Appendix IV

DWQ Water Quality Monitoring Programs in the Roanoke River Basin

DWQ Water Quality Monitoring Programs in the Roanoke River Basin

Staff in the Environmental Sciences Branch (ESB) and Regional Offices of DWQ collect a variety of biological, chemical and physical data. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in Roanoke River basin for that program. For more detailed information on sampling and assessment of streams in this basin, refer to the *Basinwide Assessment Report* for the Roanoke River basin, available from the Environmental Sciences Branch website at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Roanoke River Basin include:

- Benthic Macroinvertebrates
- Fish Assessments
- Aquatic Toxicity Monitoring
- Lake Assessment
- Ambient Monitoring System

Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom substrates of rivers and streams. These organisms are primarily aquatic insect larvae. The use of benthos data has proven to be a reliable monitoring tool, as benthic macroinvertebrates are sensitive to subtle changes in water quality. Since macroinvertebrates have life cycles of six months to over one year, the effects of short-term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign a bioclassification to each benthic sample based on the number of different species present in the pollution intolerant groups of Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies), commonly referred to as EPTs. A Biotic Index (BI) value gives an indication of overall community pollution tolerance. Different benthic macroinvertebrate criteria have been developed for different ecoregions (mountains, piedmont, coastal plain and swamp) within North Carolina and bioclassifications fall into five categories (except for swam streams): Excellent, Good, Good-Fair, Fair and Poor.

The Biological Assessment Unit defines “swamp streams” as those streams that are within the coastal plain ecoregion and that normally have no visible flow during a part of the year. This low flow period usually occurs during the summer, but flowing water should be present in swamp streams during the winter. Sampling during winter, high flow periods provides the best opportunity for detecting differences in communities from what is natural, and only winter (February to early March) benthos data can be used when evaluating swamp streams. The swamp stream must have visible flow in this winter period, with flow comparable to a coastal plain stream that would have acceptable flow for sampling in summer. Swamp stream bioclassifications fall into three categories: Natural, Moderate and Severe.

Overview of Benthic Macroinvertebrate Data

Based on benthic macroinvertebrate data, water quality in the Roanoke River basin is Good near the headwaters (subbasins 01-04), while in the lower reaches (subbasins 05-10) overall water quality is generally Good-Fair. Benthic macroinvertebrate basinwide samples resulted in the following bioclassifications: Excellent-1, Good-9, Good-Fair-6, Fair-3, Natural-11, and

Moderate-6. Comparisons of benthos data from 1999 to 2004 between repeat sites reveal that Dan River at NC 704 improved from Good to Excellent, North Double Creek and Country Line Creek improved from Good-Fair to Good, Marlowes Creek improved from Fair to Good-Fair, while two swamp sites (Hoggard Mill and Conoconnara Swamp) declined from Natural to Moderate. All remaining sites maintained the same bioclassification from 1999 to 2004. Overall, water quality in this basin has improved slightly since 1999, based on benthos data.

The following table lists the bioclassifications (by subbasin) for all benthos sites in the Roanoke River basin. Benthos sampling may slightly overestimate the proportion of Fair, Poor and Severe stress sites, as DWQ special studies often have the greatest sampling intensity (number of sites/stream) in areas where it is believed that water quality problems exist.

Benthic macroinvertebrate basinwide monitoring data collected in the Roanoke River basin, 1999-2004. Current basin sites are in bold.

Subbasin/ Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	BioClass
30201									
Dan R	NC 704	Stokes	22-(1)	7/7/04	91	45	3.89	3.42	Excellent
		Stokes	22-(1)	8/23/99	85	41	4.20	3.31	Good
		Stokes	22-(1)	8/16/99	74	32	4.16	3.19	Good
Dan R	SR 1695	Stokes	22-(8)	7/7/04	87	43	4.80	4.07	Good
		Stokes	22-(8)	8/23/99	72	37	4.58	3.96	Good
N Double Cr	SR 1504	Stokes	22-10	6/28/04	31	31	--	3.42	Good
		Stokes	22-10	8/23/99	25	25	--	3.95	Good-Fair
Snow Cr	SR 1673	Stokes	22-20	7/7/04	31	31	--	4.33	Good
		Stokes	22-20	9/13/00	29	29	--	4.10	Good
		Stokes	22-20	8/23/99	18	18	--	4.37	Fair
Town Fork Cr	SR 1998	Stokes	22-25	5/18/04	87	35	4.84	3.86	Good-Fair
Town Fork Cr	SR 1961	Stokes	22-25	5/25/04	67	26	5.10	4.69	Good-Fair
Town Fork Cr	SR 1917	Stokes	22-25	5/25/04	80	35	5.30	4.84	Good
Brushy Fk	SR 1998	Stokes	22-25-1	5/18/04	86	37	5.10	4.06	Good-Fair
30202									
Mayo R	SR 1358	Rockingham	22-30-(1)	7/8/04	77	33	4.71	4.13	Good
		Rockingham	22-30-(1)	8/23/99	70	32	4.26	3.44	Good
Mayo R	SR 2177	Rockingham	22-30-(10)	8/24/99	52	21	5.23	4.26	Good-Fair
30203									
Rock House Cr	SR 2127	Rockingham	22-34-(2)	4/12/01	81	23	5.00	3.80	Good-Fair
Smith R	NC 14	Rockingham	22-40-(3)	9/13/99	51	18	5.24	3.68	Fair
30204									
Dan R	NC 57	Caswell	22-(39)	8/24/99	66	32	5.42	4.52	Good
Country Line Cr	SR 1129	Caswell	22-56-(1)	7/1/04	24	24	--	4.89	Good
Country Line Cr	NC 57	Caswell	22-56-(3.7)	7/1/04	24	24	--	4.82	Good
30205									
Marlowes Cr	SR 1351	Person	22-58-12-6	6/30/04	66	14	6.67	5.87	Fair
Marlowes Cr	SR 1322	Person	22-58-12-6	6/30/04	56	13	6.43	5.93	Good-Fair
		Person	22-58-12-6	8/25/99	53	9	6.34	5.74	Fair
30206									
Grassy Cr	SR 1436	Granville	23-2-(1)	6/30/04	13	13	--	5.05	Not Rated
Mountain Cr	SR 1300	Granville	23-2-3	7/2/04	13	13	--	5.40	Not Rated
Island Cr	SR 1445	Granville	23-4	6/29/04	17	17	--	5.48	Good-Fair
		Granville	23-4	8/24/94	17	17	--	5.11	Good-Fair
Nutbush Cr	NC 39	Vance	23-8-(1)	6/29/04	70	12	7.34	6.84	Fair
Nutbush	SR 1317	Vance	23-8-(1)	6/29/04	63	9	7.00	6.70	Fair
		Vance	23-8-(1)	8/25/99	41	8	6.73	6.76	Fair
30207									
Smith Cr	SR 1217	Warren	23-10	4/26/04	69	18	6.29	5.09	Fair
Smith Cr	SR 1208	Warren	23-10	4/26/04	87	22	6.03	4.87	Good-Fair
Smith Cr	US 1	Warren	23-10	4/26/04	50	10	6.43	5.13	Fair
Smith Cr	US 1	Warren	23-10	7/16/99	59	12	6.56	5.52	Fair
Newmans Cr	SR 1218	Warren	23-10-2	4/27/04	76	15	6.30	5.32	Fair
Sixpound Cr	SR 1306	Warren	23-13	6/29/04	62	15	6.43	5.44	Good-Fair
		Warren	23-13	7/16/99	54	14	5.50	5.05	Good-Fair

Subbasin/ Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	BioClass
30208									
Deep Cr	US 158	Halifax	23-24(1)	2/23/04	62	23	5.28	4.10	Natural
				7/15/99	58	11	6.41	5.17	Not Rated
Chockoyotte Cr	Country Club Rd	Halifax	23-29	2/23/04	52	11	6.72	5.40	Moderate
Quankey Cr	NC 903	Halifax	23-30	2/23/04	53	17	5.82	4.05	Natural
				2/16/99	40	9	6.66	5.93	Natural
Quankey Cr	NC 561	Halifax	23-30	9/1/99		9		5.51	Fair
L Quankey Cr	NC 903	Halifax	23-30-1	2/23/04	46	17	5.65	4.49	Moderate
Oconeechee Cr	SR 1126	Northhampton	23-31	2/16/99	22	4	6.48	6.88	Natural
Conoconnara Swp	NC 561	Halifax	23-33	2/24/04	30	3	7.22	7.26	Moderate
				2/16/99	31	5	6.45	6.81	Natural
Kehukee Swp	SR 1804	Halifax	23-42	2/24/04	46	7	7.03	5.89	Moderate
				9/2/99	6	6	6.19	6.19	Not Rated
				2/11/99	59	8	7.11	6.64	Moderate
30209									
Conoho Cr	NC 11/42	Martin	23-49	2/4/04	31	4	7.64	7.10	Moderate
Conoho Cr	NC 125/903	Martin	23-49	2/1/99	29	3	7.29	7.58	
Conoho Cr	SR 1417	Martin	23-49	2/4/04	38	6	6.68	5.40	Natural
				2/1/99	39	5	6.27	4.80	
Hardison Mill Cr	SR 1528	Martin	23-50-3	2/4/04	36	2	7.49	5.20	Moderate
				2/1/99	27	3	7.29	7.67	Moderate
30210									
Cashie R	SR 1219, be WWTP	Bertie	24-2-(1)	2/23/04	29	3	7.47	7.03	Moderate
		Bertie	24-2-(1)	2/11/99	41	6	7.51	7.24	Natural
Cashie R	SR 1257	Bertie	24-2-(1)	2/24/04	35	7	6.51	4.90	Natural
	SR 1257	Bertie	24-2-(1)	2/15/99	34	7	6.80	6.09	Natural
Hoggard Mill Cr	SR 1301	Bertie	24-2-6	2/23/04	30	3	7.13	5.65	Moderate
		Bertie	24-2-6	2/15/99	46	7	6.81	6.38	Natural
Roquist Swp	US 13/17	Bertie	24-2-8	2/24/04	38	4	7.01	6.46	Natural
	US 13/17	Bertie	24-2-8	2/11/99	31	4	6.99	5.50	Natural
Wading Place Cr	NC 308	Bertie	24-2-8	3/8/99	35	3	7.31	7.45	Moderate

Assessing Benthic Macroinvertebrate Communities in Small Streams

The benthic macroinvertebrate community of small streams is naturally less diverse than the streams used to develop the current criteria for flowing freshwater streams. The benthic macroinvertebrate database is being evaluated and a study to systematically look at small reference streams in different ecoregions is being developed with the goal of finding a way to evaluate water quality conditions in such small streams.

DWQ will use this monitoring information to identify potential impacts to these waters even though a use support rating is not assigned. DWQ will continue to develop criteria to assess water quality in small streams.

Fish Assessments

Historical studies of fish communities in the Roanoke River basin were conducted primarily by the North Carolina Wildlife Resources Commission (NCWRC) in the 1960s and late 1970s. Several streams were sampled by DWQ during the last basinwide planning cycle (1994). Twenty-three of the 30 sites sampled in 2004 had not been sampled previously. Scores are assigned to these samples using the North Carolina Index of Biotic Integrity (NCIBI). The NCIBI uses a cumulative assessment of twelve parameters or metrics. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score.

Overview of Fish Community Data

In 2004, fish community assessments were performed at 30 sites in the basin, 29 in the Piedmont and 1 in the Coastal Plain. Chockoyotte Creek was not rated because metrics and criteria have yet to be developed for Coastal Plain streams. The Piedmont NCIBI ratings ranged from Poor to Excellent with the scores ranging from 22 to 54. The two streams rated Excellent were Archies and Peters Creeks. Based upon the fish community ratings, degraded streams (bioclassifications of Fair or Poor) included North Hyco, Little Island, Nutbush, and Smith Creeks. Fish community sampling resulted in the following bioclassifications: Excellent-2, Good-18, Good-Fair-5, Fair-2, and Poor-2. The following table lists the most recent ratings since 1990, by subbasin, for all fish community sites.

Fish community data collected from the Roanoke River basin, 1990 - 2004. Current basinwide sites are in bold font.

Subbasin/Waterbody	Location	County	Index No.	Date	NCIBI Score	NCIBI Rating
030201						
Dan R	SR 1416	Stokes	22-(1)	04/19/04	52	Good
Archies Cr	SR 1415	Stokes	22-2	04/19/04	54	Excellent
Elk Cr	SR 1433	Stokes	22-5	04/20/04	44	Good-Fair
Peters Cr	SR 1497	Stokes	22-6	04/21/04	54	Excellent
Big Cr	SR 1471	Stokes	22-9	04/20/04	48	Good
N Double Cr	SR 1504	Stokes	22-10	04/20/04	42	Good-Fair
S Double Cr	SR 1483	Stokes	22-11	04/20/04	46	Good
Snow Cr	SR 1652	Stokes	22-20	04/21/04	46	Good
Town Fork Cr	SR 1955	Stokes	22-25	04/21/04	48	Good
030202						
Big Beaver Island Cr	US 311	Rockingham	22-29	04/22/04	52	Good
Pawpaw Cr	SR 1360	Rockingham	22-30-6-(1)	04/22/04	44	Good-Fair
				08/03/90	48	Good
Hogans Cr	NC 704	Rockingham	22-31	04/22/04	48	Good
Jacobs Cr	NC 704	Rockingham	22-32-(0.5)	04/22/04	50	Good
030203						
Rock House Cr	SR 2127	Rockingham	22-34-(2)	04/23/04	48	Good
Matrimony Cr	NC 770	Rockingham	22-38	04/23/04	52	Good
Wolf Island Cr	SR 1767	Rockingham	22-48	04/23/04	50	Good
Wolf Island Cr	NC 700	Caswell	22-48	10/05/94	54	Excellent
Hogans Cr	SR 1330	Caswell	22-50	05/25/04	52	Good
Jones Cr	SR 2571	Rockingham	22-50-3	06/08/04	48	Good
030204						
Moon Cr	SR 1511	Caswell	22-51	04/30/04	46	Good
				09/07/94	44	Good-Fair
Rattlesnake Cr	SR 1523	Caswell	22-52	05/25/04	48	Good
Cane Cr	SR 1527	Caswell	22-54	05/25/04	46	Good
				10/05/94	46	Good
Country Line Cr	NC 57	Caswell	22-56-(3.7)	09/07/94	48	Good
030205						
N Hyco Cr	US 158	Caswell	22-58-1	04/30/04	30	Poor
S Hyco Cr	US 158	Person	22-58-4-(3)	04/30/04	52	Good
Marlowe Cr	SR 1322	Person	22-58-12-9	04/28/04	42	Good-Fair
				09/07/94	40	Good-Fair
030206						
Aarons Cr	SR 1400	Granville	22-59	04/28/04	46	Good
Grassy Cr	SR 1300	Granville	23-2-(1)	06/09/99	46	Good
Grassy Cr	SR 1436	Granville	23-2-(1)	06/02/94	50	Good
Johnson Cr	SR 1440	Granville	23-2-7-(1)	04/28/04	44	Good-Fair
Island Cr	SR 1445	Granville	23-4	06/09/99	54	Excellent
				06/02/94	50	Good
Little Island Cr	SR 1348	Vance	23-4-3	04/29/04	30	Poor

Subbasin/Waterbody	Location	County	Index No.	Date	NCIBI Score	NCIBI Rating
Nutbush Cr	SR 1317	Vance	23-8-(1)	04/29/04	38	Fair
				10/04/94	44	Good-Fair
030207						
Smith Cr	US 1	Warren	23-10	04/29/04	38	Fair
				05/12/94	42	Good-Fair
Sixpound Cr	SR 1306	Warren	23-13	05/12/94	42	Good-Fair
030208						
Deep Cr	US 158	Halifax	23-24-(1)	05/26/04	46	Good
				09/21/94	50	Good
Chockoyotte Cr	US 158	Halifax	23-29	05/26/04	---	Not Rated
Quankey Cr	SR 1619	Halifax	23-30	09/21/94	38	Fair
Conoconnara Swp	NC 561	Halifax	23-33	09/21/94	---	Not Rated
Kehukee Swp	SR 1804	Halifax	23-42	10/27/94	---	Not Rated
030210						
Cashie R	SR 1257	Bertie	24-2-(1)	10/26/94	---	Not Rated

In 2004, 61 different species were collected during NC DWQ's fish community monitoring program. The most commonly collected species were the bluehead chub and the redbreast sunfish (collected at 28 of the 30 sites). The most abundant species was the bluehead chub, which constituted almost one-quarter of all the fish collected. It was also the numerically dominant species at 15 of the 30 sites.

Overview of Fish Tissue Sampling

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

Tissue samples collected during the period contained PCB and organic contaminants at undetectable levels or at levels less than the US EPA, US FDA, and State of North Carolina criteria.

Elevated mercury concentrations were, however, measured in fish samples collected from the Cashie River near Windsor (Subbasin 03-02-10). Elevated levels were most often detected in largemouth bass, a species at the top of the food chain and most often associated with mercury bioaccumulation in North Carolina. Largemouth bass, yellow perch and redear sunfish (10 of 23 samples) collected from the Cashie River contained mercury concentrations exceeding the state criteria of 0.4 ppm. Presently, there are no site-specific consumption advisories for mercury contaminated fish in the Roanoke River basin; however, an advice for the consumption of shark, Swordfish, Tilefish, King mackerel, Spanish mackerel, Albacore tuna, Largemouth bass, Bowfin/Blackfish, and Chain pickerel/Jack fish east of Interstate 85 was issued by NCDHHS in 2002. For more information on NCDHHS consumption advice and advisories in North Carolina, refer to http://www.epi.state.nc.us/epi/fish/current.html.

There is a NCDHHS site specific fish consumption advisory due to dioxin contamination in the Roanoke River from Williamston to the mouth including Welch Creek and the western part of Albemarle Sound (Chapter 8). Dioxin concentrations, however, have been declining since 1994. Annual monitoring by the mill has indicated that dioxin concentrations in most fish species are gradually decreasing since the mill initiated dioxin reduction and management programs in the early 1990s. In October 2001 NCDHHS lifted gamefish from the advisory after consecutive

sampling years showed dioxin levels in gamefish dropped below the NC criteria of 4 pg/g. The advisory remains in place for catfish and carp species.

Roanoke River Basin Fish Kills

DWQ has systematically tracked reported fish kill events across the state since 1996. From September 1,1999 to August 31,2004, DWQ field investigators reported 3 fish kill events in the Roanoke River basin.

The two largest fish kills in this basin occurred after hurricane Isabel in 2003. The fish kills occurred due to low dissolved oxygen levels in the river as a result from an influx of low DO swamp water and organic matter flowing into the mainstem of the river following the hurricane. The following table lists the details of the Roanoke River Basin fish kills. For more information on fish kills in North Carolina, refer to http://www.esb.enr.state.nc.us/Fishkill/fishkillmain.htm

Detailed Fish Kill Information for the Roanoke River Basin from September 1, 1999-August 31, 2004.

Date	County	Waterbody	Location	Kill #	Kill Area	Duration	Cause	Mortality	Fish species	Comments
Subbasin 03-02-09										
9/23/03	Martin	Roanoke River	Jamesesville, Plymouth	WA03021	18 miles	2 days	Low DO	93,500 Juvenile fish are not reflected in totals.	Catfish, Sunfish, Suckers, Shad, Largemouth bass, Eels, Minnows, Flounder, Perch, Striped bass	Kill resulted from the flushing of swamp water into the river following Hurricane Isabel, and the subsequent drop in DO levels. Kill zone stretched from Devils Gut above Jamesville to the river mouth. All DO readings were < 0.5 mg/L. Fish were seen at the surface gasping for air.
Subbasin 03-02-10										
9/25/03	Bertie	Cashie River	Windsor	WA03022	17.7 miles	4 days	Low DO	22,243	Sunfish, Catfish, Crappie, Minnows	Kill caused by low DO levels resulting from an influx of swamp water and organic matter following Hurricane Isabel. Dead fish found from Windsor to the mouth of the river. All DO readings were < 0.5 mg/L.
Subbasin 03-02-05										
3/29/04	Person	Mayo Creek	Below Reservoir Spillway	RA04001	1 mile	1 day	Unknown	60	Carp, Bluehead chub	Observed ~60 dead carp in various stages of decay within 500 meters of the spillway. About 50% of the live carp in the area had sores on top of their head and body. Many carp and Bluehead chub were very lethargic and unresponsive.

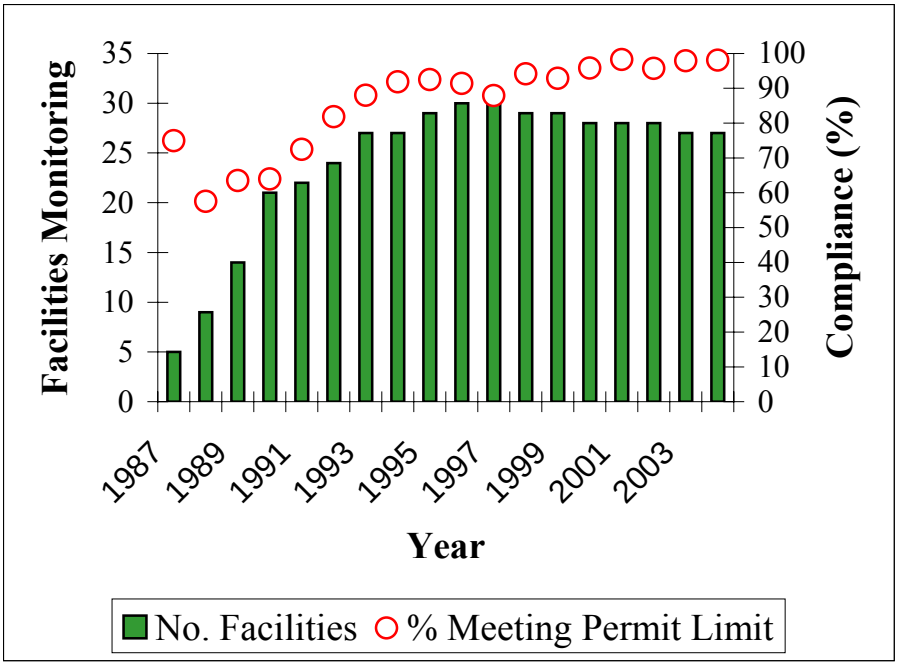
Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of

these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. Many facilities are required to monitor whole effluent toxicity (WET) by their NPDES permit or by administrative letter. Other facilities may also be tested by DWQ's Aquatic Toxicology Unit (ATU). Per Section 106 of the Clean Water Act, the ATU is required to test at least 10 percent of the major discharging facilities over the course of the federal fiscal year (FFY). However, it is ATU's target to test 20 percent of the major dischargers in the FFY. This means that each major facility would get evaluated over the course of their five-year permit. There are no requirements or targets for minor dischargers.

The ATU maintains a compliance summary for all facilities required to perform tests and provides monthly updates of this information to regional offices and DWQ administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

Thirty NPDES permits in the Roanoke River basin currently require WET testing. Twenty-seven permits have a WET limit; the other three facilities permits specify monitoring but do not have a limit. Across the state, the number of facilities required to perform WET has increased steadily since 1987, the first year that WET limits were written into permits in North Carolina. Consequently, compliance rates have also risen. Since 1998, the compliance rate has stabilized at approximately 90-95 percent. The following graph summaries WET monitoring compliance in the Roanoke River basin from 1987 to 2004. Facilities with toxicity problems during the most recent two-year review period are discussed in subbasin chapters.



NPDES facility whole effluent toxicity compliance in the Roanoke River basin, 1987-2004. The compliance values were calculated by determining whether facilities with WET limits were meeting their ultimate permit limits during the given time period, regardless of any SOCs in force.

Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine stations strategically located for the collections of physical and chemical water quality data. North Carolina currently has 365 water chemistry monitoring stations statewide, including 22 stations in the Roanoke River basin. Between 23 and 32 parameters are collected monthly at each station. These locations were chosen to characterize the effects of point source dischargers and nonpoint sources such as agriculture, animal operations, and urbanization within watersheds. The locations of these stations are listed in the following table and shown on individual subbasin maps. Notable ambient water quality parameters are discussed in the subbasin chapters. Refer to *2005Roanoke River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html for more detailed analysis of ambient water quality monitoring data.

Ambient Monitoring Stations in the Roanoke River Basin by Subbasin, 1999-2004.

Subbasin	Station	Location	Class	County
01				
	N0150000	Dan River at NC 704 near Francisco	C Tr	Stokes
02				
	N1400000	Mayo River at SR 1358 near Price	WS-V	Rockingham
03				
	N2300000	Dan River at SR 2150 near Wentworth	WS-IV	Rockingham
	N2430000[1]	Smith River at SR 1714 near Eden	WS-IV	Rockingham
	N2450000[2]	Smith River at NC 14 at Eden	WS-IV	Rockingham
	N3000000	Dan River at SR 1761 near Mayfield	C	Rockingham
04				
	N3500000	Dan River at NC 57 at VA Line at Milton	C	Caswell
05				
	N4110000[3]	Hyco Creek at US 158 near Leasburg	C	Caswell
	N4250000	Hyco River Below Afterbay Dam near Mcghees Mill	C	Person
	N4400000[4]	Marlowe Creek at SR 1322 near Woodsdale	C	Person
	N4510000	Hyco River at US 501 near Denniston VA	III NT	Halifax
	N4590000	Mayo Creek at SR 1501 near Bethel Hill	C	Person
06				
	N5000000	Nutbush Creek at SR 1317 near Henderson	C	Vance
07				
	N6400000	Smith Creek at US 1 near Paschall	C	Warren
08				
	N7300000	Roanoke River at NC 48 at Roanoke Rapids	WS-IV CA	Halifax
	N8200000	Roanoke River at US 258 near Scotland Neck	C	Halifax
	N8300000	Roanoke River at NC 11 near Lewiston	C	Martin
09				
	N8550000	Roanoke River at US 13 And US 17 at Williamston	C	Martin
	N9250000	Roanoke River 1.3 Mi Ups Welch Creek near Plymouth	C Sw	Martin
	N9600000	Roanoke River at NC 45 at Sans Souci	C Sw	Bertie
	N9700000	Albemarle Sound at Batchelor Bay near Black Walnut	B Sw	Bertie
10				
	N8950000	Cashie River at SR 1219 near Lewiston	C Sw	Bertie

[1]Sample collection at station N2430000 began on 7/24/00.
[2]Sample collection at station N2450000 ceased on 6/21/00.
[3]Sample collection at station N4110000 ceased on 6/21/00.
[4]Sample collection at station N4400000 was temporarily suspended on 10/7/03.

Lakes Assessment Program

Eleven Roanoke River Basin lakes were sampled in June through September of 2004. Generally, lake conditions were similar to previous years. Farmer Lake and Lake Roxboro had elevated chlorophyll *a* and dissolved oxygen concentrations; however, all other parameters were normal. While blue-green algae dominated the phytoplankton assemblages in Farmer Lake, Lake Roxboro had a diverse assemblage including species that may cause taste and odor problems in drinking water. Lakes with noted water quality impacts are discussed in the appropriate subbasin chapters. See the table below for a list of the lakes and their characteristic information.

Lakes Assessment – Roanoke River Basin

Subbasin		030201					030204	030205				030206	030207		030208
Lakes Ambient Program Name		Hanging Rock Lake	Kernersville Reservoir	Belews Lake			Farmer Lake	Lake Roxboro	Roxboro City Lake (Lake Isaac Walton)	Mayo Reservoir	Hyco Lake	Kerr Reservoir	Lake Gaston		Roanoke Rapids Lake
Trophic Status (NC TSI)		Oligotrophic	Eutrophic	Oligotrophic			Eutrophic	Eutrophic	Eutrophic	Mesotrophic	Mesotrophic	Mesotrophic	Mesotrophic		Oligotrophic
Mean Depth (meters)		1	5	15			5.5	6	3.5	9	6.1	10.7	6		5
Volume ($10^6 m^3$)		0.003	0.4	228			6.5	11	0.3	105	99	448	512		96
Watershed Area (mi^2)		0.8	3.5	46.3			48.3	23.9	196.1	51.4	188	7610.8	8293.4		8294.2
Assessment Unit Name		Cascade Creek	Belews Cr (Kernersville Reservoir)	Belews Cr. (including Belews Lake below elev. 725) & West Belews Cr. (W. Belews Cr. Arm of Belews Lake below elevation 725)			County Line Creek (Farmer Lake)	South Hyco Creek (Lake Roxboro)	Storys Creek [Roxboro City Lake (Lake Issac Walton)]	Mayo Cr (Maho Cr) (Mayo Res)	Hyco R., including Hyco Lake below elevation 410)	Nutbush Creek Arm of John H. Kerr Reservoir (below normal pool elevation 300 ft MSL…)	Roanoke River (Lake Gaston below normal full power pool elevation 200 MSL)		Roanoke River (Lake Gaston below normal ….)
Classification		B	WS IV	C	WS-IV	WS-IV	WS- II, HQW	WS-II, B, HQW	WS-II, HWQ	WS-V	WS-V, B	B	WS-V, B	WS-IV, B	W- IV, B, CA
Assessment Unit		22-12-(2)	22-27-(1.5)	22-27-(7)	22-27-9-(4)	22-27-(7.5)	22-56-(3.5)	22-58-4-(1.4)	22-58-12-(1.5)	22-58-15-(0.5)	22-58-(0.5)	23-8-(2)	23-(12)	23-(20.2)	23-(22.5)
Stations in Assessment Unit		ROA003A	ROA0092A	ROA009J	ROA009G	ROA009E, 009H	ROA027J, 027L, 027G	ROA0303DA, 0303DC, 0303DE	ROA031C, 031E, 031H	ROA0343A, 0342A, 0341A	ROA030C, 030E, 030F, 030G	ROA037A, 037E, 037I, 0371J	ROA038A, 039	ROA039B	ROA039C, 039D, O39E
		NL1	NL2	NL6	NL4	NL3, NL5	NL7-NL9	NL11-NL13	NL17-NL19	NL20-NL22	NL10, NL14-NL16	NL23-NL26	NL27-NL28	NL29	NL30-NL32
Number of Sampling Trips		12	8	11	11	11	12	11	4	3	3	6	5	5	3
Water Quality Standards															
Chlorophyll *a*	>40 ug/L	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE
Dissolved Oxygen	<4.0 mg/L	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE
pH	<6 s.u. or > 9 s.u.	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE
Turbidity	>25 mg/L	NCE	NCE	NCE	NCE	NCE	**E (9%)**	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE
Temperature	>32°C Lower Piedmont & Coastal Plain	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	**E (33%)**	NCE	NCE	NCE	NCE
Metals (excluding copper, iron & zinc)	15A NCAC 2B .0211	ND	NCE	ND	ND	ND	NCE	NCE	NCE	NCE	ND	ND	NCE	NCE	ND
Other Data															
% Saturation DO	>120%	N	N	N	N	**Y (9%)**	**Y (8%)**	**Y (9%)**	N	N	N	N	N	N	N
Algae	Documented blooms during 2 or more sampling events in 1 year with historic blooms	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Fish	Kills related to eutrophication	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Chemically/Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.	N	N	N	N	N	N	N	N	N	N	N	**Y**	**Y**	N
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat	N	N	N	N	N	N	N	N	N	N	N	**Y**	**Y**	**Y**
Sediments	Clogging intakes – dredging program necessary; Frequent public/agency complaints - visual	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Rating:		**S**	**NR**	**S**	**S**	**S**	**NR**	**S**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**

RATING KEY: S = Supporting; R = Not Rated; I = Impaired
KEY Water Quality Standards: NCE = No Criteria Exceeded; E = Criteria exceeded in less than 10% of the measurements **OR** criteria exceeded but number of sampling trips less than 10; CE = Criteria Exceeded – parameter is problematic, highly productive, or exceeds the standard in >10% of samples; ND = No Data – samples not taken for this parameter.
KEY Other Data: N = Indicates that the parameter is within the target or has not occurred per available information; Y = Exceeds target or has occurred; ND = No Data – samples not taken for this parameter