Chapter 2 -
Roanoke River Basin Overview

2.1 General Overview

The Roanoke River begins in the Blue Ridge Mountains of northwestern Virginia and flows in a generally southeastern direction for 400 miles before emptying into the Albemarle Sound in eastern North Carolina (Figure A-4). By the time it reaches the fall line near Roanoke Rapids, the river has captured water from nearly 8,000 square miles of land. From Roanoke Rapids to the coast, the river drains another 2,000 square miles and carries more water than any other river in North Carolina. In the lower portion of the basin, the river carved a floodplain up to five miles wide, where radio carbon-dating of sediment indicates that deeper soils washed down from the piedmont over 200 years ago as settlers began to clear the land.

Roanoke River Basin Statistics
(NC Portion)

Total Area: 3,503 sq. miles
Stream Miles: 2,213
No. of Counties: 15
No. of Municipalities: 42
No. of Subbasins: 10
Population (2000): 335,194*****
Estimated Pop. (2020): 356,722*****
% Increase (2000-2020): 6.4%
Pop. Density (1990): 107 persons / sq. mi.

* Based on % of county land area estimated to be within the basin (Table A-11).

The North Carolina portion of the Roanoke basin is composed of two major parts: the Dan River and its tributaries in the western section (Figure A-5); and the Roanoke River from Virginia to the Sound in the eastern section (Figure A-6). The Roanoke River enters North Carolina through John H. Kerr Reservoir and then flows into Lake Gaston and Roanoke Rapids Lake before regaining its riverine form.

There are 15 counties and 42 municipalities located wholly or partially within the basin. The most populated areas are located northeast of the Greensboro/ Winston-Salem/High Point area and around the larger municipalities in the basin such as Roanoke Rapids, Eden, Williamston and Plymouth. The overall population density is 107 persons per square mile versus a statewide average of 139 persons per square mile.

Sixty percent of the land in the basin is forested and about twenty-two percent is in cultivated cropland. Tobacco, peanuts, cotton and soybeans are among the most common crops grown. Only six percent of the land falls into the urban/built-up category. Despite the large amount of cultivated cropland and the relatively small amount of urban area, the basin has seen a significant decrease (-105,300 acres) in cultivated cropland and increase (+77,700 acres) in built-up areas over the past fifteen years (USDA, 1999).

The upper Dan River is classified as trout waters, and part of the area is also designated a State Water Trail by the NC Division of Parks and Recreation. The lower portion of the basin contains some of the largest intact and least disturbed bottomland hardwood and cypress-tupelo ecosystems on the Atlantic Coast of North America. It is also important habitat for anadromous fish, including striped bass, as well as black bear, bobcat, large populations of wild turkey, 14 species of waterfowl, and 220 additional species of birds.

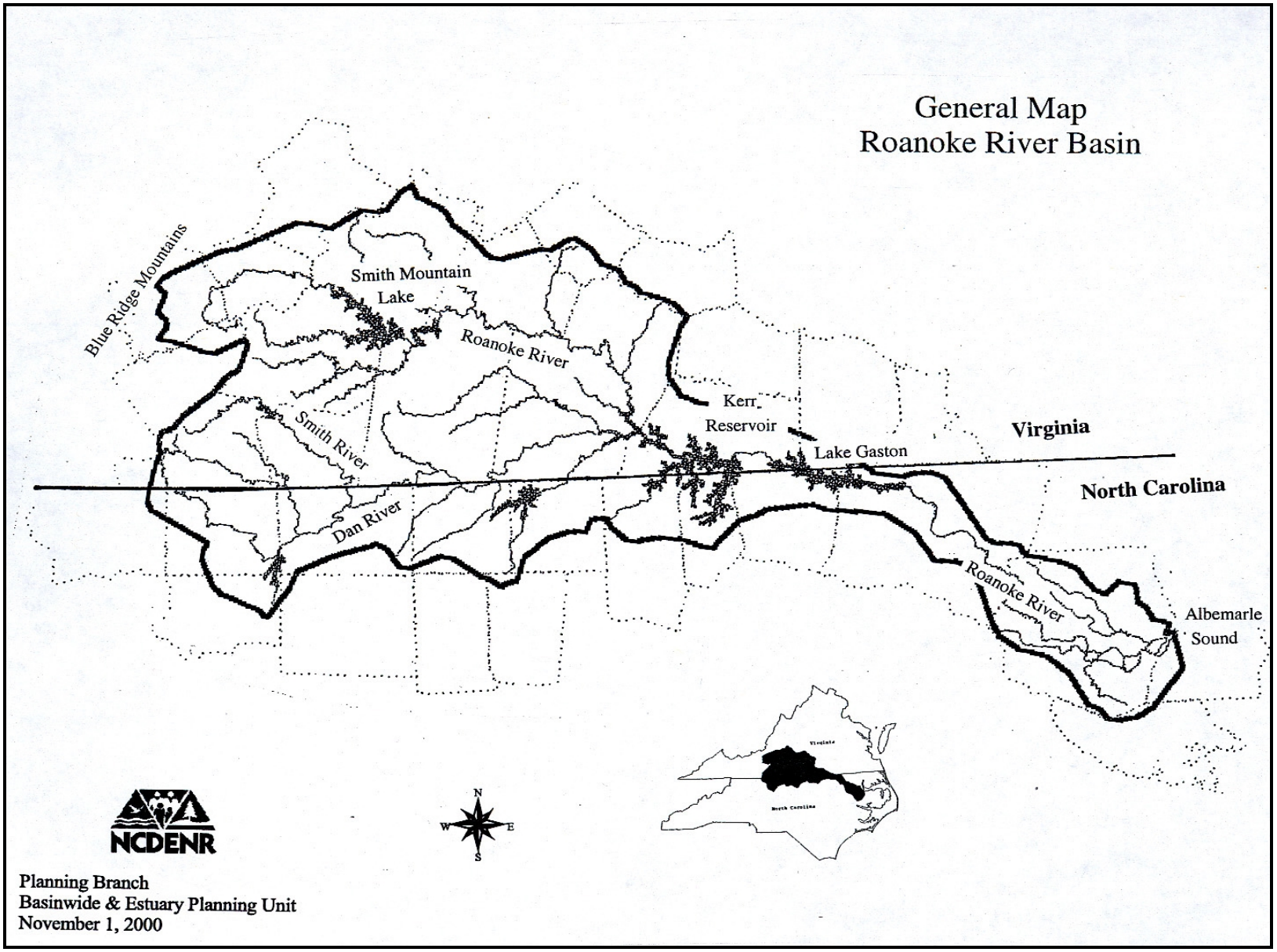

Figure A-4 General Map of the Entire Roanoke River Basin

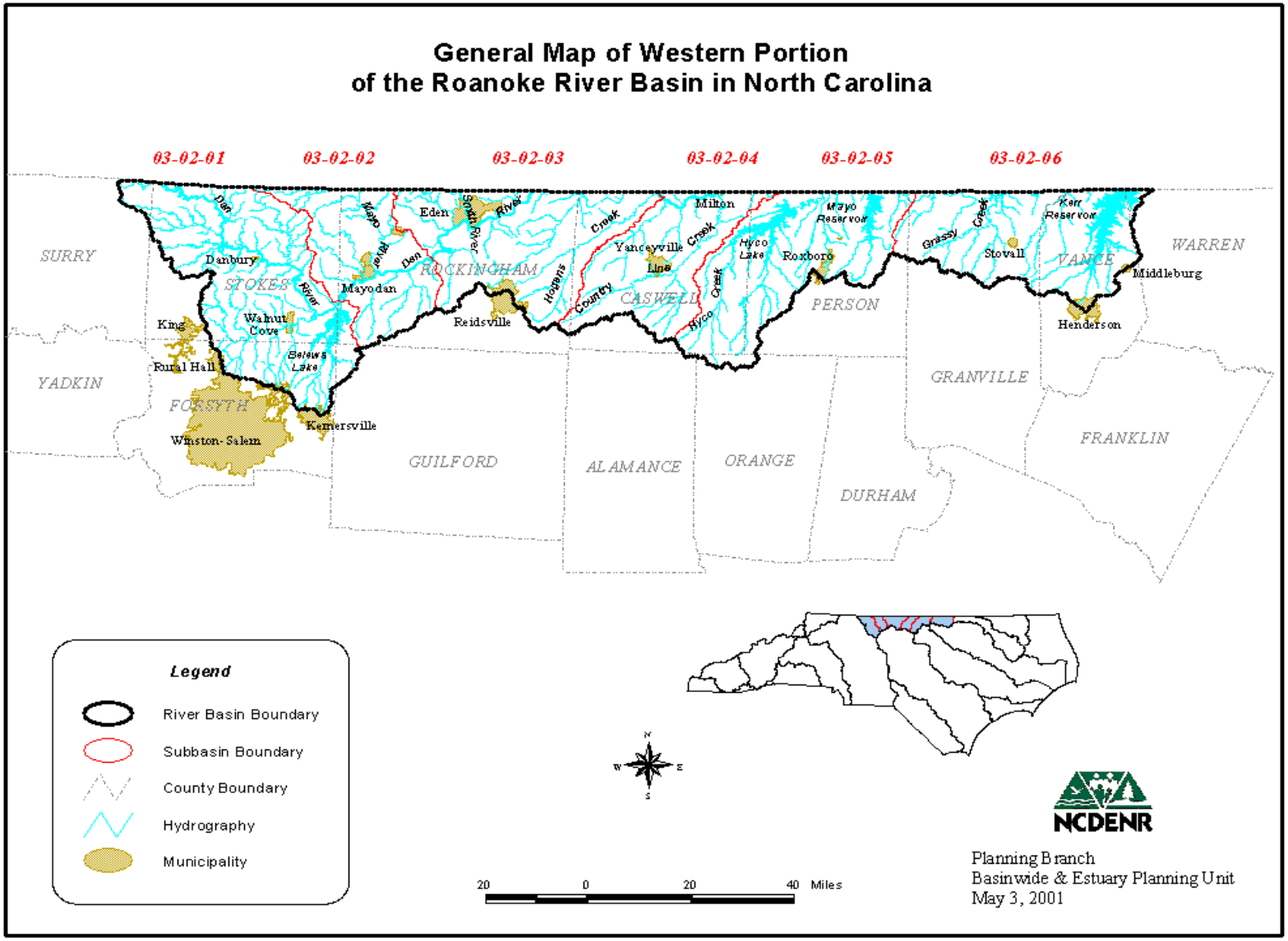

Figure A-5 General Map of the Western Portion of the Roanoke River Basin in North Carolina

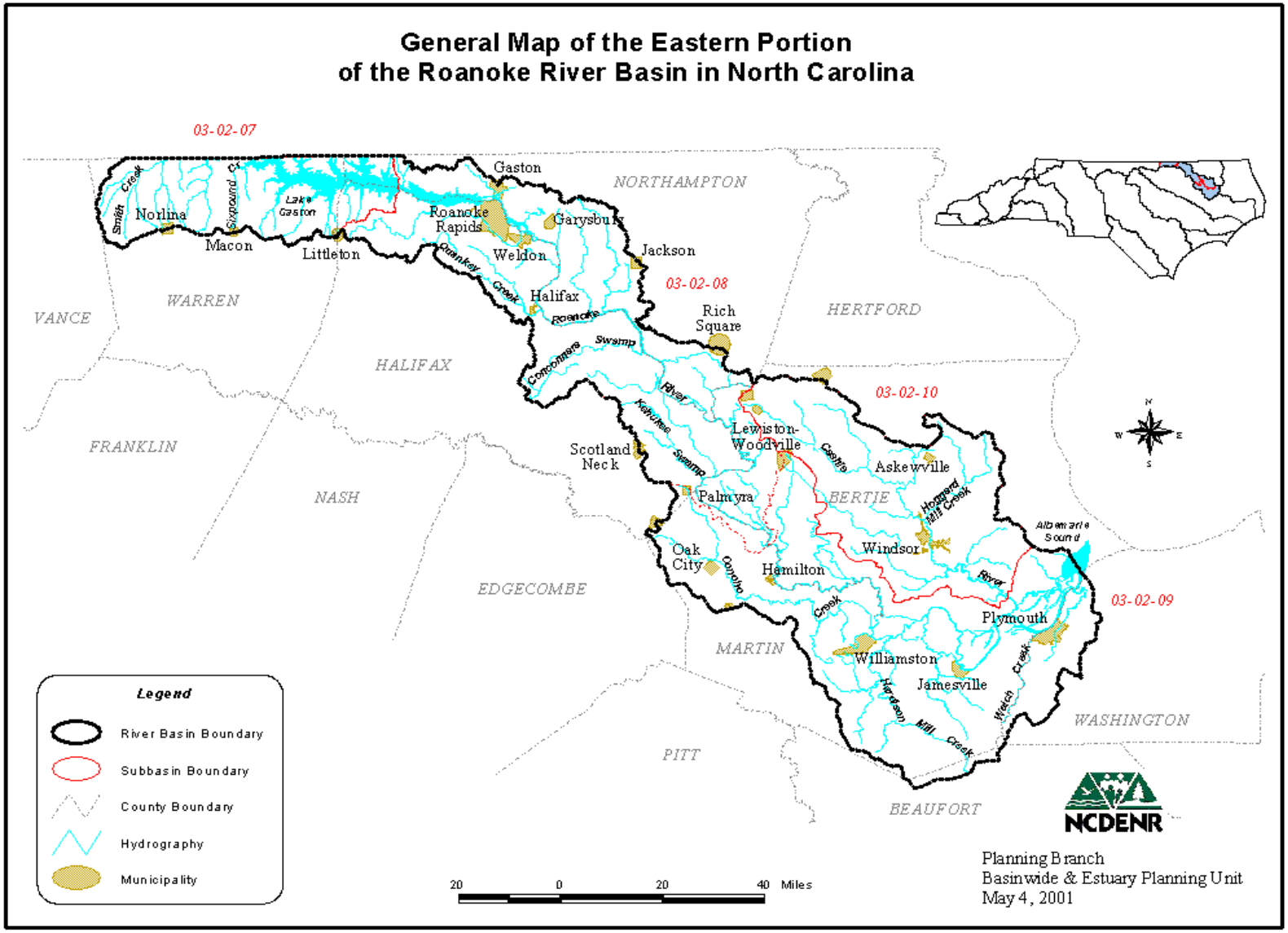

Figure A-6 General Map of the Eastern Portion of the Roanoke River Basin in North Carolina

2.2 Local Governments and Planning Jurisdictions in the Basin

The Roanoke River basin encompasses all or portions of fifteen counties and forty-two municipalities. Table A-3 provides a listing of these municipalities, along with the appropriate regional planning jurisdiction (Council of Governments), and an estimation, provided by the NC Center for Geographic Information and Analysis, of the percentage of each county's area that lies within the basin. Seventeen municipalities are located in more than one major river basin.

Table A-3 Local Governments and Planning Units within the Roanoke River Basin

County	% of County in basin	Region	Municipalities
Bertie	70%	Q	Askewville, Aulander* Kelford, Lewiston-Woodville Roxobel, Winsdor
Caswell	90%	G	Milton Yanceyville
Forsyth	21%	I	Kernersville* (♦), Rural Hall* Walkertown*
Granville	33%	K	Stovall
Guilford	<2%	G	Kernersville* (♦), Stokesdale*
Halifax	40%	L	Halifax, Hobgood* Littleton*, Roanoke Rapids Scotland Neck*, Weldon
Martin	75%	Q	Hamilton, Hassell Jamesville, Oak City Williamston
Northampton	35%	L	Garysburg, Gaston* Jackson*, Rich Square*
Orange	2%	J	None
Person	60%	K	Roxboro*
Rockingham	81%	G	Eden, Madison Mayodan, Reidsville* Stoneville, Wentworth
Stokes	85%	I	Danbury Walnut Cove
Surry	3%	I	None
Vance	52%	K	Henderson* Middleburg*
Warren	38%	K	Macon* Norlina*
Washington	13%	R	Plymouth

* Located in more than one major river basin.

♦ Located in more than one county.

Note: Counties adjacent to and sharing a border with a river basin are not included as part of that basin if only a trace amount of the county (<2%) is located in that basin, unless a municipality is located in that county. (Note: Guilford County is included because of the municipalities, Kernersville and Stokesdale.)

Region	Name	Location
G	Piedmont Triad Council of Governments	Greensboro
I	Northwest Piedmont Council of Governments	Winston-Salem
J	Triangle J Council of Governments	Research Triangle Park
K	Kerr-Tar Regional Council of Governments	Henderson
L	Regional L Council of Governments	Rocky Mount
Q	Mid-East Commission	Washington
R	Albemarle Regional Planning and Development Commission	Hertford

2.3 Surface Water Hydrology

Most federal government agencies, including the US Geological Survey (USGS) and the US Natural Resources Conservation Service (NRCS), use a system of defining watersheds that is different from that used by the Division of Water Quality (DWQ) and many other state agencies in North Carolina. Under the federal system, the Roanoke River basin is made up of five hydrologic areas referred to as hydrologic units. These include the Dan River in North Carolina, Country Line Creek and Hyco Reservoir, Kerr Reservoir and tributaries, Lake Gaston and Smith Creek, and the Roanoke and Cashie Rivers. Each hydrologic unit is defined by an 8-digit number. DWQ has a two-tiered system in which the state is subdivided into 17 river basins with each basin further subdivided into subbasins. Table A-4 compares the two systems. The Roanoke River basin is subdivided by DWQ into ten subbasins. Maps of each subbasin are included in Section B.

Table A-4 Hydrologic Subdivisions in the Roanoke River Basin

Watershed Name and Major Tributaries	USGS 8-digit Hydrologic Units	DWQ Subbasin 6-digit Codes
Dan River (NC Portion)	03010103	03-02-01
Town Fork, Snow, Wolf Island and Hogans Creeks		03-02-02
Smith and Mayo Rivers and Belews Lake		03-02-03
Country Line Creek and Hyco Reservoir	03010104	03-02-04
Country Line, Hyco and Marlowe Creeks		03-02-05
Hyco and Mayo Reservoirs		
Kerr Reservoir and tributaries	03010102	03-02-06
Grassy, Island and Nutbush Creeks		
Lake Gaston and Smith Creek	03010106	03-02-07
Roanoke and Cashie Rivers	03010107	03-02-08
Roanoke Rapids Lake and Roquist Creek		03-02-09
Quankey, Conoho, Hardison Mill and Welch Creeks		03-02-10
Conconnara, Kehukee and Connaritsa Swamps		

The entire Roanoke River basin is approximately 9,776 square miles in size. In the North Carolina portion (roughly 36 percent of the entire watershed), 2,212 miles of freshwater streams drain 3,503 square miles of terrain. The upper portion of the basin in North Carolina lies primarily in the Piedmont Physiographic Region. This region is characterized by rolling hills and geologic formations consisting of crystalline or sedimentary rocks. Because of the moderate topography, more streams drain a smaller amount of land, increasing the drainage density. The drainage density in this portion of the basin is 0.97-0.74 compared to 0.62-0.51 in the lower portion of the basin.

Areas with high drainage density are associated with high flood peaks, high sediment production, relatively low suitability for traditional agriculture, and high development costs for the construction of buildings and the installation of roads and bridges. Within the North Carolina portion of the Roanoke River basin, subbasin 03-02-01 has the highest drainage density, while subbasin 03-02-09 has the lowest.

The lower portion of the basin lies in the Coastal Plain Physiographic Region. The geology of this area consists of alternating layers of sand, silt, clay and limestone. In this portion of the basin, the land is relatively flat. The slope dips downward at a rate of only a few feet per mile. A smaller number of streams drain a large area of land on the Coastal Plain. In addition to low drainage density, the lower portion of the basin also has the lowest potential for sustaining base flow in streams. The low flow frequency, measured by a 7Q10 (annual minimum 7-day consecutive low flow, which on average, will be exceeded 9 out of 10 years) flow calculation, is zero for all but the largest drainages. This very low flow over the warmest months of the year limits streams' ability to maintain high dissolved oxygen levels (increased temperature depletes dissolved oxygen while decreased velocity inhibits reaeration). The capacity for assimilating oxygen-consuming wastes is also limited under these conditions. DWQ limits discharges containing oxygen-consuming wastes into these low base flow streams (refer to Chapter 4 of this section for further information).

Hydrologic Features

There are 11 major reservoirs in the North Carolina portion of the Roanoke River basin. Most of them are located in the upper portion of the basin on tributaries of the Dan and Roanoke Rivers. The three largest reservoirs, Kerr, Gaston and Roanoke Rapids, are impoundments of the Roanoke mainstem. They are managed by the US Army Corps of Engineers and Dominion (formerly North Carolina Power) for electrical energy production and flood control. Flow from these reservoirs influences the quality of water in the lower Roanoke River. In addition to general protection of aquatic life and secondary recreation, seven lakes are classified for primary recreation and nine are designated drinking water supplies (Table A-5).

Table A-5 Statistics for Major Lakes (Entire Size Calculations) in the Roanoke River Basin

Subbasin/Lake	County	Classification*	Surface Area (Ac)	Mean Depth (ft)	Volume (x 10^6 m^3)	Watershed (mi^2)
03-02-01						
Hanging Rock Lake	Stokes	B	12	2	0.003	1.1
Kernersville Res.	Forsyth	WS-IV, CA	45	16	0.4	5.3
Belews Lake	Forsyth/Stokes/ Rockingham/Guilford	WS-IV, B, C	4,030	49	228	46
03-02-04						
Farmer Lake	Caswell	WS-II, CA	368	20	6.5	48
03-02-05						
Hyco Lake	Person/Caswell	WS-V, B	3,750	20	99	188
Lake Roxboro	Person	WS-II, B	195	20	10.8	24
Roxboro Lake	Person	WS-II, CA	212	12	0.3	196
Mayo Res.	Person	WS-V, B	2,800	30	105	51
03-02-06						
John H. Kerr Res.	Warren/Vance/ Granville	B, C	48,999	35	448	7,610
03-02-07						
Lake Gaston	Warren/Halifax/ Northampton	WS-V, WS-IV, B, CA	20,299	20	512	8,239
03-02-08						
Roanoke Rapids Res.	Northampton/ Halifax	WS-IV, B, CA	4,893	16	96	8,294

* An index for DWQ freshwater classifications can be found in Part 3.2 of this section (Table A-20).

The lower Roanoke River basin contains extensive wetland communities also. More than 150,000 acres of bottomland hardwood and swamp forest communities provide valuable functions in terms of hydrology and water quality including water, nutrient and sediment retention, bank stabilization, and water purification and pollutant removal (especially for nutrients). Refer to Part 2.6 of this chapter for further information about these natural resources.

2.4 Land Cover

Land cover information in this section is from the most current National Resources Inventory (NRI), as developed by the Natural Resources Conservation Service (USDA, March 2000). The NRI is a statistically-based longitudinal survey that has been designed and implemented to inventory land cover types and acreages. The NRI provides results that are nationally and temporally consistent for four points in time -- 1982, 1987, 1992 and 1997.

In general, NRI protocols and definitions remain fixed for each inventory year. However, part of the inventory process includes reviewing previously recorded data when determinations are made for the new inventory year. For those cases where a protocol or definition needs to be modified, all historical data must be edited and reviewed on a point-by-point basis to make sure that data for all years are consistent and properly calibrated. The following excerpt from the *Summary Report: 1997 National Resources Inventory* provides guidance for use and interpretation of current NRI data:

> The 1997 NRI database has been designed for use in detecting significant changes in resource conditions relative to the years 1982, 1987, 1992 and 1997. All comparisons for two points in time should be made using the new 1997 NRI database. Comparisons made using data previously published for the 1982, 1987 or 1992 NRI may provide erroneous results because of changes in statistical estimation protocols, and because all data collected prior to 1997 were simultaneously reviewed (edited) as 1997 NRI data were collected.

Table A-6 summarizes acreage and percentage of land cover from the 1997 NRI for the North Carolina portion of the basin and for the major watersheds within the basin, as defined by the USGS 8-digit hydrologic units. Data from 1982 are also provided for a comparison of change over fifteen years. During this period, the amount of cultivated cropland in the basin decreased significantly (-105,300 acres), while the amount of uncultivated cropland almost doubled (+21,600 acres). Land in the urban/built-up category increased 132.8 percent or 77,700 acres. Land in the "Other" category also increased over the 15-year time frame (+1,300 acres). Figure A-7 presents these land cover changes. Descriptions of land cover types identified by the NRI are found in Table A-7.

Table A-6 Estimated Land Cover Acreage for the Roanoke River Basin - 1982 vs. 1997 (Source: USDA-NRCS, March 2000)

	MAJOR WATERSHED AREAS*														
	Upper Dan		Lower Dan		Middle Roanoke		Roanoke Rapids		Lower Roanoke		1997 TOTALS		1982 TOTALS		% change
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	since 1982
Cult. Crop	77.2	13.9	57.5	12.1	22.3	11.3	21.0	12.4	198.7	24.4	376.7	17.0	482.0	21.8	-21.8
Uncult. Crop	29.0	5.2	10.1	2.1	2.2	1.1	5.4	3.2	0.0	0.0	46.7	2.1	25.1	1.1	86.1
Pasture	27.8	5.0	28.1	5.9	15.2	7.7	4.0	2.4	11.7	1.4	86.8	3.9	110.2	5.0	-21.2
Forest	318.0	57.3	329.0	69.0	108.0	54.6	89.2	52.8	517.0	63.4	1361.2	61.5	1363.3	61.5	-0.2
Urban & Built-Up	58.8	10.6	19.0	4.0	8.5	4.3	15.8	9.4	34.1	4.2	136.2	6.1	58.5	2.6	132.8
Federal	0.0	0.0	0.0	0.0	14.0	7.1	0.0	0.0	6.2	0.8	20.2	0.9	16.9	0.8	19.5
Other	44.4	8.0	33.4	7.0	27.7	14.0	33.4	19.8	48.3	5.9	187.2	8.5	159.0	7.2	17.7
Totals	555.2		477.1		197.9		168.8		816.0		2215.0		2215.0		
% of Total Basin		25.1		21.5		8.9		7.6		36.8		100.0		100.0	
SUBBASINS	03-02-01 03-02-02 03-02-03		03-02-03 03-02-04 03-02-05 03-02-06		03-02-06		03-02-07 03-02-08		03-02-08 03-02-09 03-02-10						
8-Digit Hydraulic Units	03010103		03010104		03010102		03010106		03010107						

* Watershed areas as defined by the 8-Digit Hydraulic Units do not necessarily coincide with subbasin numbers used by DWQ.

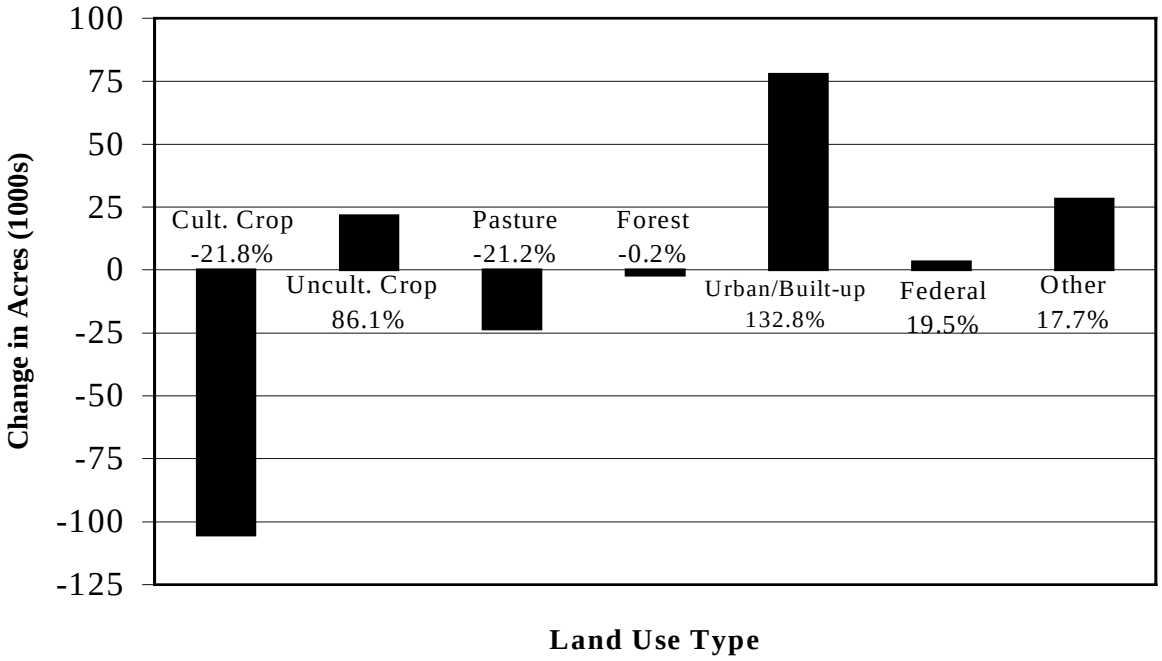

Figure A-7 Land Cover Changes from 1982 to 1997 for the Roanoke River Basin

Table A-7 Description of Land Cover Types (USDA-NRCS 1997 NRI)

Type	Description
Cultivated Cropland	Harvestable crops including row crops, small-grain and hay crops, nursery and orchard crops, and other specialty crops.
Uncultivated Cropland	Summer fallow or other cropland not planted.
Pastureland	Includes land that has a vegetative cover of grasses, legumes and/or forbs, regardless of whether or not it is being grazed by livestock.
Forestland	At least 10 percent stocked (a canopy cover of leaves and branches of 25 percent or greater) by single-stemmed trees of any size which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover. The minimum area for classification of forestland is 1 acre, and the area must be at least 1,000 feet wide.
Urban and Built-up Areas	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites, railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Includes highways, railroads and other transportation facilities if surrounded by other urban and built-up areas. Tracts of less than 10 acres that are completely surrounded by urban and built-up lands.
Other	*Rural Transportation*: Consists of all highways, roads, railroads and associated rights-of-way outside urban and built-up areas; private roads to farmsteads; logging roads; and other private roads (but not field lanes). *Small Water Areas*: Waterbodies less than 40 acres; streams less than 0.5 miles wide. *Census Water*: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than 0.5 miles in width. *Minor Land*: Lands that do not fall into one of the other categories.

The North Carolina Corporate Geographic Database contains land cover information for the Roanoke River basin based on satellite imagery from 1993-1995. The state's Center for Geographic Information and Analysis (CGIA) developed 24 categories of statewide land cover information. For the purposes of this report, those categories have been condensed into five broader categories as described in Table A-8. An important distinction between this land cover dataset and that of the NRI is that there is no actual groundtruthing of the satellite-generated data.

Figure A-8 provides an illustration of the relative amount of land area that falls into each major cover type for the Roanoke River basin. Section B of this plan provides land cover data specific to each subbasin.

Unfortunately, due to differences in the system of categorizing various land cover classes, it is not currently possible to establish trends in land cover changes by comparing this data set to previously attained land cover data. However, it is anticipated that comparisons will be possible with future satellite data since a strong consensus-based effort was made to develop the classification system that was used with the 1993-1995 data.

Table A-8 Description of CGIA Land Cover Categories

Land Cover Type	Land Cover Description
Urban	Greater than 50% coverage by synthetic land cover (built-upon area) and municipal areas.
Cultivated	Areas that are covered by crops that are cultivated in a distinguishable pattern.
Pasture/Managed Herbaceous	Areas used for the production of grass and other forage crops and other managed areas such as golf courses and cemeteries. Also includes upland herbaceous areas not characteristic of riverine and estuarine environments.
Forest/Wetland	Includes salt and freshwater marshes, hardwood swamps, shrublands and all kinds of forested areas (such as needleleaf evergreens, deciduous hardwoods).
Water	Areas of open surface water, areas of exposed rock, and areas of sand or silt adjacent to tidal waters and lakes.

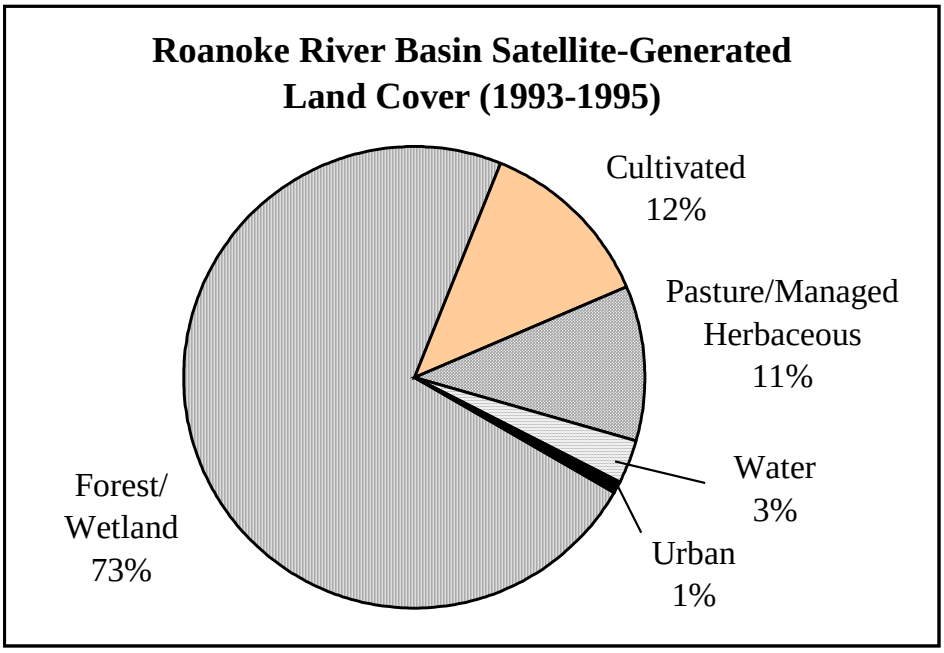

Figure A-8 Percentages within Major Land Cover Categories in the Roanoke River Basin

2.5 Population and Growth Trends

Population

The Roanoke River basin in North Carolina has an estimated population of 263,691 based on 1990 census data. Table A-9 presents census data for 1970, 1980 and 1990. It also includes population densities (persons/square mile) based on *land area* for each subbasin. Most of the basin's population (56 percent) is located in subbasins 03-02-09 (Martin, part of Bertie, and Washington counties), 03-02-01 (Stokes and Forsyth counties), and 03-02-08 (Halifax and Northampton counties). These three subbasins contain approximately 148,055 people.

Table A-9 Roanoke River Subbasin Population (1970, 1980, 1990), Percent Population Change and Land Area Summaries

SUBBASIN	POPULATION [1] (Number of Persons)			POPULATION DENSITY [2] (Persons/Square Mile)			LAND AND WATER AREAS [3]			
							Total Land and Water Area		Land Area	Water Area
	1970	1980	1990	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
03-02-01	29,829	47,011	45,777	67	106	103	289,919	453	445	8
03-02-02	18,910	20,957	19,588	83	92	86	147,839	231	229	2
03-02-03	11,103	11,980	11,695	33	36	35	217,599	340	335	5
03-02-04	26,709	27,971	27,208	113	119	115	152,959	239	236	3
03-02-05	6,747	10,175	9,903	21	32	31	215,679	337	322	15
03-02-06	20,311	22,904	21,604	69	78	73	210,559	329	295	34
03-02-07	6,676	6,681	8,338	38	38	48	124,800	195	174	21
03-02-08	41,640	42,627	43,392	88	90	91	328,319	513	473	40
03-02-09	48,718	58,768	58,886	112	135	135	357,758	559	435	124
03-02-10	14,982	15,859	17,300	52	55	60	196,479	307	290	17
TOTALS	225,625	264,933	263,691	70	82	82	2,241,910	3,503	3,234	269

[1] Population estimated based on US Census data and percentage of census block that falls within the subbasin.

[2] Population density based on land area only. Large wetlands (swamps) not included in area used to calculate density.

[3] Information generated by the NC Center for Geographic Information Analysis, August 2000.

In using these data, it should be noted that some of the population figures are estimates because the census block group boundaries do not generally coincide with subbasin boundaries. The census data are collected within boundaries such as counties and municipalities. By contrast, the subbasin lines are drawn along natural drainage divides separating watersheds. Therefore, where a census block group straddles a subbasin line, the percentage of the population that is located in the subbasin is estimated, assuming that population density is evenly distributed throughout a census block group. This is not always the case; however, the level of error associated with this method is not expected to be significant for the purposes of this document. It is also important to note that the census block groups change every ten years so comparisons between years must be considered approximate. Figure A-9 displays estimated 1998 population density information by county.

Growth Trends

Population in the North Carolina portion of the Roanoke River basin overall decreased slightly (1,242 people) between 1980 and 1990. Figure A-10 presents projected population growth by county (1998-2018) for the Roanoke River basin in North Carolina. Stokes and Granville counties are growing the fastest, with projections indicating a 20-40 percent increase in population. Almost all of Stokes County is contained within the basin, but only 33 percent of Granville County falls within the boundary.

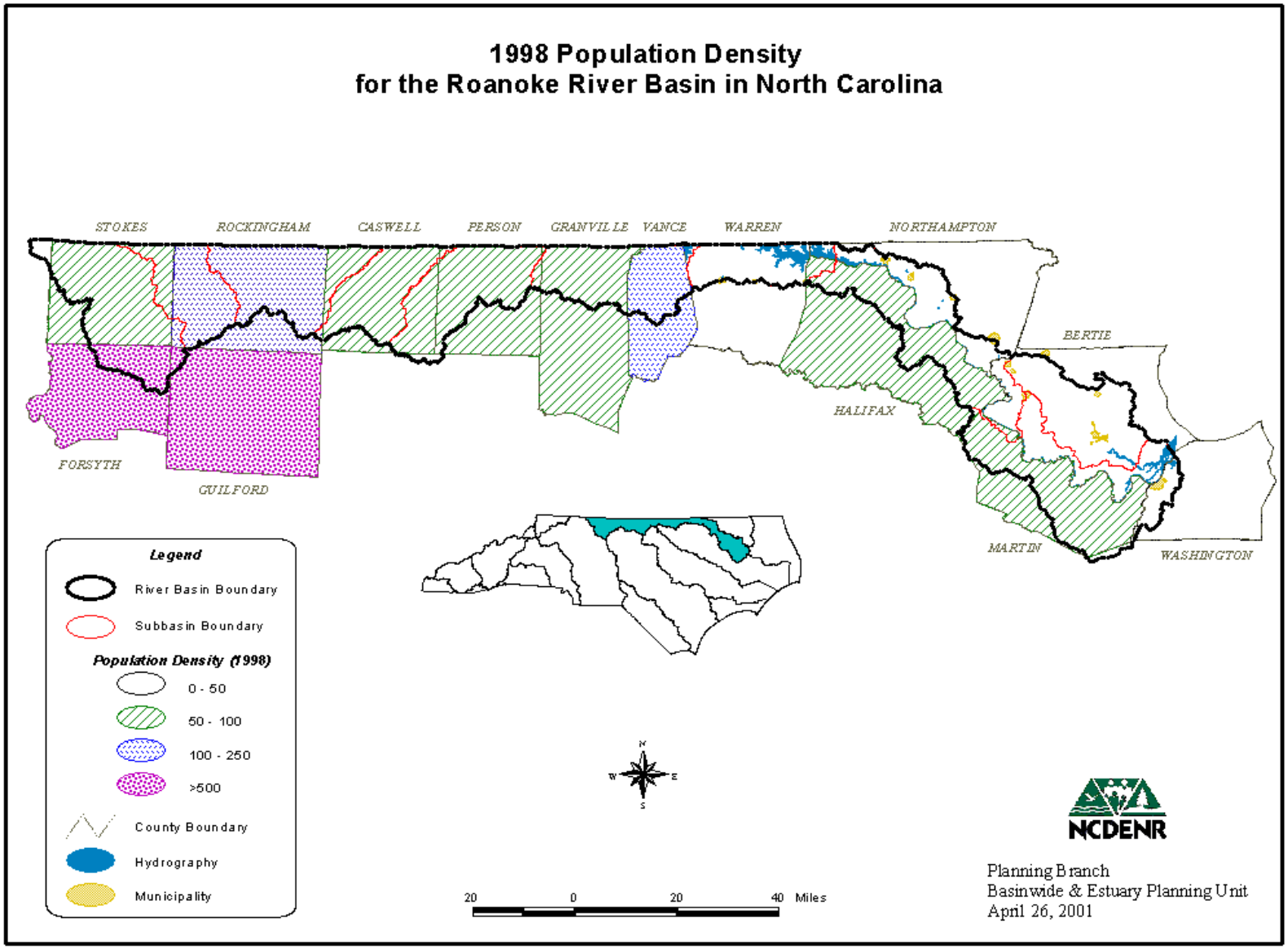

Figure A-9 1998 Population Density by County for the Roanoke River Basin

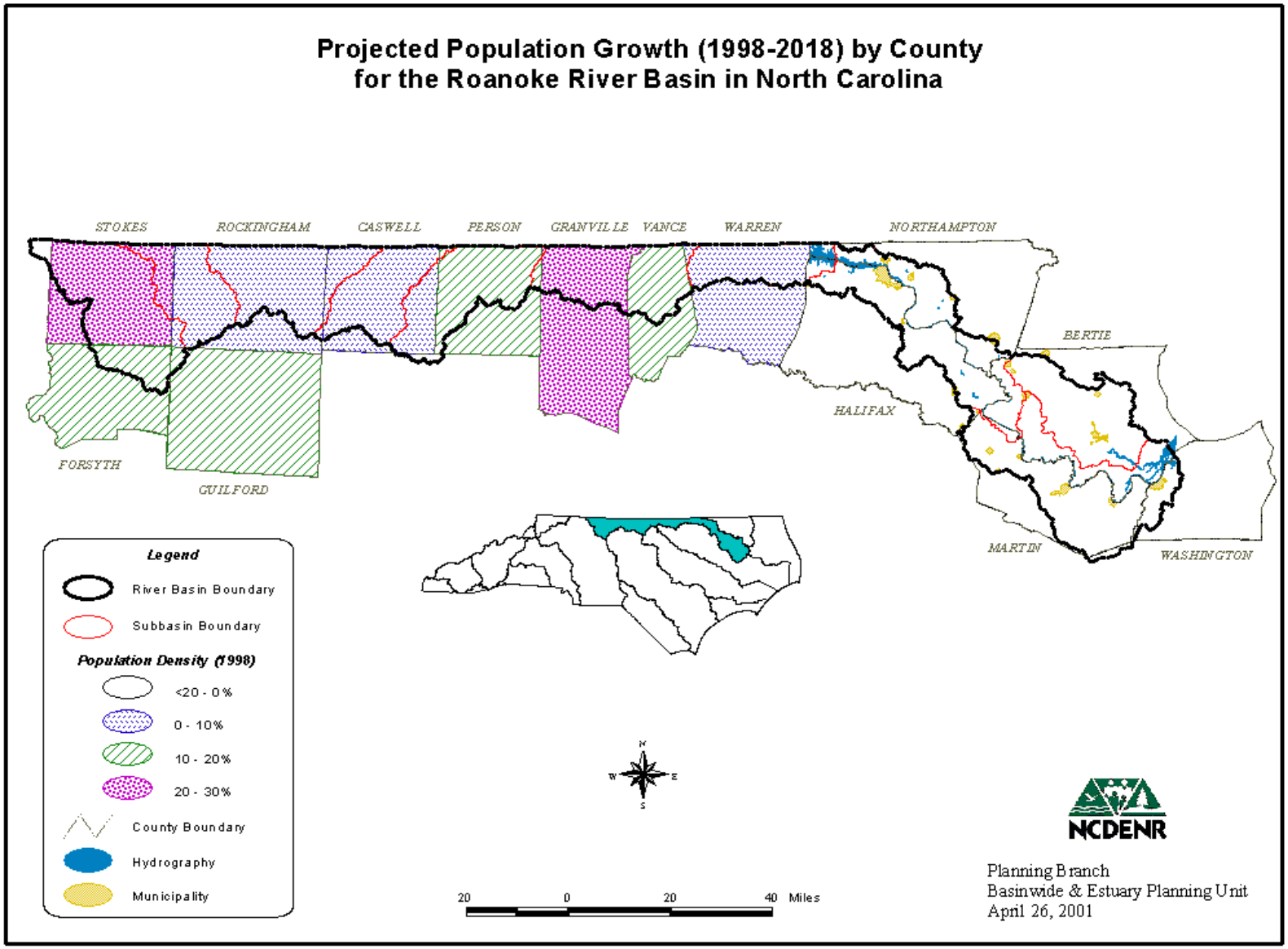

Figure A-10 Projected Population Growth (1998-2018) by County for the Roanoke River Basin in North Carolina

Table A-10 presents population data for municipalities with populations greater than 2,000 persons, located wholly or partly within the basin. Figure A-11 graphically depicts population data for selected municipalities in the North Carolina portion of the Roanoke River basin.

Table A-10 Population and Percent Change for Municipalities Greater Than 2,000 Located Wholly or Partly in the Basin as of March 2001 (NC Municipal Population, 2000)

Municipality	County	Apr-80	Apr-90	Apr-2000	Percent Change (1980-90)	Percent Change (1990-2000)
Eden	Rockingham	15,672	15,238	15,908	-2.8	4.4
Henderson •	Vance	13,522	15,655	16,095	15.8	2.8
Kernersville •	Forsyth/Guilford	5,875	10,899	17,126	85.5	57.1
Madison	Rockingham	2,806	2,371	2,262	-15.5	-4.6
Mayodan	Rockingham	2,627	2,471	2,417	-5.9	-2.2
Plymouth	Washington	4,571	4,328	4,107	-5.3	-5.1
Reidsville •	Rockingham	12,492	12,183	14,485	-2.5	18.9
Roanoke Rapids	Halifax	14,702	15,722	16,957	6.9	7.9
Roxboro •	Person	7,532	7,332	8,696	-2.7	18.6
Rural Hall •	Forsyth	1,336	1,652	2,464	23.7	49.2
Scotland Neck •	Halifax	2,834	2,575	2,362	-9.1	-8.3
Stokesdale •	Guilford	1,973	2,134	3,297	8.2	54.5
Walkertown •	Forsyth	1,321	1,200	4,009	-9.2	234.1
Williamston	Martin	6,159	5,503	5,843	-10.7	6.2
Windsor	Bertie	2,126	2,209	2,283	3.9	3.3
Yanceyville	Caswell	1,869	1,973	2,091	5.6	6.0

• - The numbers reported reflect municipality population; however, these municipalities are not entirely within the basin. The intent is to demonstrate growth for municipalities located wholly or partially within the basin.

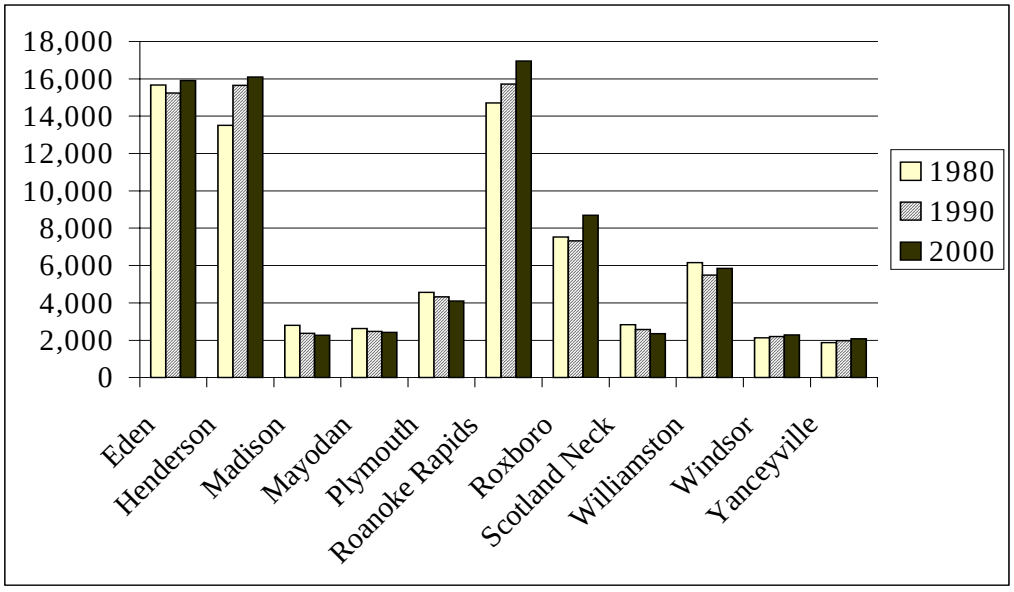

Figure A-11 Population Data for Selected Municipalities in the North Carolina Portion of the Roanoke River Basin

Table A-11 shows the projected percent change in growth between 1990 and 2020 for counties within the basin. Since river basin boundaries do not coincide with county boundaries, these numbers are not directly applicable to the Roanoke River basin. They are instead presented as an estimate of possible countywide population changes.

Table A-11 Past, Projected and Change in Population (2000 to 2020) by County as of March 2001 (Source: Office of State Planning, 2001)

County	2000	Estimated Population 2020	Estimated Population Change 2000-2020
Bertie	13,841	13,218	-623
Caswell	21,151	21,444	293
Forsyth	64,274	71,939	7,665
Granville	16,004	18,303	2,299
Halifax	22,948	21,450	-1,498
Martin	19,195	18,547	-648
Northampton	7,730	6,761	-969
Orange *	2,365	2,956	591
Person	21,374	23,149	1,775
Rockingham	74,462	75,411	949
Stokes	38,004	48,378	10,374
Surry *	2,137	2,316	179
Vance	22,336	24,138	1,802
Warren	7,589	7,312	-277
Washington	1,784	1,400	-384
Subtotal	335,194	356,722	21,528

* Less than 5% of the county is in this basin.

Note: Values have been adjusted based on the percent of county (>2%) located in the Roanoke River basin (Table A-3).

2.6 Natural Resources

2.6.1 Public Lands in the Roanoke River Basin

Figure A-12 shows public lands and significant natural heritage areas in the Roanoke River basin. Hanging Rock State Park is situated among the Sauratown Mountains, an isolated group of low elevation mountains. The most prominent feature of the park is its series of steep, quartzite-capped ridges dissected by Cascade and Indian Creeks. Three rare caddisflies (aquatic insects indicative of good water quality) are found in Cascade Creek within the park. Several rare fish species, some of which are found nowhere else in North Carolina, have been observed in a section of the Dan River which flows through the park. Refer to Part 2.6.4 for a listing of rare species.

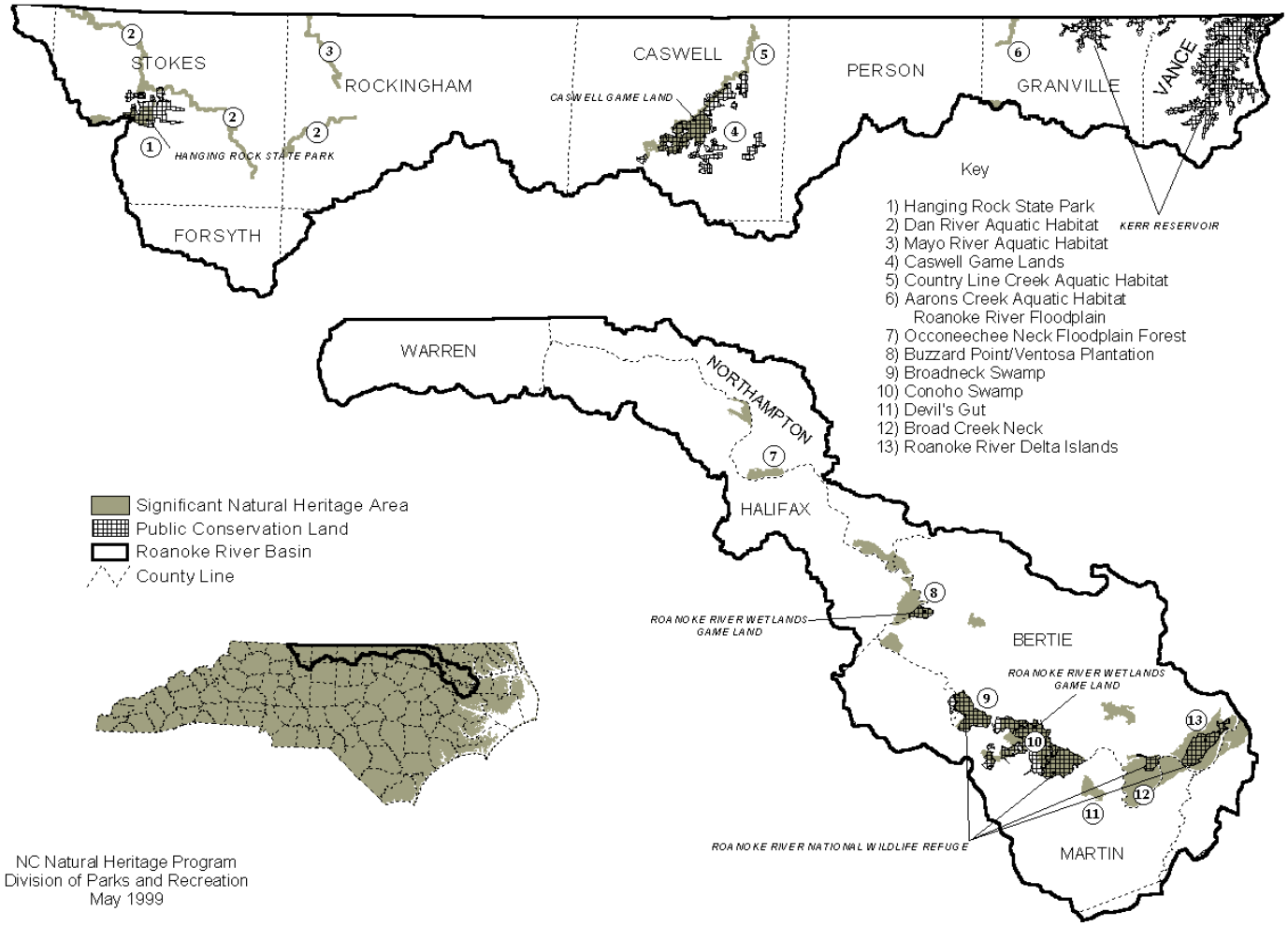

Figure A-12 Public Lands and Significant Natural Heritage Areas of the Roanoke River Basin

The Caswell Game Land protects much of one of the most extensive and high quality tracts of mature piedmont second-growth upland hardwood forest in the state. Country Line Creek flows through part of the game lands.

In the eastern portion of the basin, the Roanoke River floodplain contains the largest intact and least disturbed bottomland hardwood and cypress-tupelo ecosystems on the Atlantic Coast of North America. In 1990, the US Fish and Wildlife Service and the NC Wildlife Resources Commission began acquiring property within the floodplain. Together, the Roanoke River National Wildlife Refuge and the Roanoke River Wetlands Game Land now protect over 28,000 acres. In addition, The Nature Conservancy, a nonprofit conservation group, has a cooperative agreement to manage and protect about 21,000 acres of land, owned by Georgia-Pacific, within the floodplain. Refer to the following sections for more information regarding the extent of its ecological significance.

2.6.2 Ecological Significance of the Roanoke River Basin

Several important aquatic habitats are located in the Roanoke River basin. The section of the Dan River in Rockingham County (mentioned above) harbors several rare fish species, primarily the riverweed darter, bigeye jumprock and Roanoke hog sucker. The Mayo River, a south-flowing river tributary of the Dan River, is home to some of these same rare fish. A section of Aarons Creek in Granville County supports rare freshwater mussels including the Atlantic Pigtoe and Brook Floater; and Country Line Creek, in Caswell County, also contains an assemblage of rare mussel species, in addition to the riverweed darter.

Wetlands

Wetlands are transitional areas between land and water, such as swamps and marshes. Some are connected to streams; and others, such as low lying pine plantations and pocosins, are not. Wetlands provide a variety of benefits to society and are very important in watershed planning because of the functions they perform. Wetlands provide retention of flood waters to protect property values; streambank stabilization to prevent erosion and downstream sedimentation; water purification and pollutant removal (especially for nitrogen and phosphorus); habitat for aquatic life, and wildlife and endangered species protection. These values vary greatly with wetland type. Wetlands adjacent to intermittent and permanent streams are most important to protecting water quality in those streams, as well as downstream lakes and estuaries. However, wetlands located landward or away from streams also have important water storage capacity and pollutant removal potential.

Over the years, approximately half of North Carolina's wetlands have been lost to development, farming and forestry practices. Wetlands now only cover about 25 percent of the state's land area. The lower Roanoke River floodplain contains perhaps some of the best remaining forested wetland communities known to exist in the southeastern United States. The floodplain extends about 130 miles along the lower Roanoke River and varies in width from three to five miles. Surveys have documented 214 species of birds in the floodplain, including 88 resident breeding species (55 resident and 33 neotropical). This is the highest density of nesting birds anywhere in the state. Fourteen species of migratory waterfowl also use the wetlands in winter. Wildlife

officials have estimated as many as 2,500 nesting pairs of waterbirds on Conine Island near Williamston (NCWRC, November 1999).

Fisheries

The Roanoke River from the Roanoke Rapids dam downstream to the Albemarle Sound serves as an important spawning and nursery area for several species of anadromous fish. Anadromous fish are those that spend most of their adult lives in the ocean but migrate upstream into fresh waters to spawn. Each of these species has specific flow and water quality requirements necessary for successful spawning. In the Roanoke River, anadromous fish include striped bass, American shad, hickory shad, blueback herring and alewife. The upper portions of the Roanoke River also historically functioned as a spawning area for Atlantic sturgeon (a state and federally listed species of special concern) and possibly shortnose sturgeon (a federally listed endangered species). Juvenile Atlantic sturgeon have recently been collected in the western Albemarle Sound. Although these fish have not yet been collected from the Roanoke River, biologists suspect that the river provides the spawning and nursery area for these fish.

Anadromous fishes in the Roanoke River basin form the basis for recreational and commercial fisheries that are important on a local, state and coast-wide basis. Because these fishes are migratory and move across state jurisdictional lines, they are also regulated by federal agencies including the US Fish and Wildlife Service, the National Marine Fisheries Service, and the Atlantic States Marine Fisheries Commission. Fishery Management Plans for anadromous fish implemented by these entities require that states develop and implement measures to protect critical spawning and nursery area habitats.

To address the critical nature of maintaining flow and water quality for anadromous fishes in the upper reaches of Roanoke River, the NC Wildlife Resources Commission (NCWRC) has designated the portion of Roanoke River from the Roanoke Rapids dam downstream to the US Highway 258 bridge as an Inland Primary Nursery Area (15A NCAC 10C .0500). The Fisheries Reform Act of 1997 requires that the Marine Fisheries Commission, the Environmental Management Commission and the Coastal Resources Commission prepare comprehensive management plans for critical fisheries habitats. The Roanoke River plan will be developed within the next five-year basinwide planning cycle. In the interim, the Marine Fisheries Commission is considering designation of that portion of Roanoke River downstream of the US Highway 258 bridge as an Anadromous Fish Spawning and Nursery Area, pursuant to the Commission's statutory authority.

The Roanoke River also supports significant recreational and subsistence fisheries for resident fish species. Largemouth bass are sought by tournament anglers who travel to the Roanoke River from across the state and from other states. Largemouth bass thrive in the river as a result of the abundance of juvenile shad and herring. Tournament fishing on the Roanoke River occurs nearly every weekend, boosting local economies. The Roanoke River is also very popular for its bluegill, redear sunfish, crappie, white perch, yellow perch and catfish angling. Most anglers seeking these species eat their catch, and many residents of counties adjacent to the Roanoke River regularly supplement their diets with fish caught from it.

2.6.3 Rare Aquatic and Wetland-Dwelling Animal Species

Table A-12 Rare and Threatened Aquatic Species in the Roanoke River Basin (NC Natural Heritage Program, Division of Parks and Recreation, June 2000)

Major Taxon	Common Name	Scientific Name	State Status
fish	Orangefin madtom	*Noturus gilberti*	E
fish	Cutlips minnow	*Exoglossum maxillingua*	E
fish	Rustyside sucker	*Thoburnia hamiltoni*	E
fish	Riverweed darter	*Etheostoma podostemone*	SC
fish	Bigeye jumprock	*Scartomyzon ariommus*	SC
fish	Roanoke hog sucker	*Hypentelium roanokense*	SR
fish	Carolina darter	*Etheostoma collis*	SC
aq insect	Caddisfly	*Diplectrona metaqui*	SR
aq insect	Caddisfly	*Psilotreta labida*	SR
aq insect	Caddisfly	*Psilotreta frontalis*	SR
aq insect	Caddisfly	*Diplectrona metaqui*	SR
aq insect	Caddisfly	*Micrasema sprulesi*	SR
aq insect	Caddisfly	*Ceraclea mentiea*	SR
aq insect	Mayfly	*Ephemerella berneri*	SR
mollusk	Green Floater	*Lasmigona subviridis*	E
mollusk	James spinymussel	*Pleurobema collina*	E
mollusk	Atlantic pigtoe	*Fusconaia masoni*	T
mollusk	Squawfoot	*Strophitus undulatus*	T
mollusk	Notched rainbow	*Villosa constricta*	SR
mollusk	Brook floater	*Alasmidonta varicosa*	T
salamander	Mole salamander	*Ambystoma talpoideum*	SC

Rare Species Listing Criteria

E = Endangered (those species in danger of becoming extinct)
T = Threatened (considered likely to become endangered within the foreseeable future)
SR = Significantly Rare (those whose numbers are small and whose populations need monitoring)
SC = Species of Special Concern

2.6.4 Significant Natural Heritage Areas in the Roanoke River Basin

Occoneechee Neck Floodplain Forest

The privately-owned Occoneechee Neck Floodplain Forest contains some of the best remaining examples of mature floodplain forest along the upper Roanoke River valley. This area also contains several large beaver ponds, some of the oldest in the Roanoke floodplain and excellent examples of this community type.

Buzzard Point/Ventosa Plantation

Partly within the Roanoke River Wetland Game Land, the Buzzard Point/Ventosa Plantation is a large expanse of river floodplain with some of the best examples of typical bottomland and

swamp communities in the Roanoke system. Characteristics include levee forests, backswamps, alluvial flats, sloughs, low and high ridges, and beaver ponds.

Broadneck Swamp

Part of the Roanoke River National Wildlife Refuge, Broadneck Swamp contains one of the best mature natural levee forest communities in the Roanoke floodplain. A rare population of Virginia bluebells has been observed on the levees. Additionally, the area contains the largest swamp forest in the upper and middle portions of the floodplain of the Roanoke River. Bald cypress and water tupelo dominate the backwater swamp canopy and are associated with an understory of Carolina water ash. The swamp supports the second largest inland heron rookery in North Carolina and provides important nesting and wintering habitat for ducks.

Conoho Neck Swamp

Conoho Neck Swamp is located along the lower reaches of Conoho Creek, within the floodplain of the Roanoke River, and is protected as part of the Roanoke River Wetland Game Land. It is a classic example of a "backswamp", a swamp formed by the natural levees along the main channel of the river, which act as berms or dams, impeding drainage and holding water in during the winter and spring months. The deeply flooded cypress-gum swamp forest is the dominant natural community on this site and is influenced by both the blackwater Conoho Creek and brownwater Roanoke River. Also found here is a fine example of a "yazoo" tributary, formed when a tributary is deflected by the levee bordering the river and is forced to run parallel to the mainstem of the river for some distance.

Devil's Gut

Located in the lower floodplain of the Roanoke River, Devil's Gut contains diverse alluvial features such as filled river channels, point bars and natural levees. Long, narrow sand or loamy ridges with levee forests of laurel oak, swamp chestnut oak, willow oak and water oak alternate with parallel bands of bald cypress-water tupelo sloughs form a ridge and swale topography. An old growth (up to 160-year-old trees) loblolly pine/American beech community, located on higher slopes in the southeastern section of this site, supports the only known stand of American beech in the North Carolina Coastal Plain.

Broad Creek Neck

Broad Creek Neck contains the largest expanse of contiguous cypress-water tupelo swamp forest in the Roanoke River floodplain and probably in North Carolina. It also supports extensive river frontage and several distributary streams, cypress-gum flats and tidally-influenced blackwater stream/bayou communities. A portion of the natural area is within the Roanoke River National Wildlife Refuge.

Roanoke River Delta Islands

This community consists of a series of islands and distributary channels at the mount of the Roanoke River. An extensive tract of mature bald cypress/water/tupelo/Carolina water ash swamp forest is second in size only to the nearby Broad Creek Neck. It supports a high density of wildlife, including black bear, waterfowl and nesting neo-tropical songbirds. It also protects important aquatic habitat for a diversity of fish. Much of the natural area is within the Roanoke River National Wildlife Refuge.

Roquist Pocosin

A large example of a rare non-riverine wetland in the Roanoke River basin is the privately-owned Roquist Pocosin. The canopy contains trees averaging 17 inches in diameter, with trees 24-30 inches in diameter common. The forest is dominated by swamp black gum and red maple with abundant remnant cypress. On the north side is a small but excellent quality non-riverine, wet hardwood forest.

2.7 Permitted Wastewater and Stormwater Discharge Facilities

The primary pollutants associated with point source discharges are:

* oxygen-consuming wastes,
* nutrients,
* color, and
* toxic substances including chlorine, ammonia and metals.

Discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge are broadly referred to as 'point sources'. Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater collection systems for municipalities which serve populations greater than 100,000 and stormwater discharges associated with certain industrial activities. Point source dischargers in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit. Discharge permits are issued under the NPDES program, which is delegated to DWQ by the Environmental Protection Agency.

2.7.1 Wastewater Discharges in the Roanoke River Basin

Currently, there are 88 permitted wastewater discharges in the Roanoke River basin. Table A-13 provides summary information (by type and subbasin) about the discharges. Various types of dischargers listed in the table are described in the inset box. A list of all facilities can be found in Appendix I.

Table A-13 Summary of NPDES Dischargers and Permitted Flows

	Roanoke River Subbasin										
Facility Categories	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**TOTAL**
Total Facilities	23	9	18	3	7	4	0	11	9	4	88
Total Permitted Flow (MGD)	1.3	4.1	19.8	0.5	26.03	4.2	0.0	41.7	87.5	1.3	186.3
Major Discharges	1	1	4	0	3	1	0	4	3	1	18
Total Permitted Flow (MGD)	0.0	3.0	19.2	0.0	26.02	4.1	0.0	40.5	86.0	1.15	180.05
Minor Discharges	22	8	14	3	4	3	0	7	6	3	70
Total Permitted Flow (MGD)	1.3	1.1	0.6	0.5	0.01	0.01	0.0	1.2	1.5	0.15	6.3
100% Domestic Waste	18	4	9	1	2	2	0	5	3	2	46
Total Permitted Flow (MGD)	1.3	0.8	0.08	0.02	0.01	0.01	0.0	0.4	2.2	1.3	6.1
Municipal Facilities	2	3	2	1	1	1	0	4	4	2	20
Total Permitted Flow (MGD)	0.6	4.02	14.0	0.5	5.0	4.1	0.0	9.8	3.03	1.3	42.3
Nonmunicipal Facilities	21	6	16	2	6	3	0	7	5	2	68
Total Permitted Flow (MGD)	0.7	0.07	5.8	0.03	21.03	0.01	0.0	31.9	84.5	0.0	144.06

The majority of NPDES permitted discharges in the Roanoke River basin are from wastewater treatment plants serving communities and schools. Many of them are small facilities with less than one million gallons of flow per day. However, there are a few larger discharges in the basin as well. Facilities, large or small, where recent data show problems with a discharge are listed and discussed in each subbasin chapter in Section B.

Figure A-13 shows the location of major and minor permitted wastewater discharges within the basin. The number of sites on the map depicting major discharges differs from the number of major facilities listed in Table A-13. Since some major facilities have more than one outfall point, each outfall received a symbol on the map.

Types of Wastewater Discharges:

Major Facilities: Wastewater Treatment Plants with flows ≥1 MGD (million gallons per day); and some industrial facilities (depending on flow and potential impacts to public health and water quality).

Minor Facilities: Facilities not defined as Major.

100% Domestic Waste: Facilities that only treat domestic-type waste (from toilets, sinks, washers).

Municipal Facilities: Facilities serving municipalities. Can treat waste from homes and industries.

Industrial Facilities: Facilities with wastewater from industrial processes such as textiles, mining, seafood processing, glass-making and power generation.

Other Facilities: This category includes a variety of facilities such as schools, nursing homes, groundwater remediation projects, water treatment plants and non-process industrial wastewater.

2.7.2 Stormwater Discharges in the Roanoke River Basin

EPA Stormwater Rules

Phase I – December 1990

- Requires a NPDES permit for municipal separate storm sewer systems (MS4s) serving populations of 100,000 or more.
- Requires a NPDES stormwater permit for ten categories of industry.
- Requires a NPDES stormwater permit for construction sites that are 5 acres or more.

Phase II – December 1999

- Requires a NPDES permit for some municipal storm sewer systems serving populations under 100,000, located in urbanized areas.
- Provides a "no stormwater exposure" exemption to industrial facilities covered under Phase I.
- Requires a NPDES stormwater permit for construction sites that are 1-5 acres.

Amendments were made to the Clean Water Act in 1990 and most recently in 1999 pertaining to permit requirements for stormwater discharges associated with industrial activities and municipal separate storm sewer systems (MS4s). DWQ administers these regulations in North Carolina through the state's NPDES stormwater program. The goal of the DWQ stormwater discharge permitting regulations is to prevent pollution via stormwater runoff by controlling the source(s) of pollutants.

The municipal permitting requirements are designed to lead into the formation of comprehensive stormwater management programs for municipal areas. No municipalities in the Roanoke River basin were required to obtain a NPDES permit for stormwater sewer systems under the Phase I rules (population >100,000). Additionally, no municipalities in the basin are automatically required (US Census designated Urban Areas) to obtain a NPDES stormwater permit under the Phase II rules. However, Eden, Reidsville, Henderson and Roanoke Rapids will be considered for inclusion under the Phase II rules because of a population greater than 10,000 and/or a

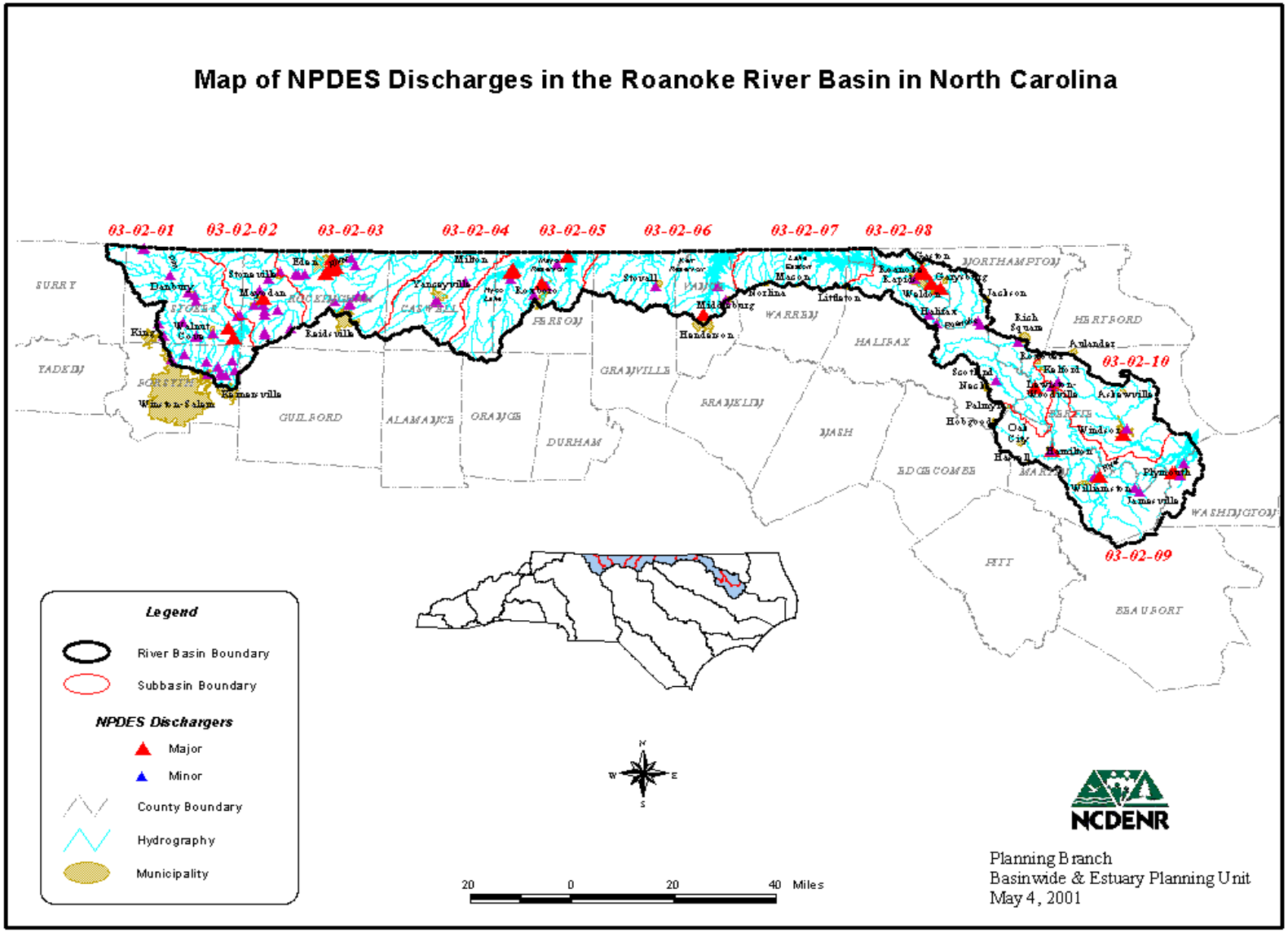

Figure A-13 Location of NPDES Permitted Discharges in the Roanoke River Basin

population density greater than 1000 persons per square mile. DWQ is currently developing criteria that will be used to determine whether these and other municipalities should be required to obtain a NPDES permit.

Industrial activities which require permitting are defined in categories ranging from sawmills and landfills to manufacturing plants and hazardous waste treatment, storage or disposal facilities. Stormwater permits are granted in the form of general permits (which cover a wide variety of more common activities) or individual permits. Excluding construction stormwater general permits, there are 132 general stormwater permits and 9 individual permits active within the Roanoke River basin. Individual permit holders are presented in Appendix I.

The primary concern with runoff from industrial facilities is the contamination of stormwater from contact with exposed materials. Poor housekeeping can lead to significant contributions of sediment and other water quality pollutants. To address these issues, each NPDES stormwater permitted facility must develop a Stormwater Pollution Prevention Plan (SPPP) that addresses the facility's potential impacts on water quality. Facilities identified as having significant potential to impact water quality may also be required to conduct analytical monitoring to characterize pollutants in stormwater discharges.

The state stormwater management rules (15A NCAC 2H .1000) regulate development activities in 20 coastal counties and on lands statewide that drain to Outstanding Resource Waters (ORW) and/or High Quality Waters (HQW). Under this program, development is permitted as either low density or high density. Low density limits the impervious, or built upon, area on a project and allows natural infiltration and attenuation of stormwater runoff. High density requires installation and maintenance of structural best management practices to control and treat stormwater runoff from the site. Surface waters in the Roanoke River basin where development activities are regulated under these special rules are presented on Figures A-14 and A-15 (Part 3.2).

2.8 Animal Operations

In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H.0217) establishing procedures for managing and reusing animal wastes from intensive livestock operations. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve animal populations of at least the following size: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system. Within the past five years there have been several additional pieces of legislation enacted that affect animal operations in North Carolina (see text box).

Key Animal Operation Legislation (1995-1999)

1995 – Senate Bill 974 requires owners of swine facilities with 250 or more animals to hire a certified operator. Operators are required to attend a six-hour training course and pass an examination for certification. Senate Bill 1080 established buffer requirements for swine houses, lagoons and land application areas for farms sited after October 1, 1995.

1996 – Senate Bill 1217 required all facilities (above threshold populations) to obtain coverage under a general permit, beginning in January 1997, for all new and expanding facilities. DWQ was directed to conduct annual inspections of all animal waste management facilities. Poultry facilities with 30,000+ birds and a liquid waste management system were required to hire a certified operator by January 1997 and facilities with dry litter animal waste management systems were required to develop an animal waste management plan by January 1998. The plan must address three specific items: 1) periodic testing of soils where waste is applied; 2) development of waste utilization plans; and 3) completion and maintenance of records on-site for three years. Additionally, anyone wishing to construct a new, or expand an existing, swine farm must notify all adjoining property owners.

1997 – House Bill 515 placed a moratorium on new or existing swine farm operations and allows counties to adopt zoning ordinances for swine farms with a design capacity of 600,000 pounds (SSLW) or more. In addition, owners of potential new and expanding operations are required to notify the county (manager or chair of commission) and local health department, as well as adjoining landowners. DENR was required to develop and adopt economically feasible odor control standards by 3/1/99.

1998 – House Bill 1480 extended the moratorium on construction or expansion of swine farms. The bill also requires owners of swine operations to register with DWQ any contractual relationship with an integrator.

1999 – House Bill 1160 extended (again) the moratorium on new construction or expansion of swine farms, required DENR to develop an inventory of inactive lagoons, and requires owners/operators of an animal waste treatment system to notify the public in the event of a discharge to surface waters of the state of 1,000 gallons or more of untreated wastewater.

Table A-14 summarizes, by subbasin, the number of registered livestock operations, total number of animals, total acres in operation, and total steady state live weight as of January 2000. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in each subbasin.

The largest subbasin, 03-07-08, contains the largest number of registered animal operations with four cattle operations, one poultry operation and fourteen swine operations. Overall the majority of registered animal operations are found in the lower portion of the basin. Registered animal operations where recent data show problems are discussed in the appropriate subbasin chapter in Section B.

Steady State Live Weight (SSLW) is the result, in pounds, after a conversion factor has been applied to the number (head count) of swine, cattle or poultry on a farm. The conversion factors, which come from the US Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS) guidelines, vary depending on the type of animals on the farm and the type of operation (for example, there are five types of hog farms). Since the amount of waste produced varies by hog size, SSLW is the best way to compare the sizes of the farms.

Table A-14 Registered Animal Operations in the Roanoke River Basin (January, 2000)

Subbasin	Cattle			Poultry			Swine		
	No. of Facilities	No. of Animals	Total Steady State Live Weight	No. of Facilities	No. of Animals	Total Steady State Live Weight	No. of Facilities	No. of Animals	Total Steady State Live Weight
03-02-01	2	365	511,000	--	--	--	1	3,200	417,600
03-02-02	--	--	--	--	--	--	1	4,000	522,000
03-02-03	--	--	--	--	--	--	1	1,800	243,000
03-02-04	2	325	455,000	--	--	--	2	7,325	1,190,680
03-02-05	2	240	336,000	--	--	--	4	5,000	708,500
03-02-06	--	--	--	--	--	--	2	13,756	1,940,810
03-02-07	3	700	980,000	--	--	--	3	13,875	2,002,750
03-02-08	4	1,205	1,192,000	1	60,000	240,000	14	55,935	7,075,415
03-02-09	--	--	--	--	--	--	6	16,363	2,252,480
03-06-10	--	--	--	--	--	--	2	13,150	2,277,580
TOTALS	**13**	**2,835**	**3,474,000**	**1**	**60,000**	**240,000**	**36**	**134,404**	**18,630,815**

Information on animal capacity by subbasin (Table A-15) was provided by the USDA. Two percent of the state's total capacity for swine and poultry is found in the Roanoke River basin; however, the basin contains three percent of the state capacity for dairy, with the highest concentrations located in subbasins 03-02-07 and 03-02-01. Overall, swine and poultry production in the basin increased over the past five years by 48 and 9 percent, respectively, while dairy production decreased 18 percent.

Table A-15 Estimated Populations of Swine, Dairy and Poultry in the Roanoke River Basin (1998 and 1994)

Subbasin	Total Swine Capacity		Swine Change	Total Dairy Capacity		Dairy Change	Poultry Capacity		Poultry Change
	1998	1994	94-98 (%)	1998	1994	94-98 (%)	1998	1994	94-98 (%)
03-02-01	411	957	-57	731	901	-19	43,750	23,650	85
03-02-02	1,710	9	100+	119	119	0	71,000	0	100+
03-02-03	3,892	3,742	4	136	323	-58	22,415	280	100+
03-02-04	1,564	1,579	-1	265	581	-54	25,400	0	100+
03-02-05	4,183	4,482	-7	130	130	0	76,200	0	100+
03-02-06	448	1,485	-70	453	621	-27	38,000	48,000	-21
03-02-07	11,281	13,876	-19	845	630	34	418,861	431,200	-3
03-02-08	78,909	42,003	88	230	230	0	381,500	316,500	21
03-02-09	33,441	27,320	22	0	0	0	1,348,800	1,056,200	28
03-02-10	16,970	7,627	100+	0	0	0	2,839,500	2,945,500	-4
TOTALS	152,809	103,080	48	2,909	3,535	-18	5,265,426	4,821,330	9
% of State Total	2%	2%		3%	3%		2%	3%	

2.9 Water Quantity Issues

2.9.1 Local Water Supply Planning

The North Carolina General Assembly mandated a local and state water supply planning process in 1989 to assure that communities have an adequate supply of potable water for future needs. Under this statute, all units of local government that provide, or plan to provide, public water supply service are required to prepare a Local Water Supply Plan (LWSP) and to update that plan at least every five years. The information presented in a LWSP is an assessment of a water system's present and future water needs and its ability to meet those needs.

Surface water is used to meet the majority of overall water needs in the North Carolina portion of the Roanoke River basin (approximately 56 percent of estimated total water use). In 1997, 43 public water systems used water from the basin providing 30.7 million gallons of water per day to 114,000 people in the basin. Water demand from these public systems is projected to increase 55 percent by 2020. Seven of the 43 systems (1.8 percent) reported that available supply was not adequate to meet estimated demand through 2020, and seventeen other systems (40 percent) report that by 2020 demand levels will exceed 80 percent of available supply.

In addition, water supply systems in other river basins are looking toward the Roanoke River basin for a water source. In 1995, the City of Virginia Beach, Virginia obtained the right to withdraw up to 60 million gallons of water per day from Lake Gaston. In 1998, following a very involved and contested Federal Energy Regulatory Commission (FERC) approval process, water withdrawal began. Urban areas within North Carolina have also discussed obtaining a permit to withdraw water from the Roanoke River basin.

Not everyone gets water from public water supply systems. Many households and some commercial and industrial operations supply their own water from both surface and groundwater sources in the basin. The US Geological Survey estimates that self-supplied users, excluding power-generating facilities, account for 58 percent of the total water used in the Roanoke River basin. Water used for industrial and irrigation purposes comprises the majority of self-supplied water use in the basin (Figure A-14).

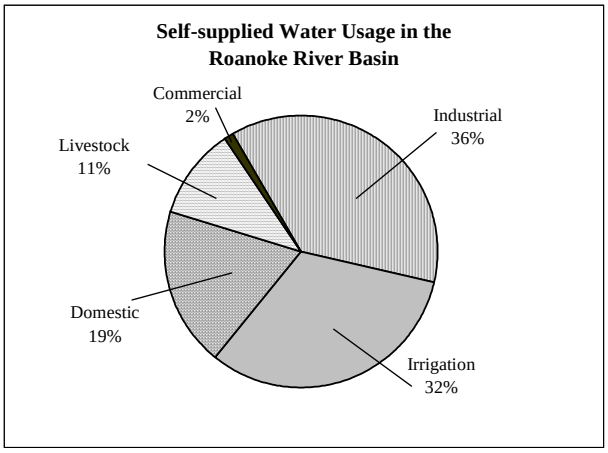

Figure A-14 Estimated Self-Supplied Water Use in the Roanoke River Basin (USGS)

The State Water Supply Plan is a compilation of over 500 LWSPs developed by local government water systems in North Carolina. More detailed information is available in the plan about water supply and water usage in the Roanoke River basin. This draft plan is available online at the Division of Water Resources website at http://www.dwr.ehnr.state.nc.us or by calling (919) 733-4064.

2.9.2 Water Withdrawals

Prior to 1999, North Carolina required water users to register their water withdrawals with the Division of Water Resources (DWR) only if the amount was 1,000,000 gallons or more of surface or ground water per day. In 1999, the registration threshold for all water users except agriculture was lowered to 100,000 gallons per day. Table A-16 presents registered withdrawals.

Table A-16 Registered Water Withdrawals in the Roanoke River Basin (August 2000)

County	1999 Average (MGD)	1999 Maximum (MGD)	Source of Withdrawal	Facility
Stokes Rockingham	1170	1459	Belews Lake	Duke Power Company
Stokes	0.0011	0.0241	Roanoke River	RJ Reynolds Tobacco Company
Stokes	0.036	0.054	Roanoke River	RJ Reynolds Tobacco Company
Rockingham	216.9	279.9	Dan River	Duke Power Company
Rockingham	Inactive	Inactive	Pit	Vulcan Materials Company
Caswell	0.008	0.016	Pit	Vulcan Materials Company
Person	1060	1102	Hyco Reservoir	Carolina Power & Light Company
Person	5.138	7.551	Mayo Reservoir	Carolina Power & Light Company
Vance	0.028	0.04	Pit	Vulcan Materials Company
Halifax	26.13	34.52	Roanoke River	Champion International Corporation
Halifax	1.8	3.6	Roanoke River	NC Dept. of Corrections, Caledonia Prison
Northampton	0.02	0.48	Groundwater	Henry B. Long, Inc.
Northampton	--	3.89	Pond	William R. Johnston
Bertie	1	1.872	Cashie River	H & H Farms
Bertie	4.6	5	Roanoke River	Ward Farms
Bertie	1.512	1.512	Cashie River	Ted Winslow
Bertie	5.56	8.3	Roanoke River	Gillam Farming, Inc./Gillam Outlaw Farms
Bertie	1.388	1.388	Cashie River	Hyman Ferry Farms, Inc. and Ted Winslow
Bertie	--	2.16	Groundwater and pond	Brinkley Farms, Inc.
Bertie	--	0.9	Pond	Brinkley Farms, Inc.
Bertie	2.46	3.59	Groundwater	Perdue Farms, Inc.
Martin	2.2	2.4	Roanoke River	C. Wesley Copeland, Jr.
Martin	2.5	2.5	Roanoke River	Fate B. Everett, Jr.
Martin	65.2	79.1	Roanoke River & Warren Neck Creek	Weyerhaeuser Plymouth Plant
Martin	1.00	6.22	Groundwater	Weyerhaeuser Plymouth Plant
Martin	--	0.144	Groundwater	Woodridge Timber, Inc.

There are 26 registered water withdrawals in the North Carolina portion of the Roanoke River basin. Sixteen of these (62 percent) are surface water withdrawals. Excluding public water systems or power generating facilities, there is a cumulative permitted capacity to withdraw 147.8 million gallons of surface water per day.

Consumption of water from the Roanoke River basin through direct withdrawals, along with interbasin transfers (discussed in the following section) and floodplain exchange (discussed in Chapter 4), has the potential to affect the salinity of the lower Roanoke River. Consideration of the cumulative effects of saltwater intrusion on the lower Roanoke River should be considered when additional water withdrawals are proposed.

2.9.3 Interbasin Transfers

In addition to water withdrawals (discussed above), water users in North Carolina are also required to register surface water transfers with the Division of Water Resources if the amount is 100,000 gallons per day or more. In addition, persons wishing to transfer two million gallons per day (MGD) or more, or increase an existing transfer by 25 percent or more, must first obtain a certificate from the Environmental Management Commission (G.S. 143-215.22I). The river basin boundaries that apply to these requirements are designated on a map entitled *Major River Basins and Sub-Basins in North Carolina*, on file in the Office of the Secretary of State. These boundaries differ slightly from the 17 major river basins delineated by DWQ.

In determining whether a certificate should be issued, the state must determine that the overall benefits of a transfer outweigh the potential impacts. Factors used to determine whether a certificate should be issued include:

- the necessity, reasonableness and beneficial effects of the transfer;
- the detrimental effects on the source and receiving basins, including effects on water supply needs, wastewater assimilation, water quality, fish and wildlife habitat, hydroelectric power generation, navigation and recreation;
- the cumulative effect of existing transfers or water uses in the source basin;
- reasonable alternatives to the proposed transfer; and
- any other facts and circumstances necessary to evaluate the transfer request.

A provision of the interbasin transfer law requires that an environmental assessment or environmental impact statement be prepared in accordance with the State Environmental Policy Act as supporting documentation for a transfer petition.

Currently, there are no certified interbasin transfers in the Roanoke River basin. However, Kerr Lake Regional Water System (KLRWS) was allowed to continue transferring up to 10 MGD out of the Roanoke River basin under the new law without having to undergo the certification process. The system only currently transfers about 5.5 MGD into the Tar-Pamlico River basin. KLRWS has indicated that it will exceed its 10 MGD capacity before 2010 and will be required to obtain a certificate in order to increase the transfer amount. The Town of Henderson, which is a partner in KLRWS, has contracted to sell a maximum of 3 MGD to Franklin. This transaction will be a transfer from the Roanoke River basin into the Tar-Pamlico River basin.

Table A-17 lists eight known potential transfers involving the North Carolina portion of the Roanoke River basin (not required to be certified). Approximately 3.41 MGD is transferred out of the basin and a relatively small unknown quantity is transferred into the basin for an estimated net loss of water. Please note that all local water systems are now required to report existing and anticipated interbasin transfers as part of the Local Water Supply Planning process. This information will be available for future updates of this basinwide plan and will allow for a better assessment of cumulative impacts.

Table A-17 Interbasin Transfers in the Roanoke River Basin (1997)

Supplying System	Receiving System	Source Subbasin	Receiving Subbasin	Estimated Transfer (MGD)
Kerr Lake Regional WS	Henderson	Roanoke	Tar-Pamlico	0.06
Kerr Lake Regional WS	Oxford	Roanoke	Tar-Pamlico	2.0
Kerr Lake Regional WS	Warren County	Roanoke	Tar-Pamlico	1.3
Henderson	Franklin	Roanoke	Tar-Pamlico	3.0 (proposed)
Roanoke Rapids	Northampton-Gaston	Roanoke	Chowan	0.05
Roxboro	Roxboro	Roanoke	Tar-Pamlico	Unknown
Winston-Salem	Winston-Salem	Yadkin-Pee Dee	Roanoke	Unknown
Reidsville	Reidsville	Cape Fear	Roanoke	Unknown
King	King	Yadkin-Pee Dee	Roanoke	Unknown

The most significant interbasin transfer in the Roanoke River basin is not reflected in Table A-17 because it takes place primarily in the State of Virginia. In 1995, the City of Virginia Beach obtained the right to withdraw up to 60 MGD from Lake Gaston. Between January 1998 and April 2000, withdrawals ranged from 44.8 MGD to 0.6 MGD. The average withdrawal during 1999 was 17 MGD.

2.9.4 Minimum Streamflow

One of the purposes of the Dam Safety Law is to ensure maintenance of minimum streamflows below dams. Conditions may be placed on dam operations specifying mandatory minimum releases in order to maintain adequate quantity and quality of water in the length of a stream affected by an impoundment. The Division of Water Resources, in conjunction with the Wildlife Resources Commission, recommends conditions relating to release of flows to satisfy minimum instream flow requirements. The permits are issued by the Division of Land Resources. Table A-18 summarizes minimum flow requirements in the Roanoke River basin.

Table A-18 Minimum Streamflow Projects in the Roanoke River Basin

Name	Location	Waterbody	Drainage Area (sq. mi.)	Min. Release (cu.ft/sec)
Dams associated with Power Production				
Roanoke Rapids Dam	Near the NC/VA state line at Roanoke Rapids, NC	Roanoke River	8,371	1000-2000[1]
Hyco Reservoir Afterbay	Near the NC/VA state line north of Roxboro, NC	Hyco River	202	10[2]
Pinnacles Dam	Near Meadow of Dan, VA	Dan River	32.9	30 or inflow[3]
Avalon Dam*	1.5 miles NE of the Town of Mayodan, NC	Mayo River	310	79 or inflow[3]
Mayo Dam*	At the Town of Mayodan, NC	Mayo River	312	85 or inflow[3]
Other Impoundments				
Fullers Creek Reservoir	Near the Town of Yanceyville in NC	Fullers Creek	1.71	0.3

* Project is not yet complete.

Notes

[1] Roanoke Rapids and Gaston are operated in coordination with peak flow releases from Kerr Reservoir upstream. The minimum flow requirements are at times not sufficient for successful spawning of striped bass; therefore, flow regimes vary between April 1 and June 15 (Table A-19).

[2] Under severe hydrologic conditions (water level below 375 feet), minimum flow requirement drops to 2 cfs.

[3] If inflow is less than the specified minimum release, the release must be equal to the inflow. In other words, the project must operate in a run-of-river mode (i.e., instantaneous inflow equals instantaneous outflow) until the inflow becomes greater than the specified minimum release.

Flow Augmentation to Support Fish Communities

Striped bass, American shad, hickory shad and other anadromous fish migrate up the Roanoke River each spring to spawn. These species support recreational and commercial fisheries that are economically important on a local, statewide and an Atlantic coast-wide basis (refer to Part 2.6.2 of this section for more information). These migratory species need flowing water to create suitable habitat for successful spawning and/or to keep their eggs suspended. The minimum flow requirements shown in Table A-18 are insufficient for these species to successfully reproduce. An agreement, entered into by Dominion (formerly North Carolina Power), the US Army Corps of Engineers and the NC Wildlife Resources Commission (WRC), establishes a plan for the springtime storage of water in John H. Kerr Reservoir and flow releases through Lake Gaston and Roanoke Rapids Lake.

The original agreement between these three parties was signed in 1971, but it only addressed minimum flows during the spawning season. In 1987, a multiagency team known as the Roanoke River Water Flow Committee analyzed flow data for the river and recommended the current flow regime (Table A-19) (Manooch, 1989; Rulifson, 1991). The rationale for the recommended flows was to provide flow conditions that would mimic pre-impoundment flows.

Table A-19 Flow Augmentation Regime

Dates	Target Average Daily Flow (cfs)	Lower Limit (cfs)	Upper Limit (cfs)
April 1-15	8,500	6,600	13,700
April 16-30	7,800	5,800	11,000
May 1-15	6,500	4,700	9,500
May 16-31	5,900	4,400	9,500
June 1-15	5,300	4,000	9,500

In 1989, the WRC requested an amendment of the flow agreement based upon the recommendations of the Flow Committee. As part of this amendment, Dominion agreed to cease hydropower peaking operations during the spawning period. Since implementation, striped bass have successfully reproduced to the extent that the population has been declared "recovered" by federal regulatory agencies. Hickory shad populations have increased beyond historical levels as well. Because state and federal resource agencies believe that flow management has been critical to the viability of these fish populations, the three-party agreement was extended indefinitely in 2001.

Hydroelectric Project Relicensing

The license issued by the Federal Energy Regulatory Commission (FERC) to Dominion (formerly North Carolina Power) for the operation of the Roanoke Rapids and Gaston Hydropower Project expired on January 31, 2001. The relicensing process began in early 1995 and includes an assessment of how current and future project operations will affect environmental resources in the Roanoke River basin. Several studies related to instream flow and water quality are at various stages of completion. Three technical work groups, including a water quality subcommittee, are analyzing the results of these studies. Refer to Chapter 4, Part 4.6.2 for further information.

The Pinnacles Hydro-Electric Project is also undergoing relicensing at this time. It is owned by the City of Danville, but is located on the headwaters of the Dan River near Meadow of Dan, Virginia. The project consists of two impoundments: Talbott and Townes Reservoirs. Talbott is used as storage and supplies water to Townes downstream. From Townes Reservoir, water bypasses a stretch of the Dan River channel to the powerhouse where water is returned to the river. Changes in the flow regimes or general operation of this project have the potential to impact water quality in the North Carolina portion of the Dan River.

2.10 Physical Impacts to Wetlands and Streams

DWQ has issued approvals for wetland filling activities since the mid-1980s; however, in 1989, the Environmental Management Commission directed DWQ to begin reviewing wetland fill and stream alteration activities using a review sequence of (1) avoidance, (2) minimization and (3) mitigation of wetland impacts. Rules finalized in 1996, required that wetland values, such as

whether or not the wetland is providing significant uses or whether the filling activity would remove or degrade those uses, be considered. The rules also specify wetland and stream mitigation ratios and type and location of projects to make the mitigation process more predictable and manageable for the regulated community. DWQ's emphasis continues to be on water quality and the essential role that wetlands play in maintaining water quality. The issuance of a 401 Water Quality Certification by DWQ is required before the US Army Corps of Engineers can issue a Section 404 Permit authorizing the fill or alteration of wetlands and/or streams in North Carolina.

Despite efforts to protect and restore wetland and stream functions on the part of DWQ and many other agencies and organizations in North Carolina, there is still an annual net loss of wetlands and streams statewide. DWQ and Division of Land Resources (DLR) regulate construction activities near streams and wetlands. These regulatory programs ensure that construction projects cause minimal damage to these resources and that unavoidable impacts are addressed through mitigation projects. Restoration projects are also funded through the Wetland Restoration Program (WRP), Section 319 Program, Clean Water Management Trust Fund and Division of Water Resources Grant Program that can help offset stream and wetland impacts.

DWQ tracks wetland and stream losses that are authorized through the issuance of a 401 Water Quality Certification. In addition to the permitted wetland and stream impacts that are tracked by DWQ, an unknown amount of permanent wetland and stream losses also occurs. Projects that affect less than one-third of an acre of wetland or less than 150 linear feet of stream are not required to receive written confirmation from DWQ, and therefore, might not be reported. The magnitude of unauthorized impacts to wetlands and streams is not known.

Over the past five years (1995-1999), DWQ issued permits for approximately 76 acres of wetland fill activities and alteration activities that affected at least 1,804 linear feet of stream in the Roanoke River basin. A significant percentage of stream impacts statewide are associated with highway construction projects.

In June 1998, a federal court declared that the US Army Corps of Engineers' Tulloch Rule, which prohibited the ditching and draining of wetlands, was illegal. As a result, during FY 1999-2000, approximately 9,220 acres of wetlands on about 80 sites (mostly in southeastern NC) were ditched and drained. This activity stopped in March 1999 when DWQ began to enforce its wetland standards. DWQ, EPA and DLR have spent an extensive amount of time visiting each of these sites to check for compliance with environmental rules. Most of these wetlands were slated to be restored by December 2000.