5)
Poor	

Benthic Sampling Summary

- Total Stations Monitored 39
- Total Samples Taken 42
- Number of New Stations 17

Figure ES-5: Benthic Macroinvertebrate Stations Color Coded by Current Rating in the Roanoke River Basin

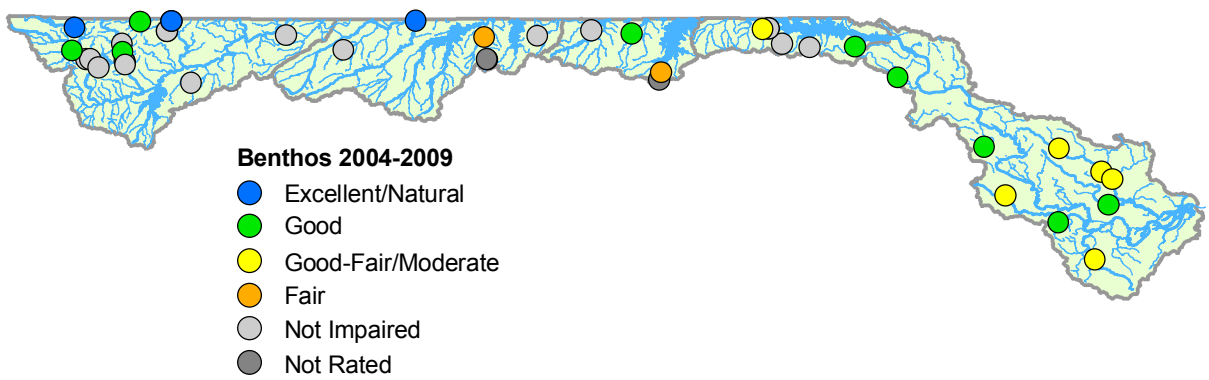


Figure ES-6: Current Benthic Macroinvertebrate Site Ratings

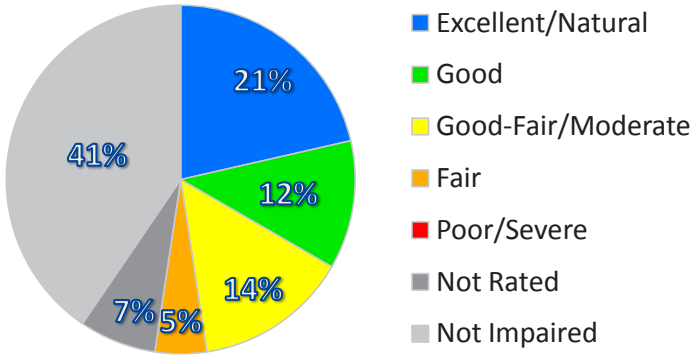
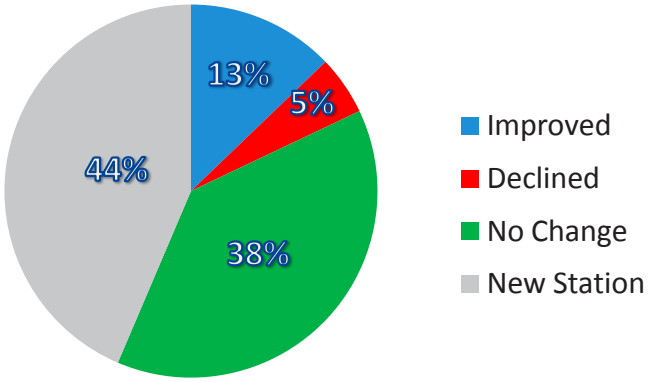


Figure ES-7: Change in Benthic Macroinvertebrate Site Ratings



Fish Community Sampling

Each fish community station monitored during the current cycle is shown in Figure ES-8 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section, below. Figure ES-9 shows the percentages of each rating given during this sampling cycle within the basin. Figure ES-10 is a comparison of fish community site ratings sampled during the last two cycles to determine if there are any overall watershed shifts in ratings. The majority of stations had no change in rating; however, six stations declined in rating and six increased in rating.

FISH COM. SAMPLING SUMMARY

Total Stations Monitored	26
Total Samples Taken	29
Number of New Stations	3

FIGURE ES-8: FISH COMMUNITY STATIONS COLOR CODED BY CURRENT RATING IN THE ROANOKE RIVER BASIN

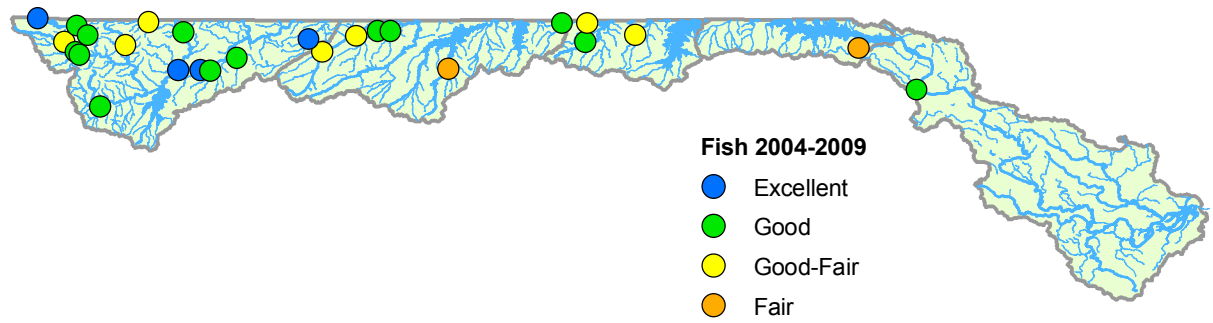


FIGURE ES-9: CURRENT FISH COMMUNITY SITE RATINGS

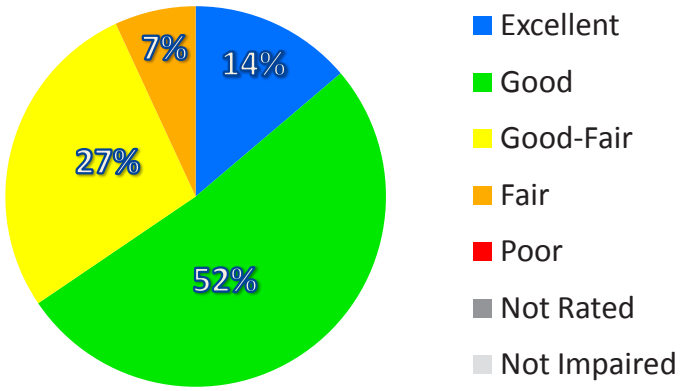
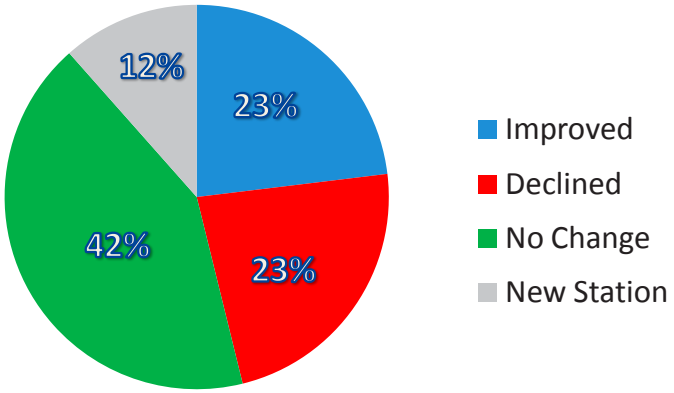


FIGURE ES-10: CHANGE IN FISH COMMUNITY SITE RATINGS



For more information about biological data in this basin, see the **2010 Roanoke River Basinwide Assessment Report**. Detailed data sheets for each sampling site can be found in **Appendix 1-B**.

AMBIENT MONITORING DATA

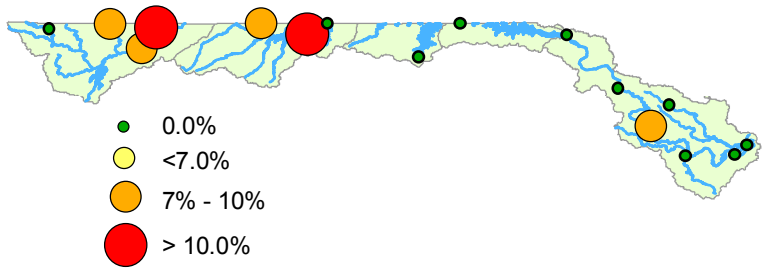
During the 2004-2008 sampling cycle, DWQ collected samples at 18 Ambient Monitoring System (AMS) stations in the basin. Each station was sampled ten or more times and used for use support assessment. The assessment shows that the majority of exceedances were for copper and turbidity parameters. Fecal coliform bacteria is also a parameter of concern within the Roanoke River Basin. All three parameters are discussed below.

Specific information about ambient monitoring methodology, seasonal variation, and data sheets for ambient stations in this basin are in the **Roanoke River Basin Ambient Monitoring System Report**.

Copper

Two ambient stations exceeded the State standard for copper levels more than 10% of the time (Smith River and Marlowe Creek). These stations are indicated by the large red dots in Figure ES-11. Four stations exceeded the standard in less than 10% of samples and 12 stations had no exceedances. The cause of the elevated levels is unknown; however, possible sources could be past instream mining operations, agricultural use such as pesticides, or urban influences such as dust from brake pads. The current copper standard is relatively low and maybe revised during this upcoming cycle. If samples continue to exceed the standard during the next sampling cycle, a source study is recommended.

Figure ES-11: Percent of Samples Exceeding the Copper Standard (2005-2009)

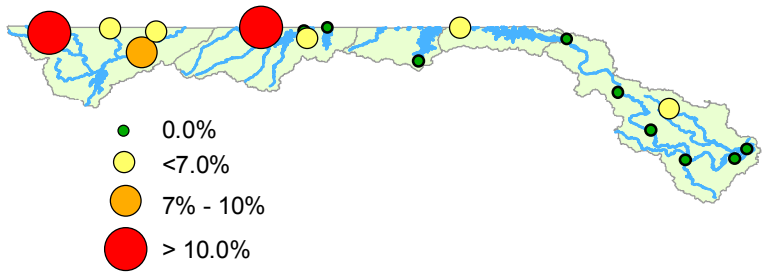


Turbidity

The two ambient stations exceeding the State standard, as indicated in Figure ES-12 by large red dots, are both on the Dan River. The Dan River has a long history of being turbid. Six other stations exceeded the standard in less than 10% of samples.

The cause of turbidity in the Dan River has previously been linked to instream mining operations and agricultural fields along the river. However, no permitted mining operations remain and many agricultural practices have adopted better management practices to reduce sediment reaching the streams.

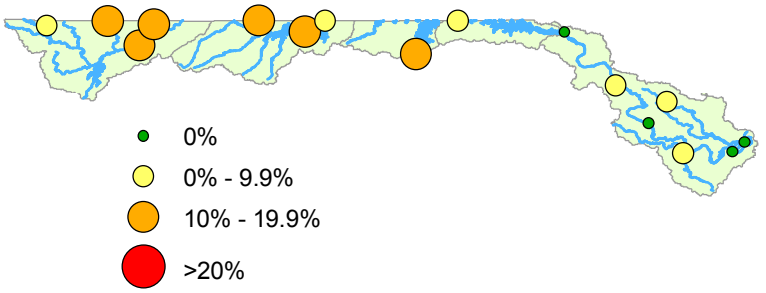
Figure ES-12: Percent of Samples Exceeding the Turbidity Standard (2005-2009)



Fecal Coliform Bacteria (FCB)

The FCB standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100 ml or 400 colonies/100 ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results

Figure ES-13: Percent of Samples Exceeding the FCB Screening Criteria (2005-2009)



from a 5-in-30 study are used to determine whether a stream is Impaired or Supporting. Waters with a use classification of B (primary recreational waters) receive priority over other waters for 5-in-30 studies.

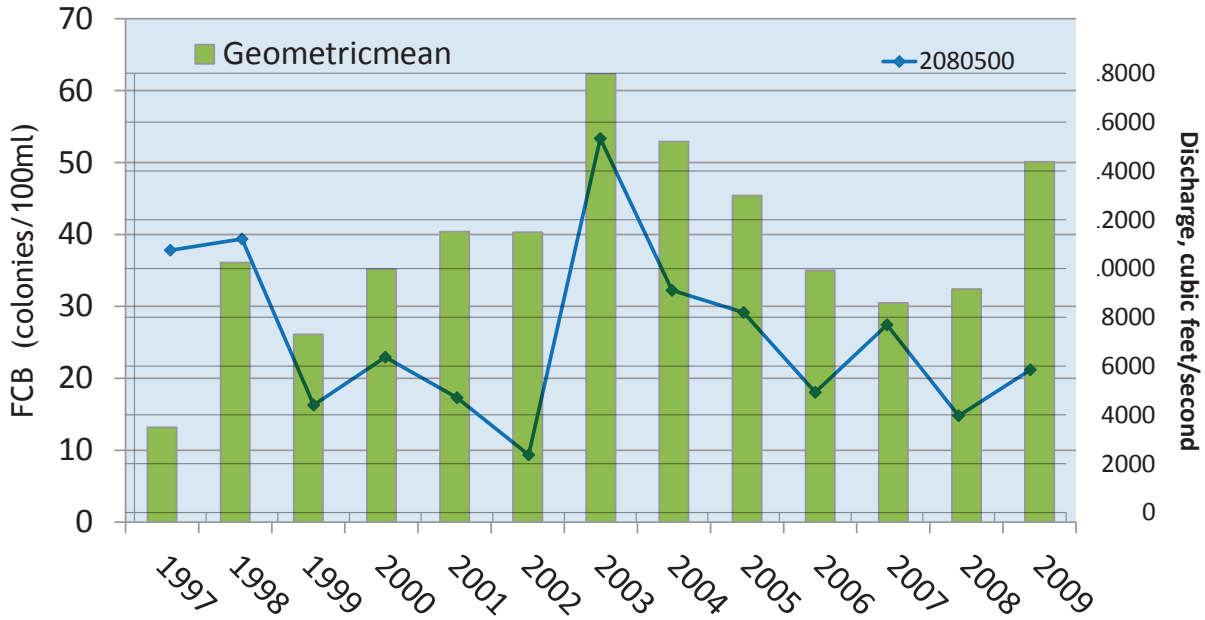
DWQ uses a screening criteria of 400 colonies/100 ml in 20% of samples to consider the need for a 5-in-30 study. Figure ES-13 shows the percentage of samples at each station that exceeded this screening criteria. Recreational waters that exceed this criteria would be prioritized for additional sampling. However, none of the recreational waters in the Roanoke River Basin exceeded the screening criteria.

Figure ES-14: Livestock in Stream

The geometric mean of FCB per year for the basin between 1997 and 2009 is shown in Figure ES-15. Overlaying the yearly flow averages for the Roanoke River with the yearly geometric mean of FCB indicates an influence of flow on FCB levels.

The overall decrease in levels from 2003-2008 could be attributed to a number of reasons including reduced flow levels and watershed groups that have actively been fencing livestock out of streams, as in Figure ES-14. Recommendations to further reduce FCB levels can be found in the subbasin chapters.

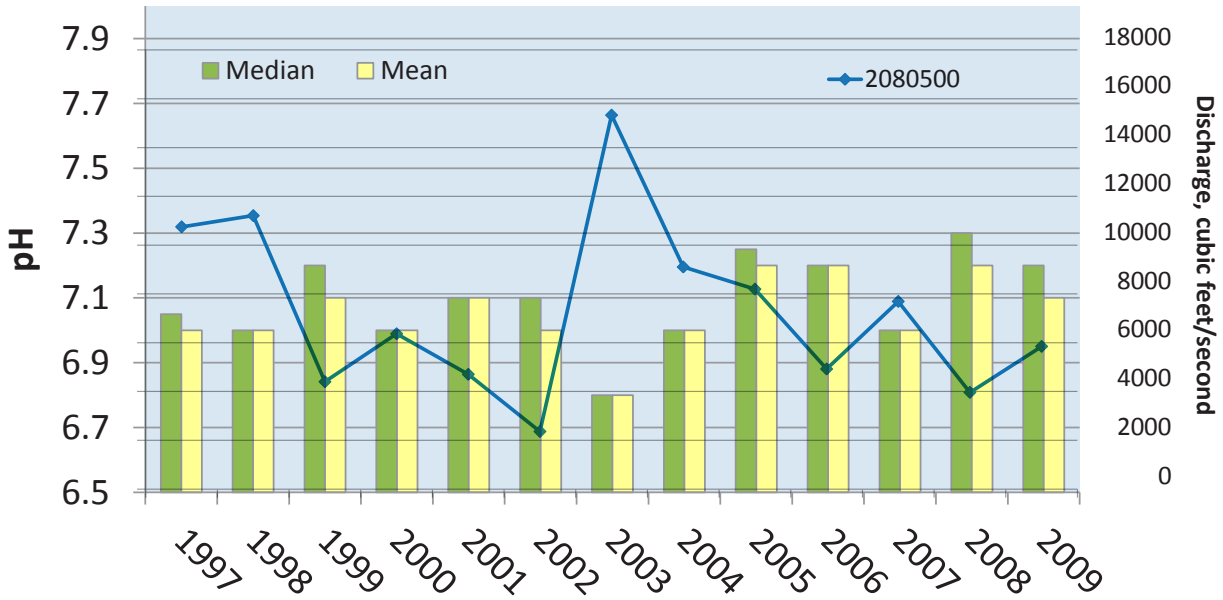
Figure ES-15: Yearly Geometric Mean Fecal Coliform Bacteria Data within the Roanoke River Basin with Flow Gage Data From the Roanoke River at Roanoke Rapids (Between 1997 & 2009)



pH

Figure ES-16 shows the mean and medians of all pH data collected in the basin per year over time along with the flow line for the Roanoke River. A few of the eastern AMS stations are exceeding the state standard for pH; however, in less than 10% of samples. The graph may indicate pH levels in the basin are at least somewhat linked to stream flow.

Figure ES-16: Mean & Median Yearly pH Data within the Roanoke River Basin with Flow Gage Data From the Roanoke River at Roanoke Rapids (Between 1997 & 2009)



Population & Land Cover

Urbanization most often has a detrimental affect on to aquatic resources. Small towns and communities are usually not considered urban centers, but even small concentrations of urbanization can have significant impacts on local waterways. For example, a one-acre parking lot produces 16 times more runoff than a one-acre meadow (Schueler and Holland, 2000). A wide variety of studies over the past decade converge on a central point: when more than 10 percent of the acreage in a watershed is covered in roads, parking lots, rooftops, and other impervious surfaces, the rivers and streams within the watershed become seriously degraded. Studies show that if urbanized areas cover more than 25 percent of a watershed, the decline in the health of the ecosystem is irreversible (Beach, 2002; Galli, 1991).

POPULATION

Population growth and urban stormwater runoff are likely contributing factors to stream pollution in urban areas throughout the Roanoke River Basin. The 2010 census population of the North Carolina portion of the Roanoke River basin is 289,784. This is an increase of roughly 4,300 (1.5%) individuals from the 2000 census. The two figures below show distribution in population throughout the basin by 12-digit subwatersheds between 2000 and 2010. The subwatersheds with the highest populations are indicated by red and those with smaller populations are indicated by green. The two 12-Digit HUCs with largest growth contains the Town of Windsor and the 12-Digit HUC just down stream. These two HUCs had 33% and 121% growth, respectively. Subwatersheds around the Mayo and Kerr Reservoirs had growth of 25% and 31%, respectively (as indicated in Figure ES-18).

FIGURE ES-17: 2000 US CENSUS POPULATION IN THE ROANOKE RIVER BASIN BY 12-DIGIT SUBWATERSHED

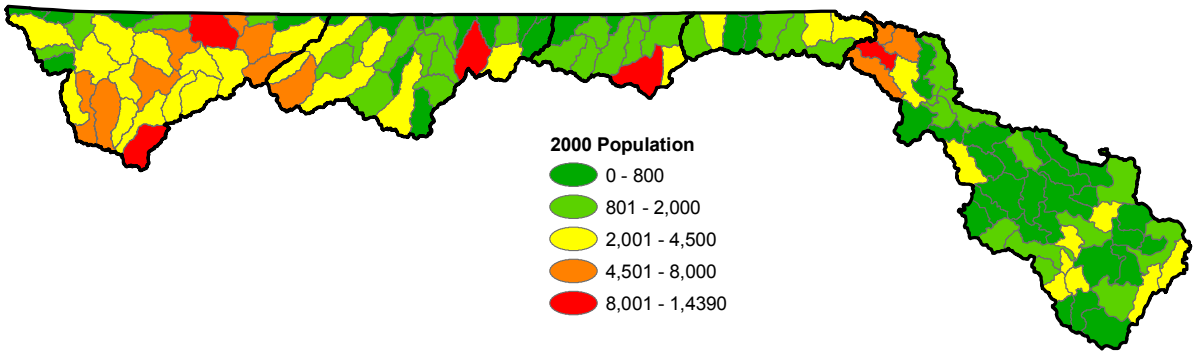
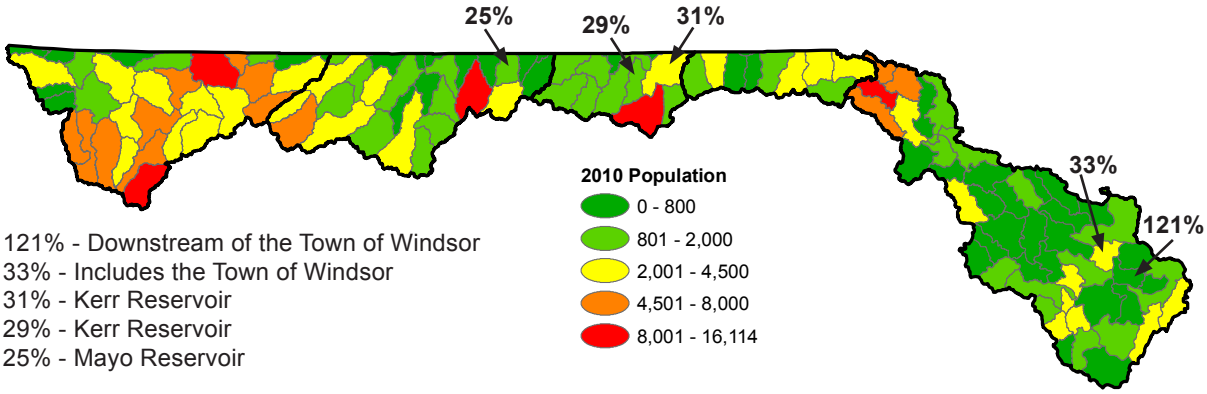


FIGURE ES-18: 2010 US CENSUS POPULATION IN THE ROANOKE RIVER BASIN BY 12-DIGIT SUBWATERSHED



121% - Downstream of the Town of Windsor
33% - Includes the Town of Windsor
31% - Kerr Reservoir
29% - Kerr Reservoir
25% - Mayo Reservoir

Land Cover

The largest percent of land cover in the four western subbasins is forested land. In the Lower Roanoke River subbasin, it shifts to be split between wetlands and forested area. Developed area has remained about the same since 2001 and is between six and nine percent for each subbasin. Agricultural activities make up about 20% of the land cover across the basin. Table ES-1, Figure ES-19, and Figure ES-20 show the distribution of land cover across the basin during 2001 and 2006. There was very little change in overall land cover between the two years compared.

Table ES-1: Percent of Land Cover by Category for 2001 & 2006 in the Roanoke River Basin

Category	% in 2001	% in 2006
Open Water	2.4	2.6
Developed, Open Space	4.2	5.1
Developed, Low Intensity	1	1
Developed, Medium Intensity	0.2	0.3
Developed, High Intensity	0.1	0.1
Barren Land	0.6	0.1
Forest	52.3	48.2
Shrub/Grassland	6.7	9.6
Agriculture, Pasture Hay	13.2	11.8
Agriculture, Cultivated Crops	9.4	9.3
Wetlands	9.8	11.9

Figure ES-19: 2001 Land Cover in the Roanoke River Basin

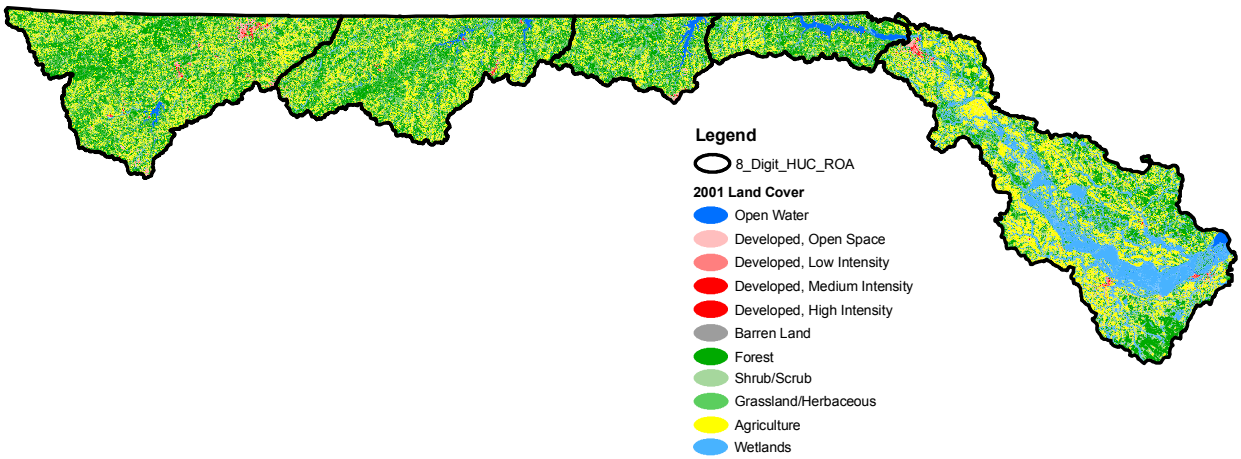
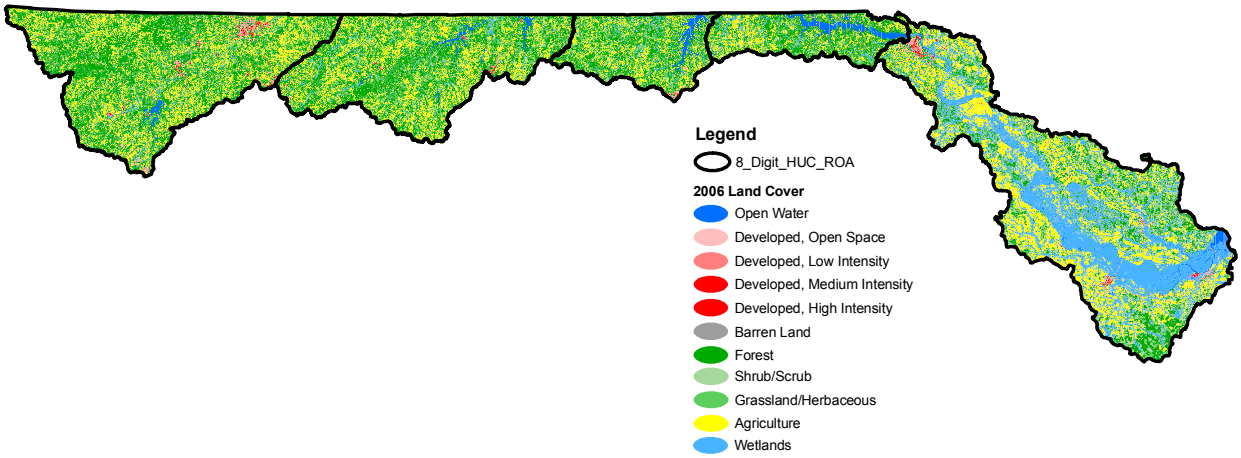


Figure ES-20: 2006 Land Cover in the Roanoke River Basin



Subbasin Water Quality Summaries

Upper Dan River Subbasin (03010103)

The Upper Dan River Subbasin is the western-most subbasin and runs along the North Carolina/ Virginia state line. The subbasin contains two Impaired streams: five segments of the Dan River are Impaired for either fecal coliform bacteria, turbidity or both; and the Smith River is Impaired for biological integrity, fecal coliform bacteria, and copper.

Monitoring results the biological community during this basinwide cycle showed only a small percent declined. There were no major ambient monitoring violations; however, a long term pattern of a slight increase in pH was seen.

There is a coordinated effort between Virginia and North Carolina to focus studies and restoration implementation on the greater Dan River drainage area. More details about this effort are in Chapter 1.

Lower Dan River (03010104)

The Lower Dan River Subbasin is the second western-most subbasin and runs along the North Carolina/Virginia state line. The subbasin contains two Impaired streams: Dan River is newly Impaired for fecal coliform bacteria and turbidity; Marlowe Creek remains Impaired for biological integrity and zinc in the downstream segment.

Monitoring results of the biological community during this time showed a small percent improved. There were no major ambient monitoring violations; however, there were a few elevated levels for turbidity and FCB.

Middle Roanoke River Subbasin (03010102)

The Middle Roanoke River Subbasin located around the middle of the basin along the North Carolina/Virginia state line, contains one Impaired stream: Nutbush Creek remains Impaired for biological integrity. During this assessment cycle, the subbasin experienced prolonged drought between 2007 and 2008.

The John H. Kerr Dam and Reservoir Section 216 Feasibility Study project is partially located in this subbasin. The study has focused on examining the feasibility of addressing downstream environmental resource concerns in the Lower Roanoke River drainage area through changes in operations or structures at the John H. Kerr Dam and Reservoir.

Roanoke Rapids Subbasin (03010106)

The Roanoke Rapids Subbasin is the second eastern most subbasin and runs along the North Carolina/Virginia state line. The subbasin contains two Impaired streams: Newmans Creek is newly Impaired for biological integrity; Smith Creek remains Impaired for low DO, and the upper and lower segments are Impaired for biological integrity.

Monitoring results of the biological community during this time did not indicate much change between cycles. There were no major ambient monitoring violations; however, there is a general downward long term pattern in pH levels and a few spikes in turbidity and fecal coliform bacteria levels were measured.

The John H. Kerr Dam and Reservoir Section 216 Feasibility Study project is also partially located in this subbasin.

Lower Roanoke River Subbasin (03010107)

The Lower Roanoke River Subbasin is the eastern most subbasin and empties into Albemarle Sound. The subbasin contains three Impaired streams. One segment of Quankey Creek remains Impaired for biological integrity. Welch Creek remains Impaired for dioxin and low pH; and one of the two most downstream segments of the Roanoke River is Impaired for low DO and the other is Impaired for dioxin.

Monitoring the biological community showed only a small percent declined and some improved. There were no major ambient monitoring violations.

The John H. Kerr Dam and Reservoir Section 216 Feasibility Study project is also partially located in this subbasin.

Other Basinwide Water Quality Information

John H. Kerr Dam & Reservoir Section 216 Feasibility Study

The John H. Kerr Dam and Reservoir Section 216 Feasibility Study project is located in three subbasins (HUCs 03010102, 03010106, and 03010107). The study has focused on examining the feasibility of addressing downstream environmental resource concerns in the Lower Roanoke River drainage area through changes in operations or structures at the John H. Kerr Dam and Reservoir. Along with USACE, the non-federal cost sharing partners for this study are Virginia and North Carolina. The process includes forming diverse workgroups, conducting a wide range of studies and developing a plan of recommendations. The project is currently completing phase 2 and beginning phase 3, the final phase. A more detailed description of the project is found in the Additional Study section of Chapter 2.

NC/VA Cooperative Efforts

North Carolina and Virginia have been communicating periodically over the last few years to coordinate watershed efforts. The entire Dan River drainage area which crosses the state lines several times, has been selected as a larger area in which to coordinate efforts between the states. More information about this effort is provided in Chapter 2.

Interbasin Transfers (IBTs)

The Kerr Lake Regional Water System (KLRWS) is a regional provider of drinking water. The system sells bulk water to Henderson, Oxford, and Warren County. These three customers, in turn, serve portions of Vance, Granville, Franklin, and Warren Counties.

KLRWS has an existing, grandfathered surface water transfer capacity of 10 MGD. The grandfathered capacity allows the system to move water from the Roanoke River Basin (Kerr Lake) to the Tar and Fishing Creek River Basins, both of which are sub-basins to the Tar-Pamlico Major River Basin. On February 18, 2009, KLRWS submitted a *Notice of Intent to Request an Interbasin Transfer (IBT) Certificate* to the Environmental Management Commission (EMC). In that notice, KLRWS requested to increase the authorized transfer from 10 MGD to 24 MGD, and to transfer 2.4 MGD from the Roanoke River Basin to the Neuse River Basin. These transfer amounts are based on water use projections to the year 2040.

Dates of interest for this request are as follows:

- February 18, 2009 - KLRWS submitted a Notice of Intent to Request an Interbasin Transfer Certificate to the EMC.

- February 26, 2009 - CH2MHill (consultant for KLRWS) provided written notice of scheduled public meetings as required by §143-215.22L(c).
- March 12, 2009 - A status update was presented to EMC's Water Allocation Committee.
- April 1-8, 2009 - The applicant held five public meetings to collect comments on the scope of the *draft Environmental Impact Statement* (EIS).
- May 31, 2009 - Public comment scoping period ended.
- November 2009 - The applicant provided a **status report** to the Division of Water Resources.

Status:

The applicant is currently working to develop a *draft Environmental Impact Statement* (EIS). The EIS must address the following requirements, which are also set forth in G.S. §113A-4 and §143-215.22L(d):

1. A comprehensive analysis of the environmental impacts that would occur in the source and receiving river basins if the petition for a certificate is granted;
2. Any significant adverse environmental effects which cannot be avoided;
3. A description of measures to mitigate any adverse impacts that may arise from the proposed interbasin transfer;
4. An evaluation of alternatives to the proposed interbasin transfer, including water supply options that do not require an interbasin transfer and use of water conservation measures;
5. The relationship between the short-term uses of the environment involved in the proposed action and the maintenance and enhancement of long-term productivity and;
6. Any irreversible and irretrievable environmental changes which would be involved in the proposed action should it be implemented.

The draft EIS is expected to be available for review in 2011. The EMC may not act on any petition until they have determined that the EIS is adequate.

Status of the IBT will be updated periodically on the Division of Water Resources' **Kerr Lake Regional Water System Interbasin Transfer Certification Request** webpage.

Roanoke River Basin Bi-State Commission

The Roanoke River Basin Bi-State Commission (RRBBC) was established as a bi-state commission composed of members from the Commonwealth of Virginia and the State of North Carolina. The purpose of the RRBBC is to:

- Provide guidance, conduct joint meetings, and make recommendations to local, state, and federal legislative and administrative bodies, and to others as it deems necessary and appropriate, regarding the use, stewardship, and enhancement of the Basin's water and other natural resources;
- Provide a forum for discussion of issues affecting the Basin's water quantity, water quality, and other natural resources;
- Promote communication, coordination, and education among stakeholders within the Basin;
- Identify Basin-related problems and recommend appropriate solutions; and

- Undertake studies and prepare, publish, and disseminate information through reports, and other communications related to water quantity, water quality, and other natural resources of the Basin.

Topics and issues the Bi-State Commission have been discussing over the past few years include: importance of natural resources to the economic vitality of the basin; interbasin transfer of water; as well as discussions on the controversial topic of uranium mining and its potential occurrence in Virginia. Annual reports, meeting minutes, and membership lists are found on the Commission's website.

Source Water Assessment of Public Water Supplies

Public Water Supply Susceptibility Determinations in the Roanoke River Basin

In April 2004, the Division of Environmental Health's Public Water Supply Section completed source water assessments for all drinking water sources and generated reports for the PWS systems using these sources. The assessments are updated regularly; the most recent updates were published in May 2010. The results of the assessments can be viewed in two different ways, either through the interactive ArcIMS mapping tool or compiled in a written report for each PWS system. To access the ArcIMS mapping tool, simply click on the "NC SWAP Info" icon on DEH's website. To view a report, select the PWS System of interest by clicking on the "Source Water Assessment Results-2010" link found on the SWAP web page.

In the Roanoke River Basin, 422 public water supply sources were identified. Twelve are surface water sources and 410 are groundwater sources. Of the 410 groundwater sources, nine have a Higher, 373 have a Moderate and 28 have a Lower susceptibility rating. Table ES-2 identifies the surface water sources and their overall susceptibility ratings. It is important to note that a susceptibility rating of Higher does not imply poor water quality as susceptibility is an indication of a water supply's potential to become contaminated.

Table ES-2: SWAP Results for Surface Water Sources in the Roanoke River Basin

PWS ID Number	Inherent Vulnerability Rating	Contaminant Rating	Overall Susceptibility Rating	Name of Surface Water Source	PWS System Name
0217010	M	L	M	Farmer Lake	Town of Yanceyville
0217010	M	L	M	Fuller's Creek	Town of Yanceyville
0273010	M	L	M	City Lake	City of Roxboro
0273010	M	L	M	Lake Roxboro	City of Roxboro
0273409	M	L	M	Hyco Lake	Roxboro Steam Plant
0279010	H	H	H	Dan River	Town of Eden
0279025	H	L	M	Mayo River	Town of Mayodan
0279030	H	M	H	Dan River	Town of Madison
0291010	M	L	M	Kerr Lake	Henderson-Kerr Lake Regional Water
0442010	H	L	M	Roanoke River	Roanoke Rapids Sanitary District
0442010	M	L	M	Roanoke Rapids Lake	Roanoke Rapids Sanitary District
0442020	H	L	M	Roanoke River	Weldon Water System

Additional information concerning SWAP on a statewide level can be found in Chapter 18 of the *2006 Roanoke River Basinwide Water Quality Plan*.

Ecological Flow in the Roanoke River Basin

The North Carolina General Assembly enacted legislation in 2010 directing the Department of Environment and Natural Resources to develop hydrologic models for each river basin in N.C. An important part of this bill requires the department to determine the flows needed to maintain ecological integrity in surface waters. The bill further authorized the creation of a Science Advisory Board to assist the department in assessing these ecological flows. The members and alternates of the board all have a strong background in aquatic ecology and represent a diversity of water use interests. The board has a charter that will help guide them through this process.

Updates on the progress of the Roanoke River model are on the Division of Water Resources website.

Basinwide Needs

To achieve the goal of restoring Impaired waters throughout the basin, DWQ will need to continue to work closely with other state agencies in NC and across state lines as well as stakeholders to identify and control pollutants. The costs of restoration can be high, but several programs exist to provide funding for restoration efforts.

Balancing economic development and water quality protection will be a challenge. Some impacts on surface waters can be measured and addressed through the basinwide planning process. Others can be identified through the basinwide plan, but actions to address these impacts must be taken at the local level. Such actions should include: development and enforcement of local sediment and erosion control ordinances; stormwater best management practices for existing and new development; development and enforcement of riparian buffer ordinances; and land use planning that assesses impacts on natural resources. This basinwide plan presents many water quality initiatives and accomplishments that are underway throughout the Roanoke River Basin that provide a foundation on which future initiatives can be built.

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