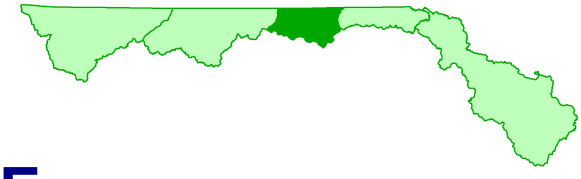


CHAPTER 3

Middle Roanoke River Subbasin

HUC 03010102

Includes: Grassy Creek, Island Creek, Little Island Creek, Nutbush Creek & John H. Kerr Reservoir

Subbasin Water Quality Overview

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 is Impaired for biological integrity. During this assessment cycle (2004-2009), 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 project area also includes HUCs 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.

Subbasin at a Glance

Counties:

Granville, Vance, & Warren

Municipalities:

Stovall, Henderson, & Middleburg

Ecoregions:

Southern Outer Piedmont, & Northern Outer Piedmont

Permitted Facilities:

NPDES Dischargers: 5
- Major 1
- Minor 2
- General 2

NPDES Non-Dischargers:.....4
Stormwater: 13
- General 13
- Individual 0

Animal Operations: 2

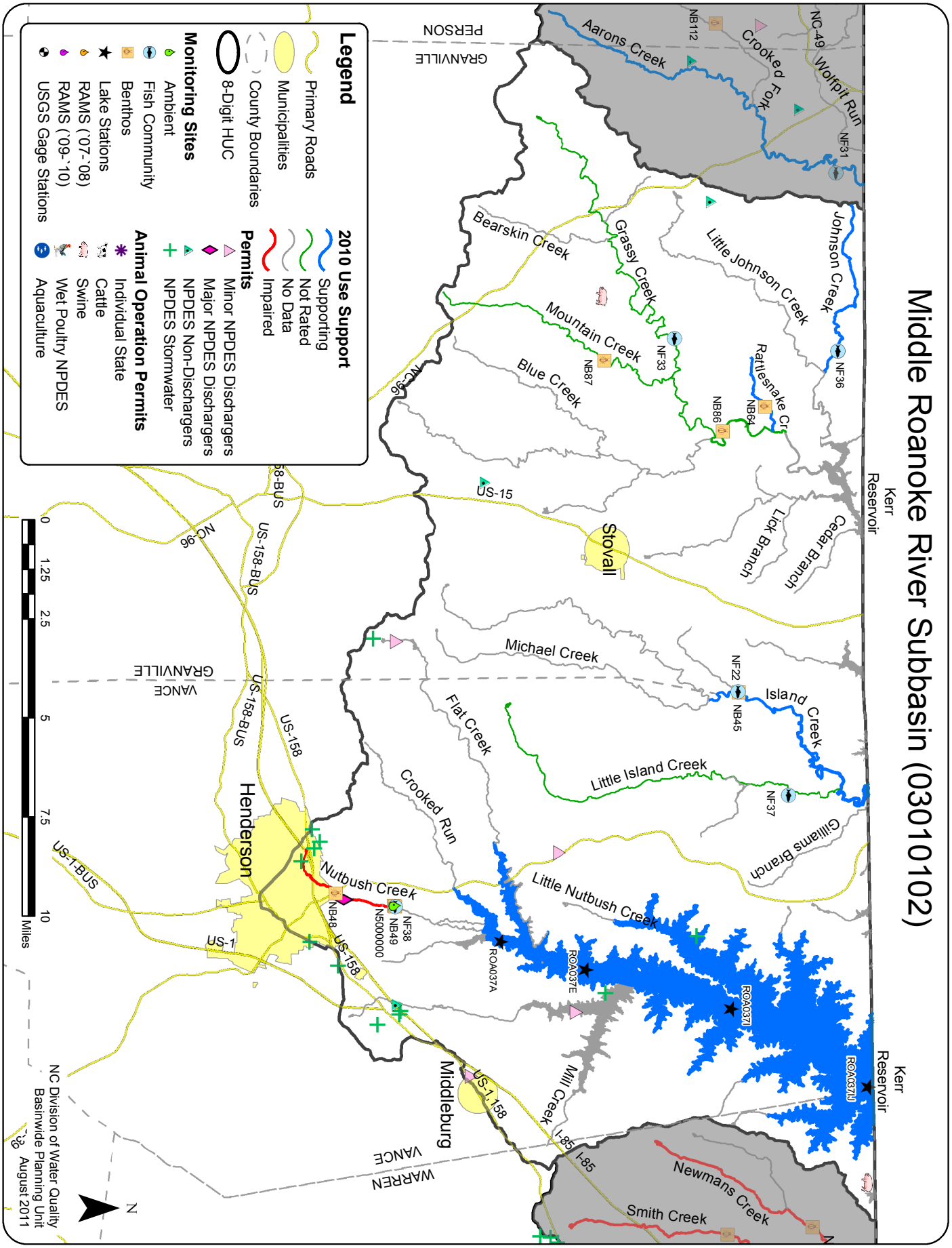
Population:

2010 Census.....22,444

2006 Land Cover:

Open Water.....5.4%
Developed.....6.0%
Forest 60.5%
Agriculture.....15.2%
Wetlands.....1.9%
Barren Land 0.2%
Shrub/Grassland 10.8%

FIGURE 3-1: MIDDLE ROANOKE RIVER SUBBASIN (03010102)



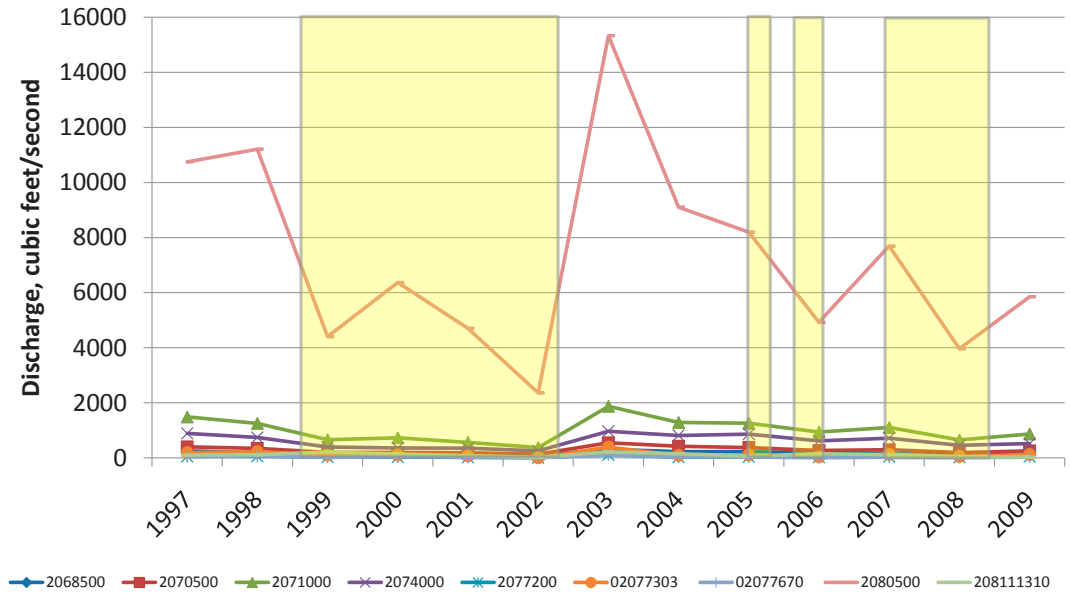
Water Quality Data Summary for this Subbasin

Monitoring stream flow, aquatic biology and chemical/physical parameters is a large part of the basinwide planning process. More detailed information about 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 from 1998-2002 and again from 2007-2008, with moderate droughts in 2005 and 2006 (Figure 3-2). More detail about flows in the Roanoke River Basin can be found in the 2010 Roanoke River Basinwide Assessment Report produced by DWQ-Environmental Science Section.

Figure 3-2: Yearly Flow Rates (cfs) of the USGS Gage Stations in the Roanoke River Basin Between 1997 & 2009



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 were collected during the spring and summer months of 2009 by the DWQ-Environmental Sciences Section as part of the five year basinwide sampling cycle, in addition to special studies. Overall, seven biological sampling sites were monitored within the Middle Roanoke River Subbasin. The ratings for each station can be seen in Appendix 3-B.

Benthic Macroinvertebrate Sampling

Each benthic station monitored during the current cycle is shown in Figure 3-3 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section below. Figure 3-5 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 similar to those received during the previous cycle indicating a relatively stable community.

Benthic Sampling Summary

Total Stations Monitored	4
Total Samples Taken	4
Number of New Stations	1

Figure 3-3: Benthic Stations Color Coded by Current Rating in the Middle Roanoke River Subbasin

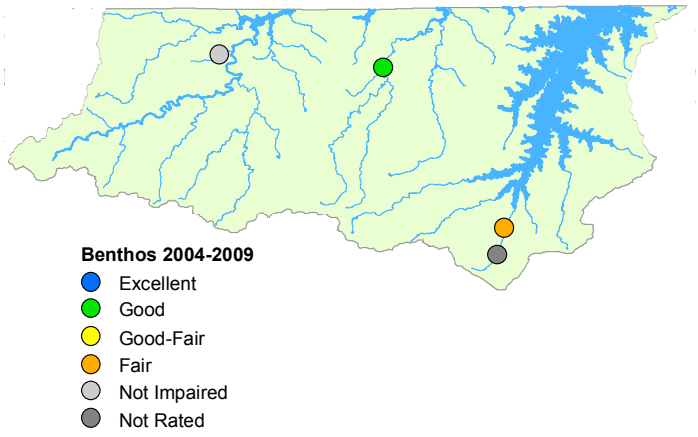


Figure 3-4: Current Benthic Site Ratings

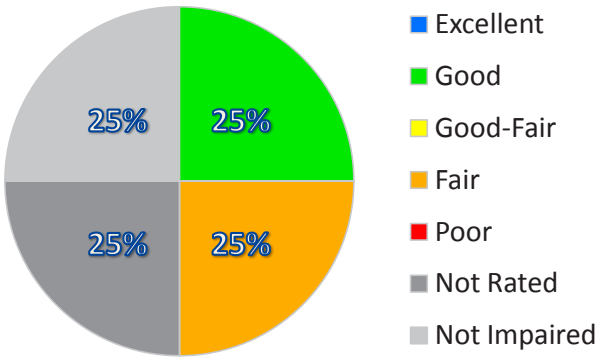
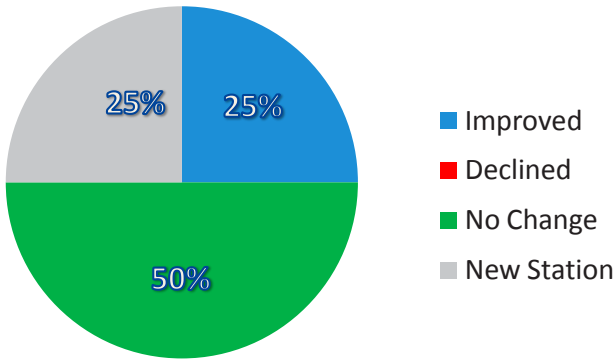


Figure 3-5: Change in Benthic Site Ratings



Fish Community Sampling

Each fish community station monitored during the current cycle is shown in Figure 3-6 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section below. Figure 3-7 shows the percentages of each rating given during this sampling cycle within this subbasin. Figure 3-8 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. Even though there was a 33% decline in ratings, overall the community is relatively stable.

Fish Com. Sampling Summary

Total Stations Monitored	3
Total Samples Taken	4
Number of New Stations	0

Figure 3-6: Fish Community Stations Color Coded by Current Rating in the Middle Roanoke River Subbasin

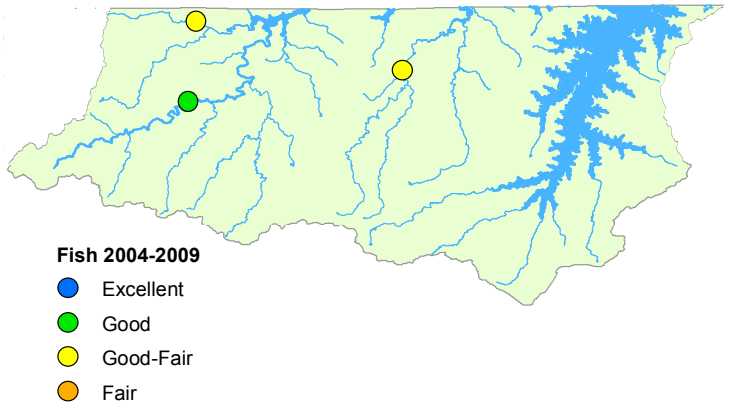


Figure 3-7: Current Fish Community Site Ratings

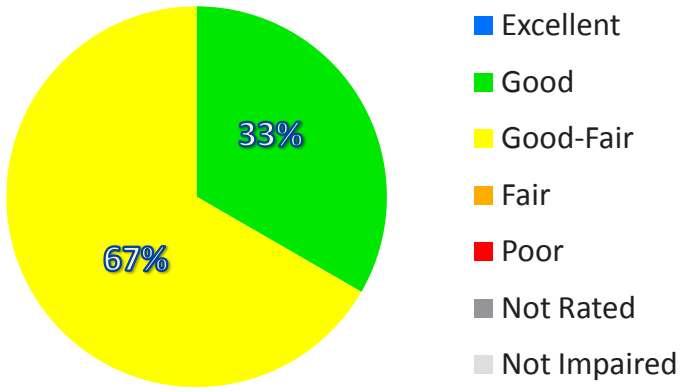
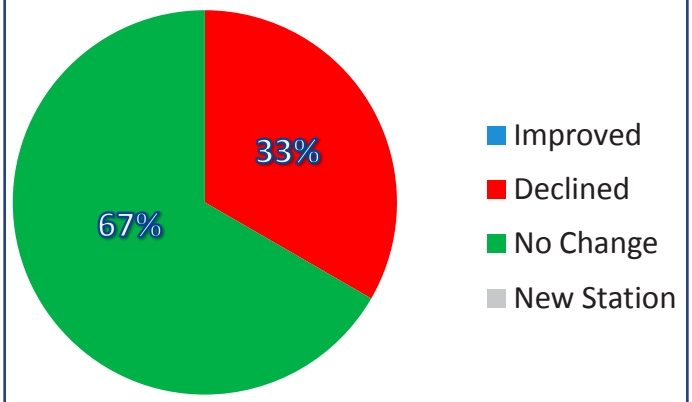


Figure 3-8: Change in Fish Community Site Ratings



For more information about biological data in this subbasin, see the 2010 Roanoke River Basinwide Assessment Report. Detailed data sheets for each sampling site can be found in Appendix 3-B.

Fish Kills/Spill Events During This Cycle

UT to Crooked Creek:

A pond located on a spring fed tributary to Nutbush creek experienced a fish kill event with a mortality count of about 500. A failing septic system from upstream had been piped into a tributary by a property owner for undetermined length of time. Low DO and Nitrates were noted in water samples taken by a private pond management company prior to calling DWQ. Aerators had been put in the pond by the time DWQ was contacted so DO levels were acceptable upon investigation. DWQ followed the progression of the pond for several weeks. Correcting the upstream problem appeared to solve the problems in the pond.

Ambient Data

The ambient data are used to develop use support ratings every two years, which are then reported to the EPA via the Integrated Report (IR). The IR is a collection of all monitored waterbodies in North Carolina and their water quality ratings. The most current IR is the 2010 version and is based on data collected between 2004 and 2008. The ambient data reported in this basin plan were collected between 2005 and 2009 and will be used for the 2012 IR. If a waterbody receives an Impaired rating, it is then placed on the 303(d) Impaired Waters List. The Roanoke River Basin portion of the 2010 IR can be found in Appendix 3-A and the full 2010 IR can be found on the Modeling & TMDL Unit's website.

One Ambient Monitoring System (AMS) station is located in the Middle Roanoke River subbasin (see Figure 3-1 for the station location). During the current sampling cycle (January 2005 and December 2009), samples were collected for all parameters on a monthly basis except metals which were sampled quarterly until May 2007 when metals sampling was suspended. For more information about the ambient monitoring, parameters, how data are used for use support assessment and other information, see Chapter 2 of the **Supplemental Guide to North Carolina's Basinwide Planning**.

Long Term Ambient Monitoring

The following discussion of ambient monitoring parameters of concern include graphs showing the median and mean concentration values for ambient station N5000000 in this subbasin by specific parameter over a 13 year period (1997-2009). The geometric mean is a type of mean or average, which indicates the central tendency or typical value of a set of numbers. The graphs are not intended to provide statistically significant trend information, but rather an idea of how changes in land use or climate conditions can affect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the data set. Box and whisker plots of individual ambient stations were completed by parameter for data between 2005 and 2009 by DWQ's Environmental Sciences Section (ESS) and can be found in the **Roanoke River Basin Ambient Monitoring System Report**.

Fecal Coliform Bacteria

Fecal coliform bacteria (FCB) occurs in water as a result of nonpoint sources such as animal waste from wildlife, farm animals and/or pets, as well as from sanitary sewer overflows (SSOs). 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 from a 5-in-30 study are used to indicate whether the stream is Impaired or Supporting. Waters with a use classification of B (primary recreational waters) receive priority for 5-in-30 studies. Other waters are studied as resources permit.

As seen in Figure 3-9, 10% of samples taken at station N5000000 during this cycle, resulted in levels over 400 colonies/100 ml. The geometric mean (calculated average) for this basinwide cycle was 115.9 colonies/100 ml at this station. When the geometric mean breaches 200 colonies/100 ml at a station, it is very likely a 5-in-30 study would result in an impairment. Possible sources of the elevated FCB levels at this station are discussed in the watershed section. Figure 3-10 shows the yearly geometric mean for all samples taken over the course of 13 years in the Middle Roanoke River subbasin. The highest yearly geometric mean was recorded in 2003 (222 colonies/100 ml). For additional data from this site, see **Appendix 3-C**.

Figure 3-9: Percentage of Samples with Elevated FCB Levels (2004-2008)

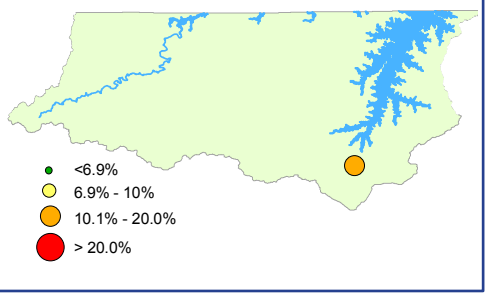
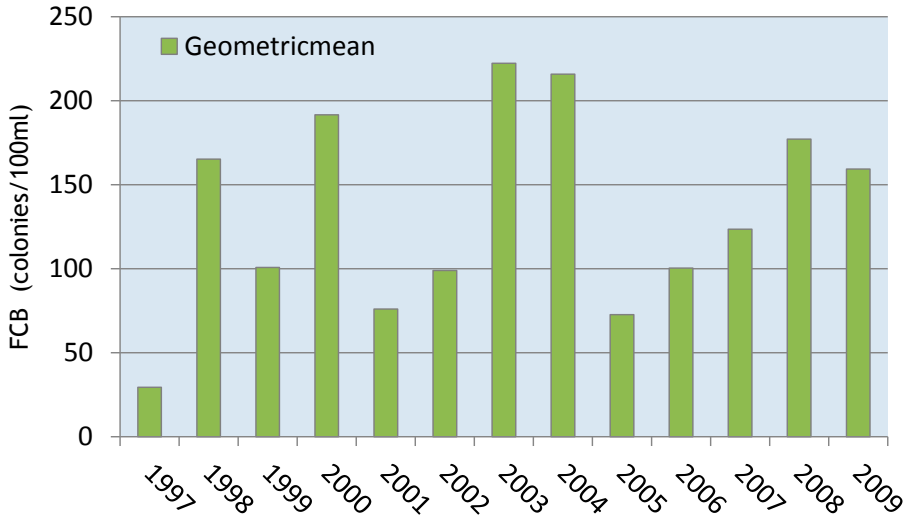


Figure 3-10: Summarized Fecal Coliform Bacteria Values for Data Collected at the Ambient Sampling Station in HUC 03010102



Additional information about possible causes of parameters discussed above for particular stations, see the stream write ups below. For more information regarding any of the parameters listed above, see Section 3.3 of the Supplemental Guide to North Carolina's Basinwide Planning. For additional information about ambient monitoring data collected in this river basin, see the Roanoke River Basin Ambient Monitoring System Report.

Understanding the Data

Biological & Ambient Ratings Converted to Use Support Categories

Biological (benthic and fish community) samples are given a bioclassification/rating based on the data collected at the site by DWQs Environmental Sciences Section (ESS). These bioclassifications include Excellent, Good, Good-Fair, Not Impaired, Not Rated, Fair and Poor. For specific methodology defining how these rating are given see Benthic Standard Operating Procedures (SOP) or the Fish Community SOP. Once a rating is given, it is then translated into a Use Support Category (see Figure 3-11).

Figure 3-11: 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	

Ambient monitoring data are analyzed based on the percent of samples exceeding the state standard for individual parameters for each site within a five year period. In general, if a standard is exceeded in greater than 10.0% of samples taken for a particular parameter, that stream segment is Impaired for that parameter. The fecal coliform bacteria parameter is exception to the rule. See the Fecal Coliform Bacteria section in the Ambient Data portion below.

Figure 3-12: Category Number to Use Support Rating

Category #	Use Support Rating
1	Supporting
2	
3	Not Rated
4	Impaired
5	

Each biological parameter (benthic and fish community) and each ambient parameter is assigned a Use Support Category based on its rating or percent exceedance. A detailed description of each category can be found on the first page of Appendix 3-A. Each monitored stream segment is given an overall category number which reflects the highest individual parameter category. Figure 3-12 shows how the category number is translated into the use support rating.

Example

Stream A had a benthic sample that rated Good-Fair and 12% of turbidity samples taken at the ambient station were exceeding the standard. The benthic sample would be given an individual category number of 1 (Figure 3-11) and the turbidity parameter would be given a category number of 5 since >10% of samples exceeded the standard. Therefore, stream A's overall category number would be a 5, indicating the stream has a use support rating of Impaired.

Additional Studies

John H. Kerr Dam & Reservoir Virginia & North Carolina (Section 216) Feasibility Study

Summary

The purpose of the feasibility study is to review the operation of the John H. Kerr Dam and Reservoir and provide recommendations to Congress on the advisability of modifying the structure or the structure's operation for improving the quality of the environment in the overall public interest, as authorized under Section 216 of Public Law 91-611, the River and Harbor and Flood Control Act of 1970. Based on the interests of the Sponsors and opportunities for improvement identified to date, the study has focused on examining the feasibility of addressing downstream environmental resource concerns in the Lower Roanoke River 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 the Commonwealth of Virginia, and the State of North Carolina.

The study area encompasses the John H. Kerr Reservoir (Kerr Reservoir) and approximately 1,917 square miles of watershed downstream of the John H. Kerr Dam (Kerr Dam), and is shown in Figure 3-14. The Kerr Dam is located on the Roanoke River, about 178.7 river-miles above the mouth (Figure 3-13). It is in Mecklenburg County, Virginia, 20.3 miles downstream from Clarksville, Virginia, 18 miles upstream from the Virginia-North Carolina border, and 80 miles southwest of Richmond, Virginia. Kerr Reservoir covers nearly 50,000 acres at its normal summer pool and extends about 39 miles up the Roanoke River. The study area includes the Kerr Dam and Reservoir project and the Roanoke River Basin from the Dam downstream to the Albemarle Sound. For this study, the area will be referred to as the Lower Roanoke River Basin. The study area is located in Charlotte, Halifax, Mecklenburg, and Brunswick Counties of Virginia, and in Granville, Vance, Warren, Halifax, Northampton, Bertie, Martin and Washington Counties of North Carolina, and it is located in the 4th and 5th Congressional District of Virginia and the 1st and 13th Congressional Districts of North Carolina.

Figure 3-13: Location of John H. Kerr Reservoir and Dam and downstream dams

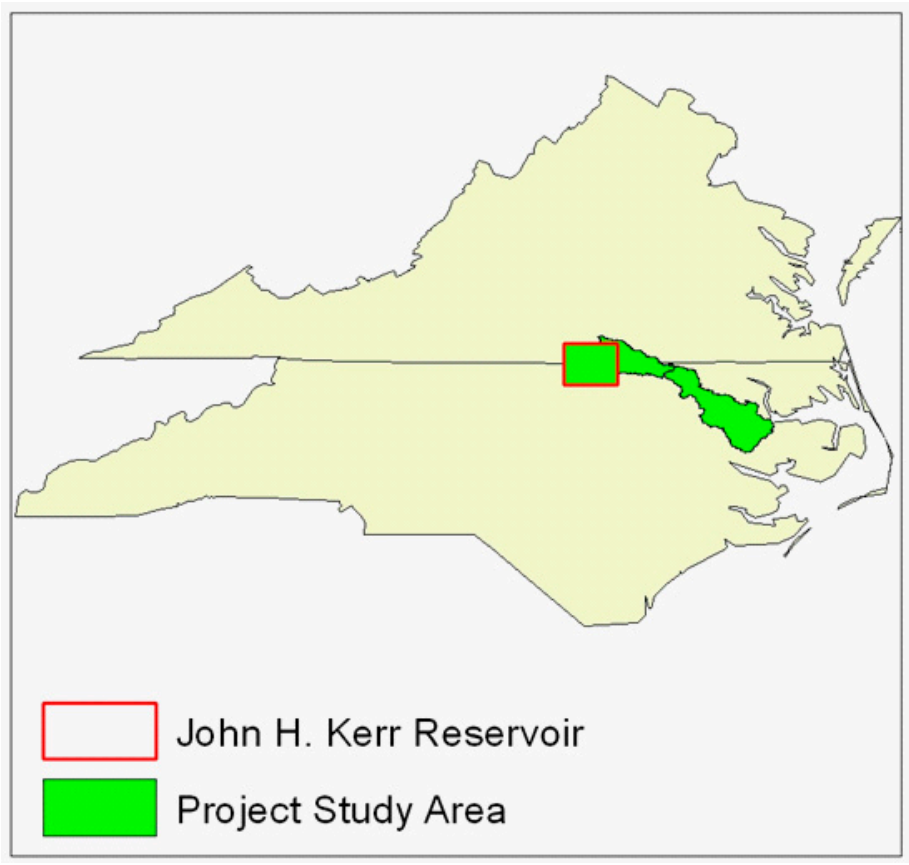
This feasibility study has proceeded in a 3 phase process. In the first phase, 11 subject area work groups were formed, consisting of members from state and federal agencies and non-profit and business organizations. These groups identified problems and opportunities in the watershed, provided input regarding planning objectives and identified constraints for the study, collected existing data, and identified needs for additional data and study. In Phase 2, which is ongoing but nearing completion, technical studies, data collection, and modeling were undertaken to address the needs identified in Phase 1. Phase 3, also currently ongoing, includes the formulation and evaluation of alternative plans, leading to the selection of a tentatively recommended plan and approval of an integrated feasibility report and NEPA Document.

The major problems of interest in the study area that have been identified are:

- Degradation of the lower Roanoke River bottomland hardwood ecosystem due to long-term inundation during flood operations, potentially leading to a 60% decline in habitat quality over the next 50 years in the without project condition.
- Impaired dissolved oxygen (DO) levels below Kerr Dam and in the lower Roanoke River, which has degraded in-stream habitat to a condition which is expected to persist in the future without project condition.
- Bank erosion in the lower Roanoke River, which is estimated at between 27 – 60 mm a year depending on location, and which will continue in the without project condition.
- Loss of connectivity in the Roanoke River due to the presence of the dams, which in particular have prevented and continue to prevent the American shad and American eel from populating upstream areas where they have historically occurred.

Based on the identified problems, opportunities, constraints, and established study planning objectives, a series of management measures, consisting of both structural and operational changes and activities, have been proposed. These measures have undergone a preliminary screening process based on the study planning constraints as well as a simplified cost-effectiveness analysis. The measures that remain from the screening process and that will require more detailed evaluation are:

FIGURE 3-14: LOCATION OF OVERALL PROJECT AREA



- Measure 6B with potentially a duration of release trigger. This operational measure would allow for more frequent 35,000 cfs releases at the reservoir from January 1st to June 30th, thus reducing the duration of 20,000 cfs releases during the growing season, with adjustments to the reservoir guide curve meant to minimize impacts to hydropower revenue.
- Quasi run of the river measure. Under this operational measure, releases from the reservoir would equal the inflows into the reservoir, up to 35,000 cfs, and would be implemented year round.
- Short bursts of higher (>20,000 cfs) releases from Roanoke Rapids Dam. This operational measure would involve having pulses of shorter duration releases at higher flows during the growing season.
- Plug man-made canals that breach the river levee. This structural change would involve identifying and plugging man-made canals that breach the natural river levee and currently allow high flows to enter the floodplain.
- Use Roanoke River Basin Reservoir Operations Model (RRBROM) probabilistic model forecasting. Use of the forecasting component of this model could be used to supplement to assist in water management decisions that could affect the duration of flooding in downstream areas.

- Place a fabric weir upstream of Kerr Dam. This is a structural measure for improving DO between Kerr and Gaston Dams.
- Oxygen or air injection upstream of Kerr Dam. This is a structural measure for improving DO between Kerr and Gaston Dams.
- Implement actions indicated by USGS water quality modeling. Ongoing USGS modeling efforts may suggest additional measures that could improve DO conditions in lower Roanoke River.

Adaptive management, which would include monitoring of project performance, would be a fundamental aspect of any of the remaining measures if they were to be implemented.

The benefits of measures identified to date are non-monetary, National Ecosystem Restoration (NER) benefits and will be quantified in terms of increases over the no-action alternative in average annual ecosystem habitat outputs. The models used for measuring benefits are Habitat Evaluation Procedures (HEP) Habitat Suitability Index (HSI) models, and a Roanoke River riparian wetland assessment model, based on Hydogeomorphic (HGM) principles, that was developed and calibrated specifically for use on this study. Additionally, some measures may result in a loss of National Economic Development (NED) hydropower or flood risk management benefits. Measures will be compared against each other using a trade-off analysis, as gains in one benefit category (NER/ecosystem restoration) will, in some cases, need to be compared to losses in other benefit categories (NED/hydropower and flood damage reduction, for example). The trade-off analysis will be displayed in a system of accounts format.

An appropriate NEPA (EA or EIS) document will be prepared, and will be integrated into the feasibility report. Additional information can be found on the **US Army Corps of Engineers** website or the **Kerr 216 Water Wiki** site.

Schedule

A schedule of completed and anticipated major study milestones over the next 2 years is below:

Task	Date
Feasibility Scoping Meeting	June 22, 2011
Alternative Formulation Briefing Meeting	April 2012
Submittal of Draft Feasibility Report to SAD/ HQ, USACE	December 2012
Distribute Draft Feasibility Report for NEPA/Public review	February 2013
Submit Final Feasibility Report to SAD	July 2013
SAD Submits Final Report to HQ, USACE	August 2013

Recommendations & Action Plans at the Subbasin Scale

DWQ Priority Summary

Table 3-1 is a list of waters in the Middle Roanoke River Subbasin that DWQ has prioritized for restoration/ protection. The order of priority is not based solely on the severity of the steam's impairment or impacts but rather by the need for particular actions to be taken. A stream that is currently supporting its designated uses may be prioritized higher within this table than a stream that is currently impaired. This is based on a more holistic evaluation of the drainage area which includes monitoring results, current and needed restoration/ protection efforts, land use and other activities that could potentially impact water quality in the area. Some supporting streams may have a more urgent need for protections than an impaired stream with restoration needs already being implemented.

The table also lists potential stressors and sources that may be impacting a stream including in-field observations, monitoring data, historical evidence and permit or other violations. Additional study may be needed to determine exact source(s) of the impact. The last column includes a list of recommended actions.

Table 3-1: Notable Waters in the Middle Roanoke River Subbasin (Not Ranked)

Stream Name	AU#	Class.	Potential Stressor(s)	Potential Source(s)	Qualitative Status	Actions Needed
Grassy Creek	23-2-(1) & (6)	C	Low DO, Turbidity	--	Not Rated	--
Johnson Creek	23-2-7-(1)	C	Low DO, Low Flows	--	Supporting	SS
Little Island Creek	23-4-3	C	--	Inactive Hazardous Site	Not Rated	M
Nutbush Creek	23-8-(1)a & b	C	Specific Conductivity, Nutrients	Urban Runoff	Impaired	SS
Kerr Reservoir (Nutbush Creek Arm)	23-8-(2)	B	--	--	Improving	--

Class.: Classification (e.g., C, B, WS-I, WS-II, WS-III, WS-IV, WS-V, Tr, HQW, ORW, SW, UWL)

Stressor: Chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use (e.g., low/high DO, nutrients, toxicity, habitat degradation, etc.). Fecal Coliform Bacteria (FCB),

Source: The cause of the stressor. (Volume & Velocity: when a stream receives stormwater runoff at a much higher volume and velocity than it would naturally receive due to ditching, impervious surfaces, etc.)

Status: Impaired, Impacted, Supporting, Improving (For current Use Support Assessment see the Integrated Report.)

Actions Needed: Agriculture BMPs (**Ag**), Best Management Practices (**BMPs**), Daylight Stream (**DS**), Education (**E**), Forestry BMPs (**F**), Local Ordinance (**LO**), Monitoring (**M**), Nutrient Mgnt Controls (**NMC**), Protection (**P**), Restoration (**R**), Riparian Buffer Restoration (**RBR**), Stormwater Controls (**SC**), Sediment and Erosion Control BMPs (**SEC BMPs**), Species Protection Plan (**SPP**), Stressor Study (**SS**), .

Status & Recommendations for Monitored Waters

Understanding this Section

In this Section, more detailed information about stream health, special studies, aquatic life stressors and sources and other additional information is provided by each 10-digit Hydrological Unit Code (HUC). Waterbodies discussed in this Chapter include all monitored streams, whether monitored by DWQ or local agencies with approved methods. Use Support information on all monitored streams within this watershed can be seen on the map in Figure 3-1, and a Use Support list of all monitored waters in this basin can be found in the Use Support Chapter.

Use Support & Monitoring Box:

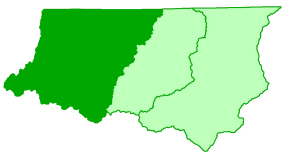
Each waterbody discussed in the Status & Recommendations for Monitored Waters within this Watershed section has a corresponding Use Support and Monitoring Box (Table 3-2). The top row indicates the 2010 Use Support and the length of that stream or stream segment. The next two rows indicate the overall Integrated Report category which further defines the Use Support for both the 2008 and the 2010 reports. These first three rows are consistent for all boxes in this Plan. The rows following are based on what type of monitoring stations are found on that stream or stream segment and may include benthic, fish community and/or ambient monitoring data. If one of these three types of monitoring sites is not shown, then that stream is not sampled for that type of data. The first column indicates the type of sampling in bold (e.g., **Benthos**) with the site ID below in parenthesis (e.g., CB79). The latest monitoring result/rating of that site is listed in the next column followed by the year that sample was taken. If there is more than one benthic site, for example, on that stream, the second site ID and site rating will be listed below the first. The last row in the sample box in Table 3-2 is the AMS data. The data window for all AMS sites listed in the boxes in this Plan is between 2004-2008. Only parameters exceeding the given standard are listed in the second column with the percent of exceedance listed beside each parameter.

Table 3-2: Example of a Use Support and Monitoring Box

Use Support: **Impaired** (14 mi)	
2008 IR Cat.	4a
2010 IR Cat.	4
Benthos (CB79) (CB80)	 Fair (2002) Fair (2002)
Fish Com (CF33)	 Good-Fair (2002)
AMS (C1750000)	Turbidity - 12% FCB - 48%

Please note any fecal coliform bacteria (FCB) listing in the last row (as seen in Table 3-2) only indicates elevated levels and a study of five samples in 30 days (5-in-30) must be conducted before a stream becomes Impaired for FCB.

Grassy Creek-John H Kerr Reservoir (0301010208)



Includes: Grassy Creek [AU#: 23-2-(1) & (6)]**, Johnson Creek** [AU#: 23-2-7-(1) & (2)]**, & Rattlesnake Creek** [AU#: 23-2-5]

Watershed contains a mix land use of agriculture, forested and some residential areas. There is one permitted swine animal operation located in the watershed and no point source discharger permits. There are also no waters on the 2010 Impaired Waters List within this watershed.

Grassy Creek [AU#: 23-2-(1) & (6)]

The first segment of Grassy Creek [AU#: 23-2-(1)] is approximately 18.3 miles from source to the second segment, which is the Grassy Creek arm of John H Kerr Reservoir [AU#: 23-2-(6)]. The majority of the drainage area is forestry

Use Support: **Not Rated** (18.3 mi)	
2008 IR Cat.	3
2010 IR Cat.	3
Benthos (NB86)	 Not Rated (2004)
Fish Com (NF33)	 Good (2009)

and agriculture with spots of residential areas. There is one two-house swine farm operation in the Grassy Creek drainage area. Both segments of the creek were given a Not Rated use support category for the 2010 Integrated Report (IR) based on the 2004 benthic sample.

Water Quality Status

Grassy Creek was monitored once during this sampling cycle. The fish site (located at Cornwall Rd; SR 1300) was somewhat effected by low flow conditions when sampled in 2009. This site had the lowest DO concentration (4.3 mg/l) and the fewest fish collected of any other site in the basin. During a sampling event at this site in 1999, 650 fish were collected where as the 2009 sample only collected a total of 81. Specific conductivity and turbidity levels were elevated. The habitat score was low (64 out of 100) mostly due to no riffle habitat and poor bottom substrate. However, it is estimated that the 2009 rating will move the segments from the Not Rated (3) use support category into the Supporting (2) category on the 2012 Integrated Report (IR).

Recommendations

The fish community site is a regional reference site and is suggested to be re-evaluated in 2014 or during a more normal flow year to determine if reference site status is still warranted.

Johnson Creek [AU#: 23-2-7-(1)]

Johnson Creek is approximately 8.3 miles from source to John H Kerr Reservoir [AU#: 23-2-(6)]. The majority of the drainage area is forestry and agriculture with spots of residential areas. The creek is in the Supporting use support category for the 2010 Integrated Report based on the 2004 fish community sample.

Use Support: Supporting (8.3 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF36)	Good-Fair (2009)

Water Quality Status

The fish community site located on Johnson Creek was monitored in 2004 as well as 2009. Results from these two samples were very similar in ratings; however, the 2009 sample had one-third fewer fish than the 2004 sample and the lowest number of fish species collected in the basin. The site had the highest specific conductivity (127 µS/cm) of any other fish community site in the basin and recorded low DO levels (5.6 mg/l). Overall habitat was good but lacked adequate riffle habitat and had poor bottom substrate. Low flows during drought conditions and limited downstream re-colonization sources are suggested to be partial causes of the this lower rating. Johnson Creek will likely continue to be placed in the Supporting (2) category for the 2012 Integrated Report based on the 2009 fish community sample.

Rattlesnake Creek [AU#: 23-2-5]

Rattlesnake Creek is approximately 2.3 miles from source to Grassy Creek [AU#: 23-2-(1)]. The majority of the drainage area is agriculture and forestry with spots of residential areas. This creek was placed in the Supporting use support category of the 2010 IR due to the Not Impaired rating received in 2005.

Use Support: Supporting (2.3 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB64)	Not Impaired (2005)

Water Quality Status

A benthic sample was taken in 2005 as part of a special study to develop biocriteria for small streams in North Carolina. The sample was given a Not Impaired rating since the studies proposed criteria has yet to be approved. Habitat was rated high (79 out of 100) and the benthic community showed no signs of being impacted.

Mountain Creek [AU#: 23-2-3]

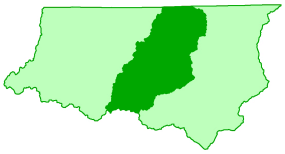
Mountain Creek is approximately 8.1 miles from source to Grassy Creek [AU#: 23-2-(1)]. The land use in this drainage area is largely agriculture with some forestry and residential areas. This creek was placed under the Not Rated use support category of the 2010 IR due to the benthic rating in 2004.

Use Support: Not Rated (8.1 mi)	
2008 IR Cat.	3
2010 IR Cat.	3
Benthos (NB87)	Not Rated (2004)

Water Quality Status

This site was sampled as a one time event in 2004 as part of a special study. However, the stream had very low flow even after a fair amount of rain four days prior to the sample being taken. Deeply incised and eroding banks suggested flashiness and unstable hydrology. For these reasons, the site was given a Not Rated and will remain in this use support category on the 2012 Integrated Report.

Butcher Creek John H Kerr Reservoir (0301010209)



Includes: Island Creek [AU#: 23-4] **& Little Island Creek** [AU#: 23-4-3]

This watershed contains a mix land use of agriculture, forested and some residential areas. There are no permitted facilities within this watershed. There are also no waters which appear on the 2010 Impaired Waters List.

Island Creek [AU#: 23-4]

Use Support: Supporting (6.4 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB45)	Good (2009)
Fish Com (NF22)	Good-Fair (2009) Good (2010)

Island Creek is approximately 6.4 miles from the confluence of Gill Creek [AU#: 23-4-1] and Michael Creek [AU#: 23-4-2] the North Carolina-Virginia state line. The land use in this drainage area is predominantly agriculture with some forestry and residential areas. This segment was placed under the Supporting use support category of the 2010 IR as a result of the Good-Fair benthic rating it received in 2004.

Water Quality Status

Island Creek was sampled twice during this sampling cycle. The benthic sample showed overall improved in the benthic community from the last time it was sampled in 2004 when it received a Good-Fair rating. The 2009 Good rating reflects an increase in the number of pollution intolerant species collected.

The fish community sample; however, did not show the same improvement. The rating actually fell from an Excellent in 1999 to a Good-Fair in 2009. The total number of fish collected for the sample dropped by three-fourths. There was still diversity among those captured but there were no pollution intolerant species. The site was re-evaluated in 2010 following a wetter winter and spring and received a Good rating.

This stream is expected to remain under the Supporting use support category on the 2012 IR.

Little Island Creek [AU#: 23-4-3]

Use Support: Not Rated (11.8 mi)	
2008 IR Cat.	3
2010 IR Cat.	3
Benthos (NB38)	Good-Fair (1988)
Fish Com (NF37)	Not Rated (2004)

Little Island Creek is approximately 11.8 miles from source to Island Creek [AU#: 23-4]. The majority of the drainage area is agriculture and forestry with residential areas mixed in. This segment was placed in the Not Rated use support category of the 2010 IR based on the 2004 fish community sample.

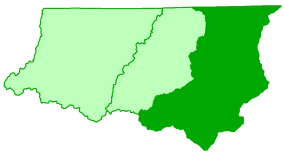
Water Quality Status

This site and the lower part of the adjacent Island Creek watershed encompass the defunct Tungsten Queen Mine, an inactive hazardous site. The mine ceased operations in 1971 but at one time was one of the largest tungsten mines in the country. The tailings (sands) in Little Island Creek appear to be similar to those at the tungsten mine and may have similar contaminant metals of concern including lead, arsenic, antimony, cadmium, and zinc. The surface water, ground water, sediments, and fish in Little Island Creek have not been monitored but have the potential to be contaminated with these metals. Currently, the area including the tailings (sands) is under a remedial action by the Inactive Hazardous Site Branch of Superfund.

Recommendations

If resources allow, benthic site NB38 should be sampled to ensure the water quality has not degraded since the previous sample was taken.

Nutbush Creek-John H Kerr Reservoir (0301010210)



Includes: Nutbush Creek Arm of John H Kerr Reservoir [AU#: 23-8-(2)]**, Nutbush Creek** [AU#: 23-8-(1)a, b & c]**, & Anderson Swamp Creek** [AU#: 23-8-6-(1)]

The majority of this watershed contains the John H Kerr Reservoir and is a mix land use of agriculture, residential and some forested areas. There are two minor NPDES permitted facilities and one permitted swine animal operation within the watershed. Nutbush Creek is the only waterbody on the 2010 Impaired Waters List.

Nutbush Creek Arm of John H Kerr Reservoir [AU#: 23-8-(2)]

The Nutbush Creek arm of John Kerr Reservoir is approximately 9,690 acres from Crooked Run [AU#: 23-8-3] to North Carolina-Virginia state line. The majority of the land use draining to the lake consist of agriculture and forestry with some residential area. The John H. Kerr Reservoir (also called Kerr Lake) is a multipurpose impoundment constructed and operated by the US Army Corps of Engineers to provide flood control, recreation and hydroelectric power. The reservoir crosses the North Carolina-Virginia state line with the majority of the lake located in Virginia. Kerr Reservoir is the first of three chain lake impoundments on the Roanoke River in North Carolina.

Use Support: **Supporting** (9,690 acres)	
2008 IR Cat.	2
2010 IR Cat.	2
Lake (ROA037A) (ROA037E) (ROA037I) (ROA037IJ)	No Exceedances

Water Quality Status

The Nutbush Creek arm of Kerr Reservoir was monitored at four lake monitoring stations during this sampling cycle. Parameters monitored all resulted in normal levels. Historically, the lake has either had high (eutrophic) or medium (mesotrophic) biological productivity. It was again found to be mesotrophic during the majority of the sampling season with exception of June. June 2009 was the first time the lake has ever recorded low (oligotrophic) productivity levels.

Section 216 Feasibility Study

This 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 the Commonwealth of Virginia, and the State of North Carolina. It is a three phase process that includes forming diverse workgroups, conducting a wide range of studies and developing a plan of recommendations. The project is currently completing phases 2 and beginning phase 3. A more detailed description of the project is found in the Additional Study section.

Nutbush Creek [AU#: 23-8-(1)a & b]

Nutbush Creek is approximately 3.3 miles from source within the Town of Henderson to SR 1317. The land use in this drainage area is urban in the headwaters and transitions to farm land outside of the Town of Henderson's city limits. This creek has been on the Impaired Waters list since 1998 based on benthic monitoring data.

Use Support: **Impaired** (3.3 mi)	
2008 IR Cat.	5
2010 IR Cat.	5
Benthos (NB48) (NB49)	Not Rated (2006) Fair (2009)
Fish Com (NF38)	Fair (2004)
AMS (N5000000)	No Exceedances

Water Quality Status

The first segment of Nutbush Creek ([AU#: 23-8-(1)a], 1.7 stream miles) was monitored once during this sampling cycle in 2006. This segment is almost entirely within the Town of Henderson's city limits. A benthic sample was taken in 2006 as part of a special study to develop biocriteria for small streams in North Carolina. The sample was given a Not Rated rating since the studies proposed criteria has yet to be approved. Habitat was poorly rated (58 out of 100) and the benthic community showed definite signs of being impacted.

The second segment of Nutbush Creek's ([AU#: 23-8-(1)b], 1.6 stream miles) benthic community was also monitored once during this sampling cycle in 2009. This segment begins just outside of the Town of Henderson's city limits and receives discharge from the towns Water Reclamation Facility. This benthic site has been monitored six times since 1988 and has received a Fair rating each time, with exception to the 1988 Poor rating. The 2009 sample continued to show a pollution tolerant macroinvertebrate community. This includes a species rarely collected here in the past but common within this sample that is generally collected only in degraded streams, as well an increase in the abundance of organic pollution tolerant species.

Habitat at the site ranked fairly high, scoring 86 out of 100; indicating the community is more likely being impacted by instream water quality pollution rather than poor habitat. This is reflected in the specific conductivity measured at the site which was the highest of any biological site within the basin (416 µS/cm). However, that level has been dropping since 1999 when it was measured at 633 µS/cm. A slight increase in benthic quality and an increase in dissolved oxygen may be a result of this decrease in specific conductivity.

An Ambient Monitoring Systems station is sampled monthly at this same location, about a mile downstream of the WRF. No parameters exceed the state standards at this station. Between 2005 and the end of 2009, fecal coliform bacteria levels, along with some nutrients (ammonia and TKN) levels had decrease. The fiftieth percentile for specific conductivity results reflects what was measured at the benthic site (458 µS/cm) with the highest result of 693 µS/cm. Other nutrient parameters (total phosphorus and NO_2 + NO_3) averages increased during this cycle. More detailed information about this AMS site as well as the biological site can be found on the site data sheets in Appendix 3-B.

Nutbush Creek is expected to remain on the Impaired Waters list in 2012.

References

References marked with (*) indicates a DWQ special study report. These reports are not currently available online. Contact the DWQ Environmental Science Section at (919) 743-8400 to receive a hardcopy.

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Appendix 3-A

Use Support Ratings for All Monitored Waters in the Middle Roanoke River Subbasin

Draft 2010 IR Category	Integrated Reporting Categories for individual Assessment Unit/Use Support Category/ Parameter Assessments. A single AU can have multiple assessments depending on data available and classified uses.
1	All designated uses are monitored and supporting
1b	Designated use was impaired, other management strategy in place and no standards violations for the parameter of interest (POI)
1nc	DWQ have made field determination that parameter in exceedance is due to natural conditions
1r	Assessed as supporting watershed is in restoration effort status
1t	No criteria exceeded but approved TMDL for parameter of interest
2	Some designated uses are monitored and supporting none are impaired Overall only
2b	Designated use was impaired other management strategy in place and no standards violations Overall only
2r	Assessed as supporting watershed is in restoration effort status overall only
2t	No criteria exceeded but approved TMDL for POI Overall only
3a	Instream/monitoring data are inconclusive (DI)
3b	No Data available for assessment
3c	No data or information to make assessment
3n1	Chlorophyll a exceeds TL value and SAC is met-draft
3n2	Chlorophyll a exceeds EL value and SAC is not met first priority for further monitoring-draft
3n3	Chlorophyll a exceeds threshold value and SAC is not met first second priority for further monitoring-draft
3n4	Chlorophyll a not available determine need to collect-draft
3t	No Data available for assessment –AU is in a watershed with an approved TMDL
4b	Designated use impaired other management strategy expected to address impairment
4c	Designated use impaired by something other than pollutant
4cr	Recreation use impaired no instream monitoring data or screening criteria exceeded
4cs	Shellfish harvesting impaired no instream monitoring data- no longer used
4ct	Designated use impaired but water is subject to approved TMDL or under TMDL development
4s	Impaired Aquatic Life with approved TMDL for Aquatic Life POI or category 5 listing
4t	Designated use impaired approved TMDL
5	Designated use impaired because of biological or ambient water quality standards violations and needing a TMDL
5r	Assessed as impaired watershed is in restoration effort status

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Grassy Creek-John H Kerr Reservoir Watershed** — **0301010208**

Roanoke River Basin — ı H Kerr Reservoir-Roanoke River Subbasin — 03010102

Roanoke River Basin — **Grassy Creek-John H Kerr Reservoir Watershed** — **0301010208**

⊙	**23-2-(1)**	**Grassy Creek (Grass Creek)**	From source to John H. Kerr Reservoir at Granville County SR 1431	**18.3**	**FW Miles**	C
	3a	**Ecological/biological Integrity Benthos**	Not Rated Bioclassification	Aquatic Life	2004	
⊙	**23-2-7-(1)**	**Johnson Creek**	From source to Little Johnson Creek	**5.3**	**FW Miles**	C
	1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004	
⊙	**23-2-3**	**Mountain Creek**	From source to Grassy Creek	**8.1**	**FW Miles**	C
	3a	**Ecological/biological Integrity Benthos**	Not Rated Bioclassification	Aquatic Life	2004	
⊙	**23-2-5**	**Rattlesnake Creek**	From source to Grassy Creek	**2.3**	**FW Miles**	C
	1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005	

Roanoke River Basin — **Butcher Creek-John H Kerr Reservoir Watershed** — **0301010209**

⊙	**23-4**	**Island Creek (Island Creek Reservoir)**	From source to North Carolina-Virginia State Line, including that portion of Island Creek Reservoir in North Carolina below normal operating elevation	**6.4**	**FW Miles**	C
	1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2004	
⊙	**23-4-3**	**Little Island Creek (Vance County)**	From source to Island Creek Reservoir, Island Creek	**11.8**	**FW Miles**	C
	3a	**Ecological/biological Integrity FishCom**	Not Rated Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Nutbush Creek-John H Kerr Reservoir Watershed** — **0301010210**

⊙	**23-8-(1)a**	**Nutbush Creek (Including Nutbush Creek Arm of John H. Kerr Reservoir below normal pool elevation)**	From source to NC 39	**1.7**	**FW Miles**	C
	5	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	1994	1998

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
23-8-(1)b	Nutbush Creek (Including Nutbush Creek Arm of John H. Kerr Reservoir below normal pool elevation)	From NC 39 to SR 1317	1.6	FW Miles	C

Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year
5	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	2004	1998
5	Ecological/biological Integrity FishCom	Fair Bioclassification	Aquatic Life	2004	1998
1	Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
23-8-(2)	Nutbush Creek Arm of John H. Kerr Reservoir (below normal pool elevation 300 feet MSL or as this elevation may be adjusted by the Corps of Engineers)	From Crooked Run to North Carolina-Virginia State Line	9,690.1	FW Acres	B

Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	

Roanoke River Basin: Middle Roanoke River Subbasin (HUC 03010102) Appendices

Appendix 3-B

Biological Sampling Site Data Sheets (Benthic Macroinvertebrate & Fish Community) for the Middle Roanoke River Subbasin

Biological Samples Taken During this Assessment Cycle

Station ID	Waterbody	County	Site Location	Sample Results
Benthic Sample Sites				
NB45	ISLAND CR	GRANVILLE	SR 1445	09 - Good
NB48	NUTBUSH CR	VANCE	NC 39	06 - Not Rated
NB49	NUTBUSH CR	VANCE	SR 1317	09 - Fair
NB64	RATTLESNAKE CR	GRANVILLE	SR 1437	05 - Not Impaired
Fish Community Sample Sites				
NF22	Island Cr	Granville	SR 1445	09 Good-Fair
NF33	Grassy Cr	Granville	SR 1300	09 - Good
NF36	Johnson Cr	Granville	SR 1440	09 - Good-Fair

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
GRASSY CR	SR 1300	05/26/09	NF33	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	6	03010102	36.47222222	-78.66444444	23-2-(1)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	20.9	340	8	0.5	Yes

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.4
Dissolved Oxygen (mg/L)	4.3
Specific Conductance (µS/cm)	104
pH (s.u.)	6.4

Water Clarity	Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	12
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	0
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**64**

Site Photograph

Substrate Cobble, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/26/09	2009-47	16	46	Good
06/09/99	99-43	15	46	Good

Most Abundant Species 2009 Highfin Shiner

Exotic Species 2009 Green Sunfish, Bluegill

Species Change Since Last Cycle

Gains -- Golden Shiner (n=11), Green Sunfish (n=6), Pumpkinseed (n=7), Warmouth (n=3), Carolina Darter (n=1). **Losses** -- Crescent Shiner (n=31), Margined Madtom (n=3), Fantail Darter (n=54).

Data Analysis

Watershed -- drains central Granville County, no municipalities in the watershed; tributary to Kerr Reservoir. **Habitats** -- primarily a run and slow moving pool upstream from the bridge, riffles absent, not much habitat in mid-channel, no coarse woody debris snags, some *Justicia* at the bridge, good riparian zones. **Water Quality** -- due to the low flow and pool conditions, the dissolved oxygen concentration was low, only at 48% of saturation. **2009** -- fewest fish collected at any site in 2009 (n=81), more than 650 fish were collected in 1999; metric scores and ratings for 2009 may be biased by this small sample size; Carolina Darter [Special Concern] collected for the first time. **1999 & 2009** -- only 19 species known from the site, including 3 species of darters, but no intolerant species; because it is a regional reference site, this site should be re-evaluated in 2014 or during a more normal flow year to determine if reference site status is still warranted.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
JOHNSON CR	SR 1440	05/26/09	NF36	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	6	03010102	36.53222222	-78.65861111	23-2-7-(1)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	7.6	325	7	0.3	Yes

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	95	0	5	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	19.7
Dissolved Oxygen (mg/L)	5.6
Specific Conductance (µS/cm)	127
pH (s.u.)	6.3

Water Clarity	Clear, easily silted

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	10
Riffle Habitat (16)	5
Erosion (7)	5
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**78**

Site Photograph

Substrate Cobble, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/26/09	2009-46	13	44	Good-Fair
04/28/04	2004-26	13	44	Good-Fair

Most Abundant Species 2009 Fantail Darter (46%)

Exotic Species 2009 Green Sunfish, Bluegill

Species Change Since Last Cycle

Gains -- Golden Shiner, Chain Pickerel, Warmouth, Carolina Darter, Johnny Darter. **Losses** -- Satinfin Shiner, Margined Madtom, Snail Bullhead, Redbreast Sunfish. All species gained or lost were represented by 1-3 fish/species, except for Golden Shiner and Margined Madtom (n=8 and 53, respectively).

Data Analysis

Watershed -- drains the extreme north-central part of Granville County and a small portion of southeast Mecklenburg County, VA; no municipalities in the watershed; tributary to Grassy Creek and Kerr Reservoir, site is ~ 3.8 miles above the creek's confluence with the reservoir. **Habitats** -- a regional reference site, a typical Carolina Slate Belt-type stream with very shallow pools and many riffles out of water; very low flow. **Water Quality** -- specific conductance has always been slightly elevated (129 µS/cm in 2004), the highest of any site in the basin in 2009. **2009** -- one-third fewer fish in 2009 than in 2004 (232 vs. 339), noticeably absent were Margined Madtom, and the number of Fantail Darters decreased from 190 to 107; fewest species of any site in 2009 (n=13); Carolina Darter [Special Concern] was collected for the first time; greater darter diversity and a higher percentage of omnivores+herbivores were offset by lower percentages of piscivores and species with multiple ages classes; lingering effects from drought may still be evident. **2004 & 2009** -- 18 species known from this site, including 3 species of darters; dominant species is the Fantail Darter; lower than expected metric scores for this small drainage area reference site are attributable to the very low flows during droughts and limited downstream re-colonization sources.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ISLAND CR	SR 1445	NB45	08/13/09	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	6	03010102	36.495240	-78.504200	23-4	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	32.5	330	9	0.1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	0	0	20 (Fallow Fields)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	22.7
Dissolved Oxygen (mg/L)	6.3
Specific Conductance (µS/cm)	103
pH (s.u.)	6.7

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	7
Bank Erosion (7)	2
Bank Vegetation (7)	5
Light Penetration (10)	9
Left Riparian Score (5)	2
Right Riparian Score (5)	4
Total Habitat Score (100)	72

Site Photograph

Substrate Mostly sand and silt with one long cobble riffle.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/13/09	10811	---	21	---	5.05	Good
06/29/04	9421	---	17	---	5.48	Good-Fair
08/24/94	6693	---	17	---	5.12	Good-Fair

Taxonomic Analysis

Four additional EPT taxa were collected since sampling began in 1994. The pollution sensitive edge-dwelling caddisfly *Mystacides sepulchralis* was common at this site in 2009. Additionally, the intolerant mayfly taxa *Acerpenna macdunnoughi* and *Leucrocuta spp.* were collected at this location. Other taxa not previously collected from this site include the Slate Belt Ecoregion endemic *Stenonema femoratum*; the stonefly *Leuctra spp.*; and the caddisflies *Pycnopsyche spp.* and *Hydroptila spp*.

Data Analysis

An improvement in water quality from Good-Fair in both 1994 and 2004 to Good in 2009 was observed at this sampling location. The EPTBI was the lowest and EPT taxa richness was the highest on BAU record at this sampling location suggesting a more intolerant benthic community and overall improved water quality. Upstream portions of this catchment are mostly rural with some agricultural land use. The site was not sampled in 1999 due to low flow conditions.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
ISLAND CR	SR 1445	05/27/09	NF22	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	6	03010102	36.495	-78.50444444	23-4	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	33.1	290	10	0.5	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	10	15	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.6
Dissolved Oxygen (mg/L)	5.5
Specific Conductance (µS/cm)	102
pH (s.u.)	6.4
Water Clarity	Slightly turbid, easily silted

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	10
Riffle Habitat (16)	3
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	8
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	**75**

Site Photograph

Substrate Cobble, gravel, sand, clay, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/16/10	2010-49	19	46	Good
05/27/09	2009-49	21	44	Good-Fair
06/09/99	99-44	24	54	Excellent
06/02/94	94-25	24	50	Good

Most Abundant Species 2009 Johnny Darter (20%)

Exotic Species 2009 Green Sunfish, Bluegill, Redear Sunfish

Species Change Since Last Cycle (2009 vs. 2004)

Gains -- Comely Shiner, Pirate Perch, Eastern Mosquitofish, Pumpkinseed, Redear Sunfish. **Losses** -- Rosyside Dace, Rosefin Shiner, Mountain Redbelly Dace, Golden Redhorse, Creek Chubsucker, Margined Madtom, Brown Bullhead, Flat Bullhead, Chain Pickerel. All species gained or lost were represented by 1-6 fish/species, except for Pirate Perch, Rosefin Shiner, and Golden Redhorse (n=13, 59, and 91, respectively).

Data Analysis

Watershed -- drains northeastern Granville and and northwestern Vance counties; no municipalities in the watershed; tributary to Kerr Reservoir. **Habitats** -- root mats, snags, pools, short, shallow riffles. **Water Quality** -- specific conductance has ranged from 90 to 106 µS/cm. **2009** -- the number of fish collected in 2009 was one-fourth the number in 1999 (208 *vs*. 895); the Crescent Shiner, the dominant species in 1999, was essentially absent in 2009 (435 *vs*. 1); greatest diversity of sunfish than at any other site (n=6); very skewed trophic structure along with decreases in the total number of fish and diversity of suckers were responsible for the decline in the NCIBI score and rating; lingering drought impacts. **1994 - 2009** -- diverse community with 30 species known from the site, including 6 species of sunfish, 3 species of suckers, and 3 species of darters including the Carolina Darter [Special Concern]; but no intolerant species; in 1994 and 1999 the dominant species was the Crescent Shiner. **Note:** the site was re-sampled in 2010 following a wetter winter and spring flow period and the community was rated Good.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NUTBUSH CR	SR 1317	NB49	08/12/09	Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
VANCE	6	03010102	36.368770	-78.408520	23-8-(1)b	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	7.0	330	8	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	20	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Henderson Water Reclamation Facility	NC0020559	6.0

Water Quality Parameters

Temperature (°C)	25.9
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	416
pH (s.u.)	7.4
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	13
Pool Variety (10)	8
Riffle Habitat (16)	12
Bank Erosion (7)	3
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	86

Site Photograph

Substrate Good mix of bedrock, boulder, rubble, and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/12/09	10810	57	12	6.54	6.03	Fair
06/29/04	9420	64	9	7.00	6.70	Fair
08/25/99	7989	41	8	6.73	6.75	Fair
10/28/94	6738	50	8	6.74	6.31	Fair
08/24/94	6694	44	8	6.84	6.89	Fair

Taxonomic Analysis

A tolerant macroinvertebrate community was observed at this Basinwide sampling location in 2009. No stoneflies were collected at the site. *Maccaffertium modestum* and *Baetis flavistriga* were the abundant tolerant mayflies collected at the site. These mayfly species commonly occur in NC peidmont streams. The tolerant filter-feeding caddisfly taxa *Cheumatopsyche spp*. and *Hydropsyche betteni* were also abundant. A rarely collected mayfly *Paracloeodes fleeki* was common at this location. This taxa is generally collected in degraded streams. The organic pollution tolerant *Dicrotendipes neomodestus* was abundant along with other tolerant chironomids such as *Phaenopsectra punctipes gr*., *Polypedilum illinoense gr.,* and *P. scalaenum gr*. Only two intolerant taxa were collected including the caddisfly *Chimarra spp.* and the beetle *Psephenus herricki*.

Data Analysis

This stream received a bioclassification of Fair in 2009 despite the highest EPT taxa richness and lowest EPTBI and NCBI on record at this station. A generally tolerant benthic community was found at this location. A more diverse macroinvertebrate community would be expected due to adequate habitat found at the site. Conductivity was the highest compared to all other Roanoke Basinwide sites at 416 µS/cm. This is most likely due to the WWTP located approximately 1 mile upstream. In 2009, the elevated conductivity was lower than in 1999 (633 µS/cm) and in 2004 (501µS/cm) and dissolved oxygen was higher in 2009 potentially parallelling decreases in biotic indices. This site has been issued permit violations in the past and continues to suffer degraded conditions most likely from point source inputs.

APPENDIX 3-C

AMBIENT MONITORING SYSTEMS
STATION DATA SHEETS
FOR THE MIDDLE ROANOKE RIVER SUBBASIN

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

Location: NUTBUSH CRK AT SR 1317 NR HENDERSON
Station #: N5000000 **Hydrologic Unit Code:** 03010102
Latitude: 36.36914 **Longitude:** -78.40834 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 23-8-(1)

Time period: 01/03/2005 to 11/18/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	47	0	<4	0	0		6.6	7	7.5	9.7	12.5	13.5	14.9
	47	0	<5	0	0		6.6	7	7.5	9.7	12.5	13.5	14.9
pH (SU)	47	0	<6	0	0		6.2	6.6	6.9	7.4	7.7	7.8	8.6
	47	0	>9	0	0		6.2	6.6	6.9	7.4	7.7	7.8	8.6
Salinity (ppt)	9	0	N/A				0.2	0.2	0.2	0.2	0.3	0.3	0.3
Spec. conductance (umhos/cm at 25°C)	48	0	N/A				221	300	360	458	572	630	693
Water Temperature (°C)	48	0	>32	0	0		5.9	7.5	10	14.9	22.5	24.3	26.1
Other													
Chlorophyll a (ug/L)	2	0	>40	0	0		4	4	4	7	10	10	10
TSS (mg/L)	19	10	N/A				2.5	2.5	2.5	6.2	12	13	15
Turbidity (NTU)	48	1	>50	0	0		1	1.4	1.8	2.2	4.8	8.7	31
Nutrients (mg/L)													
NH3 as N	47	36	N/A				0.02	0.02	0.02	0.02	0.02	0.04	0.08
NO2 + NO3 as N	46	0	N/A				4.1	5.99	7.5	11	15	18	23
TKN as N	45	7	N/A				0.2	0.2	0.35	0.55	0.6	0.69	0.89
Total Phosphorus	45	0	N/A				0.06	0.17	0.21	0.36	0.54	0.75	1
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				84	84	98	140	185	320	320
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	2	>7	0	0		2	2	2	3	4	5	5
Iron, total (Fe)	9	0	>1000	0	0		130	130	190	270	330	640	640
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	0	>50	0	0		15	15	16	18	23	34	34

Fecal Coliform Screening(#/100mL)

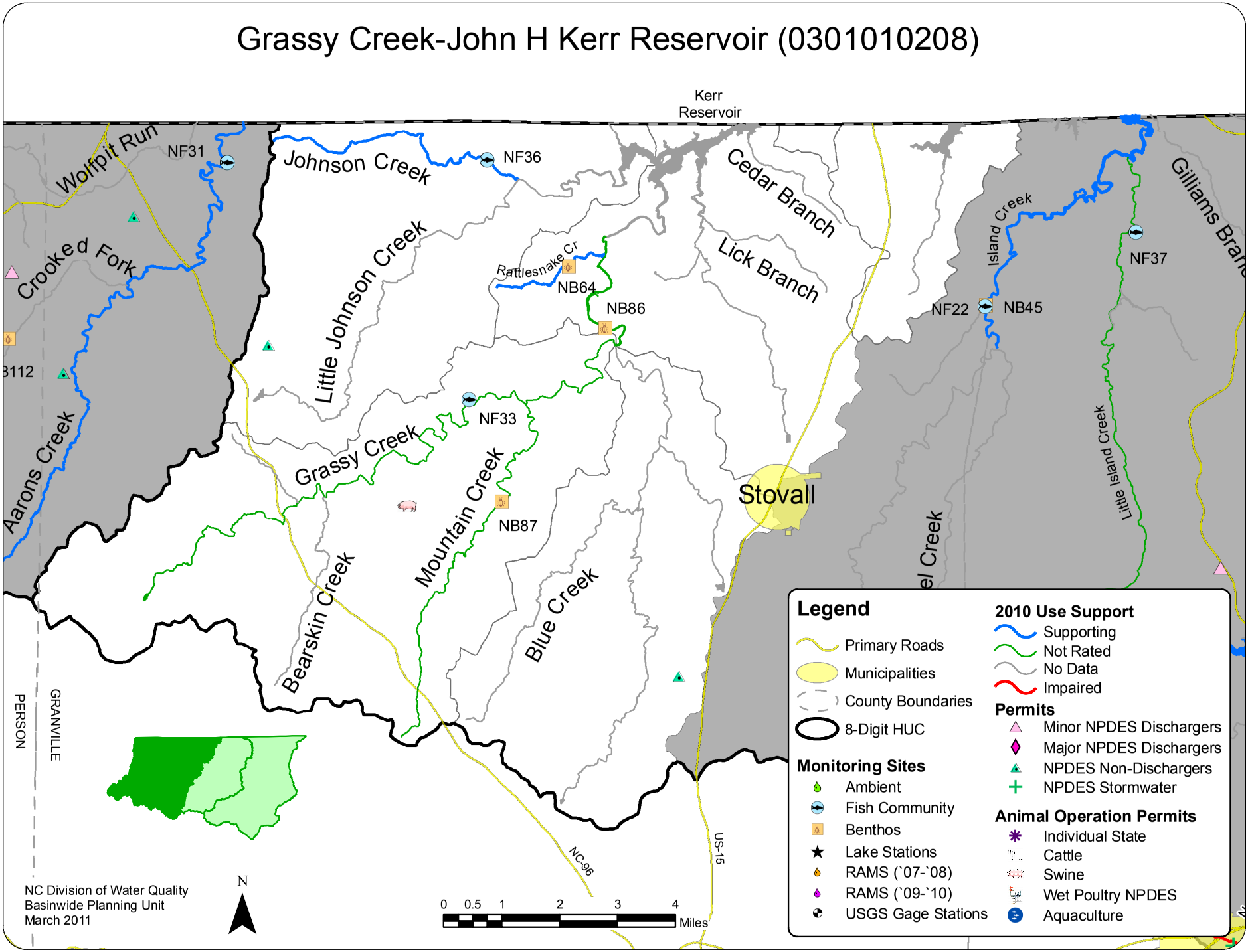
# results:	Geomean:	# > 400:	% > 400:	%Conf:
48	115.9	4	8.3	

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

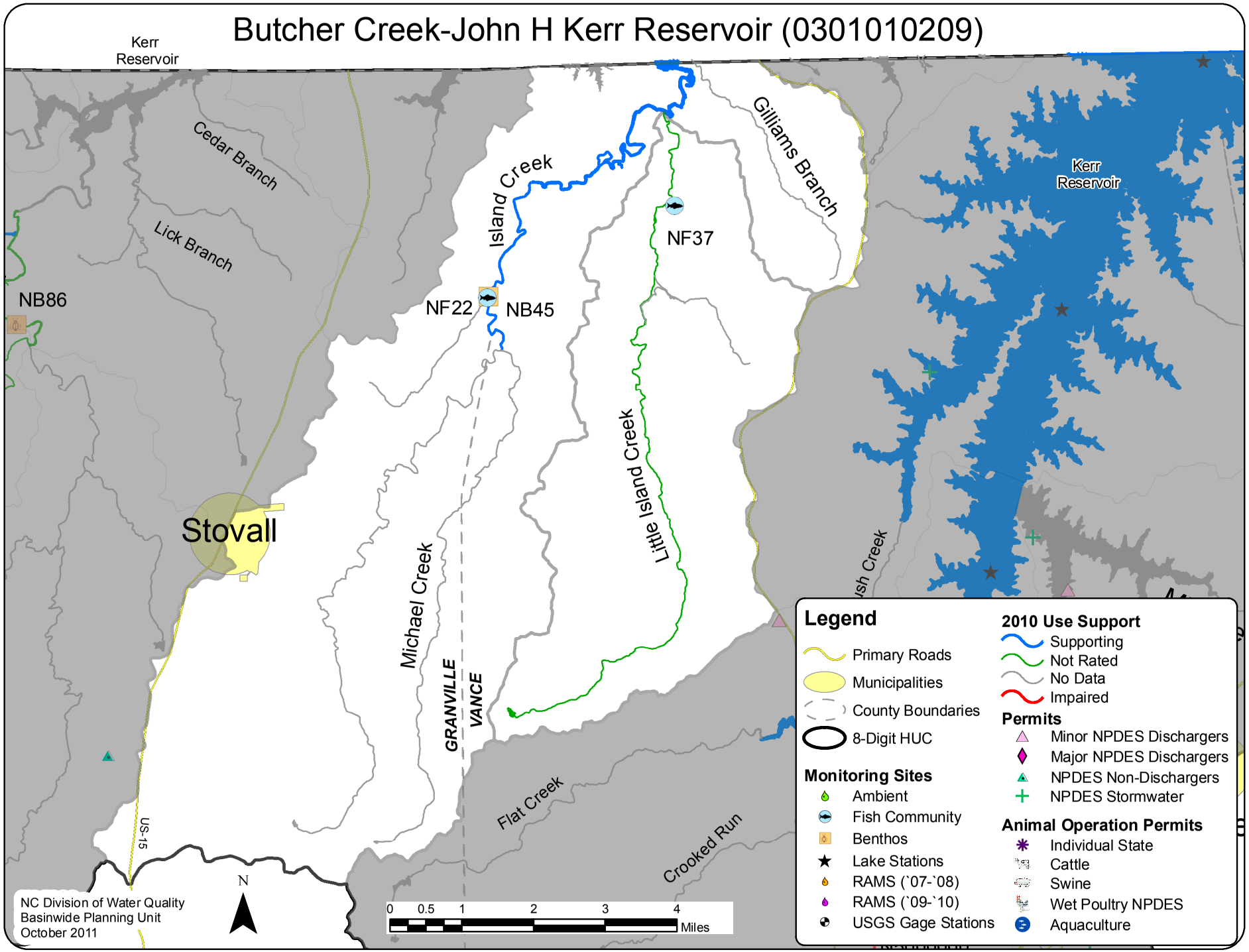
Appendix 3-D

10-Digit Watershed Maps for the Middle Roanoke River Subbasin

Grassy Creek-John H Kerr Reservoir (0301010208)



Butcher Creek-John H Kerr Reservoir (0301010209)



Nutbush Creek-John H Kerr Reservoir (0301010210)