YADKIN-PEE DEE RIVER BASIN

CURRENT STATUS
WATER SUPPLY, WATER TREATMENT, AND
WASTE WATER TREATMENT CAPACITIES

USGS

AMERICAN ASSOCIATION OF UNIVERSITY WOMEN
Educational Foundation Project
Winston-Salem Branch

1984

YADKIN-PEE DEE RIVER BASIN
CURRENT STATUS
WATER SUPPLY, WATER TREATMENT, AND
WASTEWATER TREATMENT CAPACITIES

Prepared by: Winston-Salem Branch AAUW
under project grant from
American Association of University Women Educational Foundation
in cooperation with
Northwest Piedmont Council of Governments
and the
Yadkin-Pee Dee River Basin Committee
January, 1984

ACKNOWLEDGMENTS

The success of this project depended upon the skills, knowledge, and efforts of many people. All those who were approached responded with extraordinary generosity of their time and resources. It is to all of them that those who find this document helpful owe your thanks.

Could one express to each of those who were helpful during these last months of preparation, this volume would be double in size. All space will allow is to cite those who have been most involved in the planning, preparation, and publication of this document.

First, to the American Association of University Women Education Foundation for the grant which made the publication possible. Then to Ms. Adelaide Williams who served as out technical advisor and planning expert from the inception of the project.

The members of the Winston Salem Branch AAUW who are listed on the following page contributed time, money, and skills. Without your help this project could not have been brought to so successful a conclusion.

To the Yadkin-Pee Dee River Basin Committee, especially to Mr. Joe Matthews, who first heard our plans, for commissioning the project, for providing us with office space, duplicating services, and secretarial assistance. But more than those things, was the encouragement and guidance that the committee, Mr. Matthews, and Mrs. Venable, gave in both development and publication of the document.

To Ms. Catherine Hill, Supervisory Hydrologist, United States Department of the Interior for her assistance in helping to locate current Water Resources Data for North Carolina. To the North Carolina Department of Natural Resources and Community Development, especially to Mr. Coy Batten and Mrs. Sue M. Gardner, who provided much essential data on a county by county basis. To Robert Joyce, Russell Radford, and Steve Mauny of the Northwest Piedmont office of the Department of Natural Resources and Community Development we are most grateful for duplications and clarifications of many items. To Mr. Charles E. Rundgren of the Division of Health Services who provided us with printouts of each of 520 community water systems located in the 18 counties of the river Basin and also for providing information about current statutes governing Safe Drinking Water in North Carolina. The North Carolina Department of Administration, Jane Smith Patterson, Secretary, and Ms. Chrys Baggett of the State Clearinghouse provided sundry information. To each of the County Managers and their staffs we owe thanks for your interest and help. Your willingness to grant interviews and provide needed information was most appreciated.

To all of these and to the many others who were involved in the development of this project we are glad to say, "thank you." One hopes that this document which is the fruit of all our work, will be useful to many people in the future.

THESE MEMBERS OF THE
AMERICAN ASSOCIATION OF UNIVERSITY WOMEN
CONTRIBUTED TO THIS PUBLICATION

WINSTON-SALEM, NORTH CAROLINA 1981-1983

Alexander, Betty
Allen, Charlotte
Allen, Mabel
Atwood, Martha
Arlt, Sandra
Barrow, Kate
Benbow, Margaret
Benton, Eunice
Bernhardt, Norma
Booe, Luetta
Bradford, Tomasin
Broadway, Nancy
Brown, Ruth
Bryan, Edna
Cardwell, Marilyn
Carey, Janis
Carlton, Agnes
Collier, Jewell
Cornwall, Joanna
Covey, Bonnie
Cuniggim, Whitty
David, Agnes
Dillabough, Jeanette
Dunham, Sarah
Dunning, Phyllis
Felmet, Marjorie
Ford, Octavia
Freeman, Ann
Godwin, Lena
Goldthwaite, Lillian
Griffin, Helena
Hairston, Irene
Hamilton, Louise
Hancock, Jill
Harris, Lucille
Hartz, Ann
Hill, Medora
Howard, Mary Anna
Howe, Marguerite
Howell, Patricia
Huggins, Minnie
Humbert, Jean
Hutchins, Nancy
Imgrund, Janice
Jackson, Viola
James, Candy
Johnston, Patricia
Kirby, Elisa
Law, Patsy
Leake, Lu
Levine, Rachel
Litzenburg, Jayne
Luce, Nancy
Mace, Vera
Mason, Romelia
Meis, Marcia
Meroney, Katherine
Mizelle, Mary-Stuart
Moser, Marion
Naugle, Mildred
Newell, Virginia
Nilsson, Elizabeth Sue
Northrup, Lazelle
O'Connell, Virginia
Oldham, Gladys
Orrell, Mildred
Owen, Jeanne
Pagett, Rebecca
Parker, Clarice
Patridge, Patti
Penland, Mary Louise
Perry, Margaret
Phillips, Ruth
Reed, Catherine
Ring, Barbara
Ritter, Connie
Roberts, Elizabeth
Rollins, Marilyn
Rome, Ruth
Rothman, Virginia
Rumph, Julia
Ruona, Sara
Schoonmaker, Meyressa
Schuitmaker, Jane
Sharpe, Margaret
Simpson, Margaret
Sink, Dallas
Skeeters, Christina
Smith, Barbara
Snyder, Kelly
Spaulding, Mary
Spudis, Martha
Sulkin, Dorothy
Sullivan, Patricia
Tatro, Lynn Marie
Taylor, Ruby
Teague, Suzanne
Terry, Fannie
Tomlinson, Janice
Trivett, Cynthia
Ward, Lois
Warren, Laura
Welch, Elizabeth
White, Muriel
Whitt, Janice
Williams, Ruby
Wilson, Evelyn
Wilson, Marion
Wood, Martha
Zimmerman, Blanche

TABLE OF CONTENTS

County Profiles

I.

Background of the Study

Historically, Americans have treated their abundant water resources not as a finite treasure to be cared for and preserved but as a commodity to be used without discretion. It has been a source of power for the growth of industry, a source of pleasure for those who fish and sail, a source of irrigation for those who farm. And for all of us it has stood with food and shelter as one of life's necessities. Only within the last few years have we recognized that with the growth of population in our country, with the increased use of chemicals which has accompanied the unparalled productivity of agriculture, and with the increased demands of industry on water resources, we have come to face new and dangerous problems of contamination of our water supply. No longer can we assume that the water that comes so freely from our faucets is safe to drink. Many lakes and streams that earlier generations enjoyed are now unfit.

The problem has become serious enough that in 1974 the United States Congress passed a law, the Safe Drinking Water Act (P.L. 93-523) to safeguard public drinking water supplies and to protect public health. The law directed the U.S. Environmental Protection Agency (EPA) to establish minimum national drinking water standards. These standards set limits on the amounts of various substances sometimes found in drinking water.

In providing for the implementation of the 1974 law, Congress assigned responsibility to the individual states thus recognizing that they were better equipped than the Federal Government to assess their own needs and projected growth. Under the direction and leadership of Governor James B. Hunt, Jr., the N.C. Department of Natural Resources undertook to provide a comprehensive and up-to-date overview of all important aspects of water resources in N.C. In 1979 that study was published and is known as the "Level A Study".

The Level A Study is a framework study which includes our present legislative and administrative policies for water resource management, with proposed new policies; a survey of water resource needs and problems in the State; alternative combinations of water resource management measures for each river basin; and an interim priority list for water resource projects. A careful reading of this study leads to the conclusion that wise and efficient management of the water resources of our State depends upon the informed participation of every citizen, and upon cooperation between local, State, and Federal Agencies which bear the constitutional responsibility for managing this resource.

The Level B Study published in 1981 addresses the subject of water management within the Yadkin-Pee Dee River Basin. Within the framework of the Level A Study it presents a detailed survey of the resources and proposes a course of further action on water use, control, and management. Concerns of water usage, treatment and supply both in the present and in the future are examined. The anticipated growth of the State's population and industry will make a significant impact on all of these aspects of water management.

This presentation is concerned with the quality of water within the North Carolina Counties of the Yadkin-Pee Dee Basin. It originated from the concern of members of the American Association of University Women, Winston-Salem Branch, and developed with the advice and assistance of the Yadkin-Pee Dee River Basin Commission. Funds were granted for publication of our research by the Educational Foundation of the American Association of University Women.

It has been our objective to present a county-by-county view of the publically owned water and wastewater treatment facilities in the eighteen counties comprising the N.C. Yadkin-Pee Dee River system. The most recent information on present and projected supply, treatment, use and disposal was gathered and tabulated. Both surface water and ground water have been accounted for as sources of raw water supply. Collection, storage, treatment, consumption, and wastewater collection and treatment have all been subjects of inquiry. Using the reparian doctrine as a baseline, some evaluation of present performance can be made. It is our hope that this presentation will provide the reader with an understanding of where his water comes from, how it is treated and delivered and where it goes after he uses it.

II.

MAJOR SURFACE WATER IMPOUNDMENTS AND RESERVOIRS ON THE YADKIN-PEE DEE RIVER IN NORTH CAROLINA AND THEIR STORAGE CAPACITY

1. West Kerr Scott Reservoir - 188,744,000m^3
   Wilkes County; built by US Corps of Engineers on the Yakin River, a reservoir for controlled storage, flood control, low flow augmentation and recreation. Located 2.0 miles upstream from Miller's Creek and 40 miles from Wilkesboro. (US Corps of Engineers).

2. High Rock Lake - 314,100,000m^3
   Davidson County; created by High Rock Dam on the Yadkin River. Located 256 miles upstream from the mouth of the Pee Dee River in Winyah Bay; used for hydroelectric power and recreation (Yadkin, Inc., Duke Power Co.). This lake is unofficially classed as eutrophic.

3. Tuckertown Reservoir - 52,460,000m^3
   Stanly County; created by a dam on the Yadkin River 250 miles upstream from the mouth of the Pee Dee River in Winyah Bay; used for hydroelectric power (Yadkin, Inc., Duke Power).

4. Badin Lake (also called Narrows Reservoir) - 297,302,200m^3
   Stanly County; created by a dam 242 miles upstream from the mouth of the Pee Dee River in Winyah Bay; is used for hydroelectric power (Yakin Inc., Duke Power).

5. Lake Tillery - 206,104,000m^3
   Stanly County; on the Pee Dee River, created by Norwood Dam; located 224 miles upstream from the mouth of the Pee Dee River in Winyah Bay and 5 miles upstream from Rocky River; used for hydroelectric power development (Carolina Power & Light).

6. Blewett Falls Lake - 119,661,000m^3
   Richmond County; created by Blewett Falls Dam on the Pee Dee River; located 195 miles upstream from its mouth in Winyah Bay; used for hydroelectric power development (CP&L).

7. Lexington-Thomasville Reservoir - 8,046,000m^3
   Davidson County; built as a municipal water supply for these cities on Abbot's Creek near Lexington. This city lake has been unofficially classed as eutrophic.

Yadkin-Pee Dee River Basin Committee Counties

Geopraphical Districts		COG	Major River Yadkin	
Northern:	Caldwell	E	Reddies	Little Yadkin River
	Forsyth	I	Roaring River	
	Stokes	I	Mitchell River	
	Surry	I	Fisher River	
	Wilkes	D	Ararat River	
	Yadkin	I	South Yadkin	
Middle:	Alexander	E	Major River Yadkin	
	Davidson	G		
	Davie	I	South Yadkin River	
	Iredell	F	Uwarrie River	
	Randolph	G		
	Rowan	F		
Southern:	Anson	H	Major River Pee Dee	
	Cabarrus	F		
	Montgomery	H	Rocky River	
	Richmond	H	Uwarrie River	
	Stanley	F	Yadkin River	
	Union	F	Little River	

III.

RIPARIAN DOCTRINE IN THE YADKIN-PEE DEE BASIN

The Body of law controlling surface water use is termed the riparian reasonable use doctrine. Some general observations have previously been made in public reviews or water law publications about the riparian reasonable use doctrine:

The riparian reasonable use doctrine basically states that each streambank (riparian) owner is entitled to have a watercourse flowing by or over his or her property undiminished in quantity and unimpaired in quality, provided that other riparian owners are entitled to make reasonable use of the water as it flows by their property.

The riparian reasonable use doctrine is a courtmade rather than a legislated doctrine. The doctrine has largely been expressed in judicial decisions and administered by the courts.

The riparian reasonable use doctrine emphasizes the resolution of water use conflicts between riparian owners after the conflicts have arisen and a water use injury has occurred.

The riparian rights doctrine has been used in court successfully in cases of injury due to hazardous toxic wastes released into surface waters.

Basically, rightfuly claim for water rests upon land ownership and the proximity of the land to the water. Non-riparian owners may not necessarily have a rightful claim for use or for injury.

The riparian reasonable use doctrine is considered by some to have the following advantages:

The concept of the riparian reasonable use doctrine, in theory, is that all riparian users are welcome to maximize the free and reasonable use of water as long as they do not infringe on the like rights of other riparians. In this sense, water rights reflect similar considerations in property rights.

The doctrine allows an individual riparian owner to decide what is his or her best interest in the use of water subject to the like right of other riparians.

The application of the riparian reasonable use doctrine is considered to emphasize flexibility. The doctrine only intervenes to make water allocation decisions when one or more riparians claim they have been injured.

Also, the interpretation of the doctrine by the courts is considered to be flexible enough to reflect changes in public attitudes about what constitutes a reasonable use.

The doctrine is considered by some to be an effective legal tool to retard the large-scale diversion of water from one major river basin to another.

Obviously, water diverted to another major river basin does not continue to flow by downstream property undiminished in quantity and unimpaired in quality.

Interbasin transfer of water is an issue not effectively addressed either by existing common law decisions or legislative law. Instances of interbasin transfer exist in the Yadkin-Pee Dee Basin, and elsewhere in the state. This is true in spite of an anti-diversion concept that is implicit in the riparian doctrine. Four or five statutes make some reference to either interbasin transfer or trans-watershed diversion, but they have been either inconsistent or inconclusive in their application to specific problems. Most are related to return of waste-water to sub-basins considered "fragile" and unable to handle the volume of waste.

IV.

IMPORTANT FEDERAL AND STATE FACTS RELATIVE TO WATER MANAGEMENT

Funding for the Yadkin-Pee Dee Basin Level B study was provided under the Water Resources Planning Act, which established the Water Resources Council as administrative agency for comprehensive water resources planning. The Federal Clean Water Act of 1977 was established "to restore and maintain the chemical, physical and biological integrity of the Nation's waters." It is administered by the EPA. A National Pollution Discharge Elimination System (NPDES) permit is required for the discharge of pollutants from a point-source. Applications for these permits are made to the N.C. Department of Environmental Management (D.E.M.) and approved or denied by the appointed Environmental Management Commission. These may be withdrawn if the point-source is not in compliance. The N.C. Department of Natural Resources and Community Development administers compliance with this EPA program.

The Safe Drinking Water Act is meant to assure the safety of drinking water. It is administered by the EPA with primary responsibility for enforcement by the State. The N.C. Department of Human Resources is the lead agent for much of this program.

EPA grants have provided federal funding for about 75% of the cost of waste-water systems. With North Carolina Clean Water funds providing an additional 12-1/2%, the remainder of the cost is provided by the local government.

Pollution abatement practices leading to improved soil and water conservation are administered with cost share payments to farmers under Soil Conservation Service and the Agricultural Stabilization and Conservation Service.

Rural water projects are funded through the Farmers Home Administration (FmHA) through grants and loans for rural water and waste disposal projects, irrigation, drainage, soil and water conservation, pollution control, watershed improvement, etc. The Councils of Government (COGs) of North Carolina assist in planning for these projects.

Detailed administration of water supply and sewage systems are basically under county or city government, and federal EPA grants are made to them through application after proper review and approval of all State policy making bodies.

PERTINENT NORTH CAROLINA FACTS RELATING TO WATER QUANTITY, QUALITY OR MANAGEMENT

(The General Assembly of North Carolina through general statutes has made provisions for the health and environment of citizens by providing for administration and financing).

The appointed Environmental Management Commission may issue required permits for withdrawal of over 100,000 gallons of water from areas where water depletion or water pollution are declared. New discharge may be refused in such areas. They may allocate or divert water during emergencies on request of a county or city after hearings and emergency consent by the Governor. The Department of Natural Resources and Community Development provides the detailed information and administration.

The Commission for Health Services of the Department of Human Resources sets state sanitation standards, approves public water supply system plans and designs, treatment techniques, and laboratory testing of contaminant or toxic levels.

Under the policies made by the Environmental Management Commission, two or more units of local government or a public authority or association created by them may undertake cooperative water or sewer projects. The Commission for Health Services is involved in both policy making and administration or these cooperative systems.

The General Assembly of the State of North Carolina has created a number of commissions, boards, and advisory councils to assist and advise the State Departments. Members are generally appointed by the governor from specified fields of interest to serve stated terms. Some of these bodies are largely advisory in power. Others are charged by legislative statute with the power and duty to promulgate rules and regulations and to issue permits or licenses which directly affect the protection, preservation and proper use of water, air, land and health of the citizens of the State.

Each North Carolina Department is served by a state secretary and staff and is organized into regional offices with differing counties for facility in administration of programs. No one regional office serves all of the 18 counties in the Yadkin-Pee Dee River Basin. For this reason the A.A.U.W. has provided maps outlining counties included in each regional office carrying on services most important to water quality in the Basin.

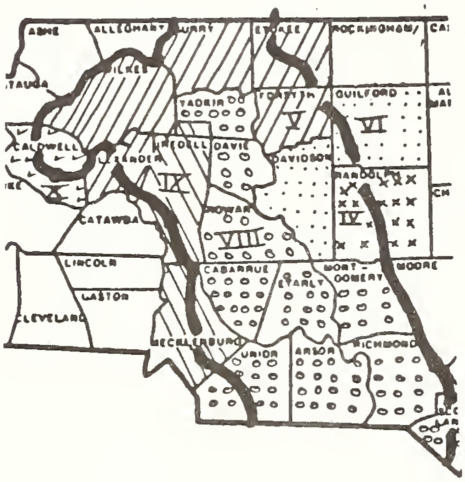
Regional Councils of Government are under the administrative office of the Governor. Councils are composed of representatives selected by the counties and municipalities within each COG district and serve as planning centers between the State of North Carolina, the local bodies of government, and the federal funding agencies. Counties in the Yadkin-Pee Dee River Basin are included in 6 separate COGs and most are also partly in other river basins.

The General Assembly is composed of senators and representatives. In some instances they represent more than one county or only a portion of a county. Maps give the senatorial district and the representative district in the General Assembly for the decade of the 1980's. These elected officials will be responsible for any major changes of water laws in the Yadkin-Pee Dee River Basin.

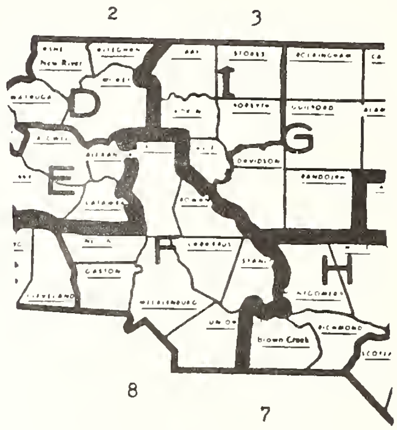
Congress provides the funding for financing a major portion of the water quantity and water quality projects in the United States. While senators represent the entire state, representatives serve congressional districts. Within the Yadkin-Pee Dee Basin there are six different representatives who will vote on the national budget including the federal agencies authorized to fund projects within the Yadking-Pee Dee Basin.

REPRESENTATIVE DISTRICTS AND N.C. STATE SERVICE OFFICES IN THE BASIN

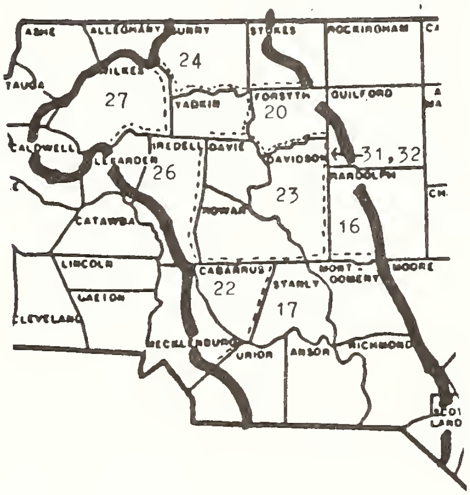
U.S. CONGRESSIONAL DISTRICTS



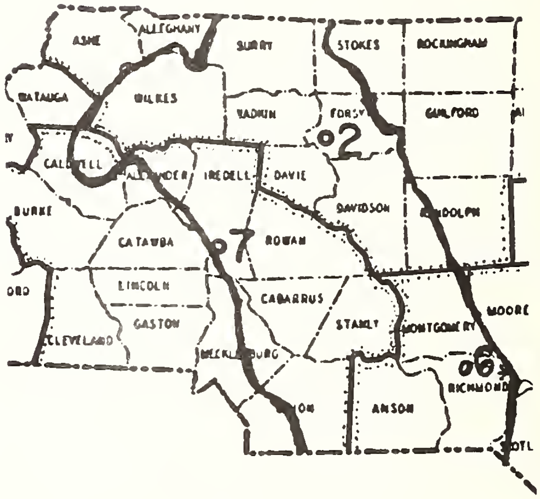
COG's D,E,F,G,H,I
SWCD's 2,3,7,8



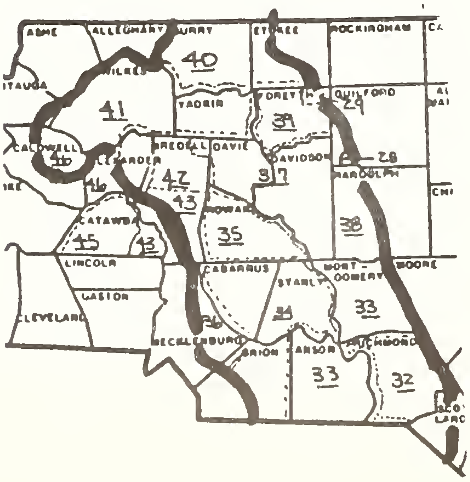
NORTH CAROLINA SENATE DISTRICTS



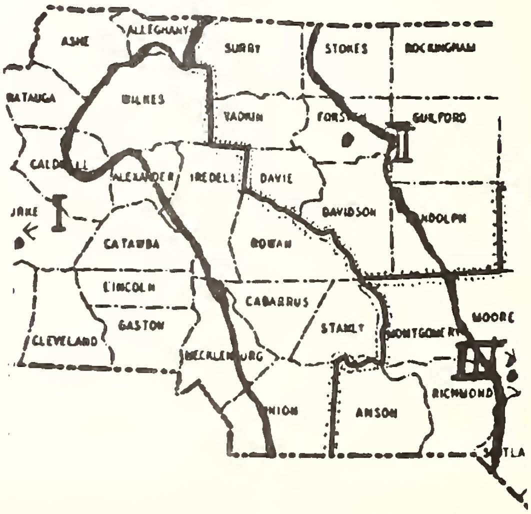
NCDNRCD



NORTH CAROLINA HOUSE DISTRICTS



NCDHR



V.

WATER TREATMENT

The Yadkin-Pee Dee River Basin is considered a water abundant area. Both surface and groundwater sources are used; but in the coming decades, the basin will experience significant growth in population and industry. Growth and development are desirable, yet they can change the quantity and quality of the source. Surface waters are now and will continue to grow in demand as the major source of raw water for human consumption and all other uses. Our sources of water supply are being endangered by hundreds of new chemicals and pollutants every year. In addition, some of our water treatment facilities have not kept pace with the technology required to remove the increasing amounts of chemical or microbiological contamination. However, the ability to detect contaminants has been improving. Modern science is now equipped to identify specific chemicals in terms of billionths of parts of the water being tested.

This new situation calls for a great deal of research. There are many questions being studied and debated by scientists, and this process will gradually produce more answers than we have now. Meanwhile, we must reduce the risks to our health by taking these steps:

--We can be sure that our water is being treated by technology capable of removing potentially harmful contaminants.
--We can test or monitor the purity of our water on a regular basis to assure its quality.
--We can develop an informed citizenry to cooperate with our water suppliers in introducing the changes necessary to protect the public health.

To safeguard public drinking water supplies and to protect public health, Congress passed a law in 1974, the Safe Drinking Water Act (P.L. 93-523). The law directed the U.S. Environmental Protection Agency (EPA) to establish minimum national drinking water standards. These standards set limits on the amounts of various substances sometimes found in drinking water. Simply, this act means that every community water supply in the country serving 15 or more connections or 25 people must ensure that its water meets these minimum standards of purity. Even non-community supplies, such as trailer parks, camping sites, and roadside motels with their own water supplies are required to meet these regulations.

To be given primary responsibility for the national safe drinking water program, the State of North Carolina was required to adopt drinking water standards at least as strict as the national standards. It must also carry on adequate monitoring and enforcement requirements.

Congress also directed EPA to provide the states with financial and technical assistance. With the help of multi-county planning units, called Councils of Government in North Carolina, many of the water treatment plants in the Yadkin-Pee Dee Basin have received EPA funding with supplements from the state.

The Environmental Protection Agency established standards (or "maximum contaminant levels," in technical language) for ten chemicals, six pesticides, bacteria, radioactivity, and turbidity (cloudiness). Most of these substances occur naturally in our environment and in the foods we eat. The national drinking water standards set by EPA reflect the levels we can safely consume in our water, taking into account the amounts we are exposed to from these other sources. Only two substances for which standards have been set pose an immediate threat to health whenever they are exceeded:

--Bacteria - Coliform bacteria from human and animal wastes may be found in drinking water if the water is not properly treated. These bacteria may cause disease themselves or indicate that other harmful organisms may be present in the water. Waterborne diseases such as typhoid, cholera, infectious hepatitis, and dysentery have been traced to improperly disinfected drinking water.

--Nitrate - Nitrate in drinking water above the national standard poses an immediate threat to children under three months of age.

The following is a listing of some other substances covered by the national drinking water standards. Water exceeding the maximum contaminant levels for these elements, for short periods of time, will pose no immediate threat to health. However, these substances must be controlled as drinking water that exceeds these standards over long periods of time may prove harmful.

Arsenic	Chromium	Mercury
Barium	Flouride	Selenium
Cadmium	Lead	Silver

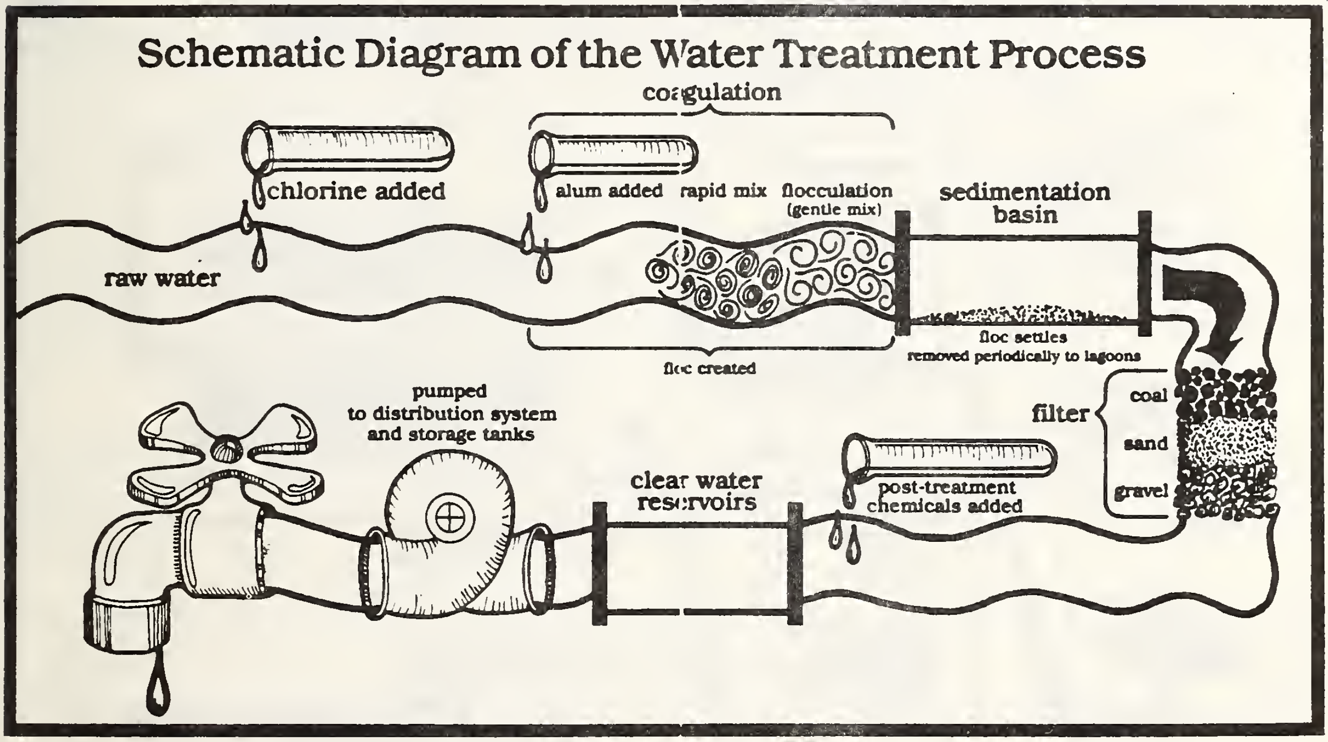
--Pesticides - Millions of pounds of pesticides are used on croplands, forests, lawns, and gardens in the United States each year. They drain off into surface waters or seep into underground water supplies. Many of them may pose health problems if they get into drinking water and the water is not properly treated. The maximum limits for pesticides in drinking water are:

Endrin, 0.0002 milligrams per liter
Lindane, 0.004 milligrams per liter
Methoxychlor, 0.1 milligrams per liter
Toxaphene, 0.005 milligrams per liter
2,4-D, 0.1 milligrams per liter
2,4,5-TP Silvex, 0.01 milligrams per liter

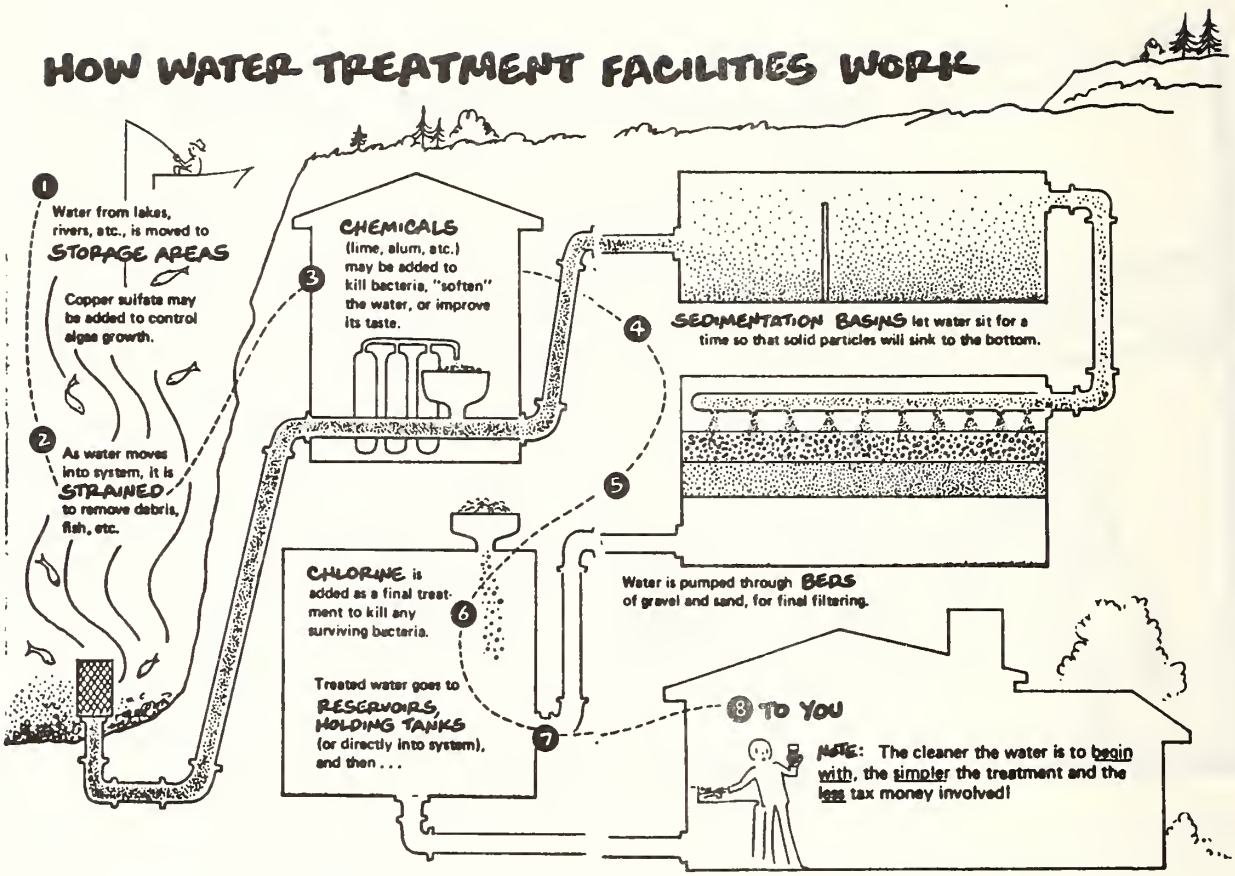
--Turbidity - The cloudiness, or turbidity, of drinking water is also covered by the national standards. The minute particles suspended in the water that cause turbidity can interfere with disinfection and with bacteria testing. Excessive turbidity can thus allow disease-causing organisms to survive. Standards have been set to provide for varying circumstances.

In addition to flooding, sand operations, road building, seasonal farm operations, building development, various natural disasters, or urban storm water run off can influence turbidity in the raw water source.

The following diagram is a basic illustration of how a water treatment plant operates. Keep in mind that all the materials listed above are then present in the sludge which will normally reenter the surface water system at the NPDES point source.



W-S/FC



10

C.L. Bete Co., Inc.

11

VI.

WASTEWATER TREATMENT

I. INTRODUCTION

A fundamental necessity in water quality management is wastewater treatment. Wastewater, for the purposes of this paper, is defined as the used water and solids from a community that enter a treatment process and are then returned to a source basin. Household wastes, also termed sewage, are included in the wastewater definition. Storm water, surface water, and ground water may also be included in the wastewater that enters a treatment works. The treatment process can be conducted from a plant, septic tank, disposal field, lagoon, pumping station, constructed drainage ditch or surface water intercepting ditch, incinerator, landfill, or other works installed for the purpose of treating, equalizing, neutralizing, stabilizing, or disposing of waste. The purpose of wastewater treatment is to return to a receiving stream a clean effluent that is environmentally compatible with that stream.

North Carolinians inherited clean water; and mindful of this rich legacy, the framers of the state constitution wrote into it a policy for the conservation and protection of the lands and waters. Through the years, population growth as well as technical developments in industry and agriculture have made it increasingly difficult to maintain the purity of our water sources.

The state, for instance, has strong laws controlling the water quality impacts of municipal and industrial discharges, construction-related activities, mining, and on-site wastewater disposal systems. Legislation is pending for control of two additional activities that can have water quality impacts - solid waste disposal and hazardous waste handling.

The means for comprehensive water quality planning, however, were not available until the passage of the Federal Water Pollution Control Act of 1972. Under Section 208 of this Act, which provided funds for water planning, the Department of Natural Resources and Community Development, and other state and local agencies working with input from the public, developed a Water Quality Management Plan. Parties participating in the plan had one common goal:

> To restore and maintain the chemical, physical and biological integrity of the source water.

The completed plan builds upon the established legislative foundation and recommends further legislative action to achieve clean water.

II. WATER POLLUTANTS

While the causes for water pollution are normal activities of modern life - tilling the land, building a shopping center or highway, harvesting timber - they can have a strongly degrading impact on the quality of our water. Improvements in controlling some pollution sources have been made, but there is only a limited understanding of the effects of many others. It is also highly probable that many degraded streams go undetected due to lack of funding for wastewater management.

Water pollutants can generally be grouped into the following categories:

Organic wastes (or oxygen demanding substances)
Bacteria
Sediment
Nutrients
Toxic substances

Organic Wastes: This waste required oxygen to dissolve. The amount of oxygen required to stabilize degradable organics is measured by the biochemical oxygen demand (BOD) test. The need for dissolved oxygen varies across the state. The Piedmont region, for example, has little dilution of water in many of its streams and this limits the amount of BOD which the streams can assimilate. However, the waste load to treatment plants has more than doubled in recent years. The result is that more streams are becoming degraded due to the amount of BOD discharged into them which they are not able to dissolve. It is recommended that funding be advanced for the building of more water treatment facilities to relieve the present overload plants.

Bacteria: A variety of pathogenic bacteria can be found in domestic wastewater and runoff from animal feedlots. Discharge of pathogenics from wastewater treatment plants is prohibited and public health is generally protected by the conventional disinfection techniques applied at wastewater treatment facilities. However, bacteria also enters the surface groundwater through septic tank seepage. Bacterial standards are violated by small water supply systems or through watershed drainage for livestock operation and through ditching or channelization for farm irrigation systems. To remedy this situation, more stringent controls are needed for granting septic tank permits and better land classification methods for livestock operation.

Sediment: Soil erosion is the leading contributor to sediment in the streams of our state. Bare soil is eroded by the force of water rushing over it during rain storms and some of this eroded soil is carried to streams, rivers, and lakes. Although highway construction, surface mines, and landfills have the highest rate of erosion, agriculture accounts for 80 percent of all erosion. These washes of soil erosion are flushed to downstream areas in the lower gradients which cannot easily flush themselves of sediment. The Soil Conservation Service has established several watersheds for erosion control on the water supply. The public pays directly for these controls, and indirectly through increased costs of treating drinking water from our muddy rivers and impoundments. Recommendations in this area include closer monitoring of soil erosion through voluntary programs and more coordination between the Mining Commission, Department of Transportation, and Bureau of Forestry for the development of soil erosion standards.

Nutrients: Phosphorous and nitrogen are nutrients that algae and other aquatic plants require in order to grow. If levels of nutrients are too high, the overgrowth of water plants not only creates taste and odor problems, changes the streams, and depletes the dissolved oxygen, which may result in fish kills. Excessive nutrient inputs may occur from wastewater discharge, septic tank leakage, and rainfall runoff from agricultural and residential areas. Studies indicate that nutrient concentrations are considerably higher in streams draining agricultural areas than in those draining from forested watersheds. The state has not yet imposed discharge restrictions of either phosphorous or nitrogen which promote overgrowth.

Toxics: Over 30,000 chemicals are in commercial production today, but little is known of the health effects of these chemicals. Techniques do not exist to routinely monitor some toxics, and limited funds also prevent adequate monitoring. Toxic substances reach the surface waters from wastewater discharges or runoff from agricultural lands or urban areas. These substances can be placed in two categories: those whose discharge is immediately dangerous to biological organisms, and causing their death; and those that interfere with biological processes over long periods of time, and result in subtle effects such as less reproductive success. Substances in the first category can cause disruption of biological wastewater treatment processes. When this happens, untreated sewage with the toxic substances is released. The more subtle toxics of the second category tend to concentrate in the sludge. These substances make it difficult to stabilize sludge and prevent its use as a soil conditioner. Both categories contain carcinogenic substances such as lead, mercury, and zinc.

The Environmental Protection Agency has published a list of hazardous and toxic substances for which pretreatment (before entering point sources for discharge treatment) is required. Although this is a step in the right direction, hazardous waste continues to be disposed of in environmentally unacceptable ways. Funding for stricter monitoring and testing of substances discharged by point sources, pesticides in agricultural streams, and for pretreating of waste as industrial plants is required.

III. WASTE-WATER TREATMENT

Waste water discharges into streams from industries and municipalities have historically been the most significant impediments to the achievement of water quality objectives. Wastewater from these sources generally flows into a waste treatment plant for processing before it is returned to a receiving basin. Waste treatment plants are established by permit only and must meet federal and state standards.

A flow diagram included in this section depicts the treatment process. The treatment removes impurities (organic and solid containments) from the wastewater. Nature's own processes, in concentrated forms, are used to break down the waste. A bacterial culture consumes the waste, and the bacteria themselves are decomposed in a controlled environment. Treated water is returned to area streams, while solid-waste end products are stockpiled and used by local residents as fertilizers.

Winston-Salem's Archie Elledge Waste Treatment Plant, one of North Carolina's largest municipal treatment facilities, has been selected to explain the wastewater treatment process. Wastewater, containing liquids and solids, and brewery waste comprise the approximately 25 million gallons of wastewater treated daily by this plant.

Collection and Treatment: Solid and liquid waste from residential and industrial contributors is collected and transported to the plant through a large network of pipes - a sanitary sewer system. Before entering the plant, the wastewater passes through large pipes called outfall sewers. Waste particularly high in oxygen demand, such as brewery waste, must undergo pretreatment in an aerated lagoon. After aerating, the water flows through mechanically cleaned bar screens which remove debris such as cans, wood and cloth material to protect the system from clogging. From the screens, the wastewater enters a grit chamber where mechanical rakes collect and deposit the sand and grit onto conveyors to be taken to a landfill. Low-lift pumps then lift the wastewater into primary settling tanks. The settling tanks, also called clarifiers, perform the primary treatment of separating the solids from the liquids entrained in the wastewater. The solid materials either float to the surface or sink to the bottom and become sludge. From this point, two different treatment processes begin, one for scum and sludge and another for liquid.

Treatment of Liquids: From the settling tanks, the liquid waste flows to another wet well where it is mixed with treated water. The liquid then is pumped into biological or trickling filters - where oxygen demand (BOD) is reduced and the consistency of the wastewater is stabilized. These filters are filled with a stone media, covered with microorganisms (zoogloeal mass) which plays a vital role in purification by consuming settled sewage. Rotary filters continuously distribute wastewater over the zoogloeal mass and into intermediate clarifiers or sludge basins. The liquid then flows onto activated sludge basins for final purification. In the sludge basin the wastewater is mixed with aerobic bacteria and oxygen. The water then travels to the final settling tanks where a portion of the bacterial growth is collected and returned to activated sludge basins. By continuously returning bacterial growth to sludge, a proper balance between microorganisms and food is maintained. Excess solids in the settling tanks are returned to primary settling tanks and combined with primary sludge. From the final clarifiers, the water flows to a mixing chamber where chlorine gas is added. The water is retained in the chlorine for about 30 minutes before it is returned into local streams-90 to 95 percent pure.

Treatment of Solids: Solids (sludge) and scum are further separated from the liquids by use of rotary screens and digesters. The scum passes through a rotary screen which separates the floating solids and grease. The solids are sent to a sanitary landfill and the liquids return to the settling tanks. From the settling tanks, the sludge is pumped into anaerobic digesters. These rounded digesters stabilize and remove water from the sludge. In the digester, the sludge is again separated into solids, liquids, and gases. The solids are sent to the drying beds for drying; the liquids returned to aerated lagoons and settling tanks; and the gases, composed of methane and carbon dioxide, are collected with the methane being used in the treatment plant to run dual fuel generators. The water returns to the settling tanks or aerated lagoon for treatment, and the solids are taken to sand drying beds. These beds consists of layers of sand and gravel with underdrains to carry any water back through the treatment plant. If the solids are dry, bridge conveyors load the sludge onto trucks to be stockpiled as fertilizer, also liquid land application is common under DEM permit.

IV. IMPACT ON WATER QUALITY FROM DISCHARGE SOURCES

As previously stated, wastewater discharged into our streams comes from many sources. These elements, listed in suggested decreasing order of detriment to water quality, are as follows:

- Point Sources
- Urban Stormwater Runoff
- Agriculture
- Construction
- Mining
- On-Site Wastewater Disposal

Solid Waste Disposal
Forestry

Point Sources: Point sources, which include the municipal water treatment plants, discharge the greatest volume of wastewater and have the greatest impact on water quality. Regulation of these point sources requires permits, and control through the permit system has solved many problems in this area. Aspects still needing to be addressed include access of small communities to water treatment grants and improved control of toxic substance discharged in wastewater.

Urban Stormwater Runoff: Precipitation cleanses the air of pollutants but washes them into streams. Surface runoffs pick up pollutants on the streets, parking lots, and industrial lands. Leaking or overloaded sewers, small unregulated point sources, intermittent dumping of toxic chemicals, all contribute to degraded stream water. While restoration of acceptable water in streams may require massive amounts of funding and new techniques, simple preventive techniques which can be applied are better street cleaning methods, catch basin cleaning, and covering of industrial stockpiles.

Agriculture: Agriculture creates a significant potential for non-point (without permit and unregulated) source water pollution. Rainfall runoff from fields can carry sediment, pesticides, and nutrients into nearby streams. Sediment is considered to be the greatest potential pollutant, but pesticides and nutrients in sufficient concentration can also cause water quality problems. Row cropping and concentrated animal production are two agricultural activities which contribute high levels of nutrients to streams. Many traditional soil conservation practices, such as terracing, grassed waterways, contour cropping, and new methods of irrigation can control erosion. Regulations limiting improper use of pesticides offer effective control. These "Better Management" practices can be enhanced with educational programs in soil conservation and better methods for monitoring nonpoint sources of wastewater discharge.

Construction: Construction of highways, utility lines, homes, and commercial spaces disturb a great deal of land acreage each year. This activity exposes streams to severe sediment drainage. Although any construction site of one acre or larger must have a written erosion control plan, there is still a need for better inspection and enforcement, on government projects in particular, and greater technical assistance to locations which adopt local ordinances for building projects.

Mining: The steep slopes of the North Carolina mountains and the fragile trout streams create a great potential for mining activities to cause water quality problems. Mining companies have made great progress in controlling the discharges from the mining sites; however, haul road, abandoned mines, and stockpiles of loosened dirt still contribute large amounts of sediments in some areas. Sand and gravel operations too close to rivers in the upper Piedmont area have caused the rivers to cut new channels through the mining operations which contribute to downstream sedimentation. The control practices most needed in mining operations are revegetation, water diversion, placement of haul roads away from streams, and general erosion controls.

On-Site Wastewater Disposal: Approximately half of the people of North Carolina use septic tank systems to dispose of household wastewater. Poor soil absorption, the presence of a high goundwater table, and high density development all contribute to the failure of many of these systems. It is suspected that there may be widespread contamination of underground water supplies from septic tank leakage, as hundreds of violations of bacterial standards are recorded each year for community water supplies. A permit from the County Health Department is required for septic tank systems, and the permit can only be issued after an inspection confirms that the site is acceptable. To control contamination from on-site systems, some additions and changes to the program for issuing permits is required, particularly funding for compliance inspection.

Solid Waste Disposal: Concern over site selection for solid waste disposal is growing as the chemical complexity of the waste is increasing. Sanitary landfills are regarded as the most environmentally acceptable means of solid waste disposal; yet they can have a major adverse impact on adjacent surface waters and underlying groundwater. North Carolina's Dolid Waste Management Act requires site permits based on approved operational plans and effective erosion controls. Federal regulations guide the operation and handling of hazardous waste and the siting of hazardous waste facilities. The various agencies involved with hazardous waste disposal need to develop and document their respective responsibilities for better coordination of activities in this area.

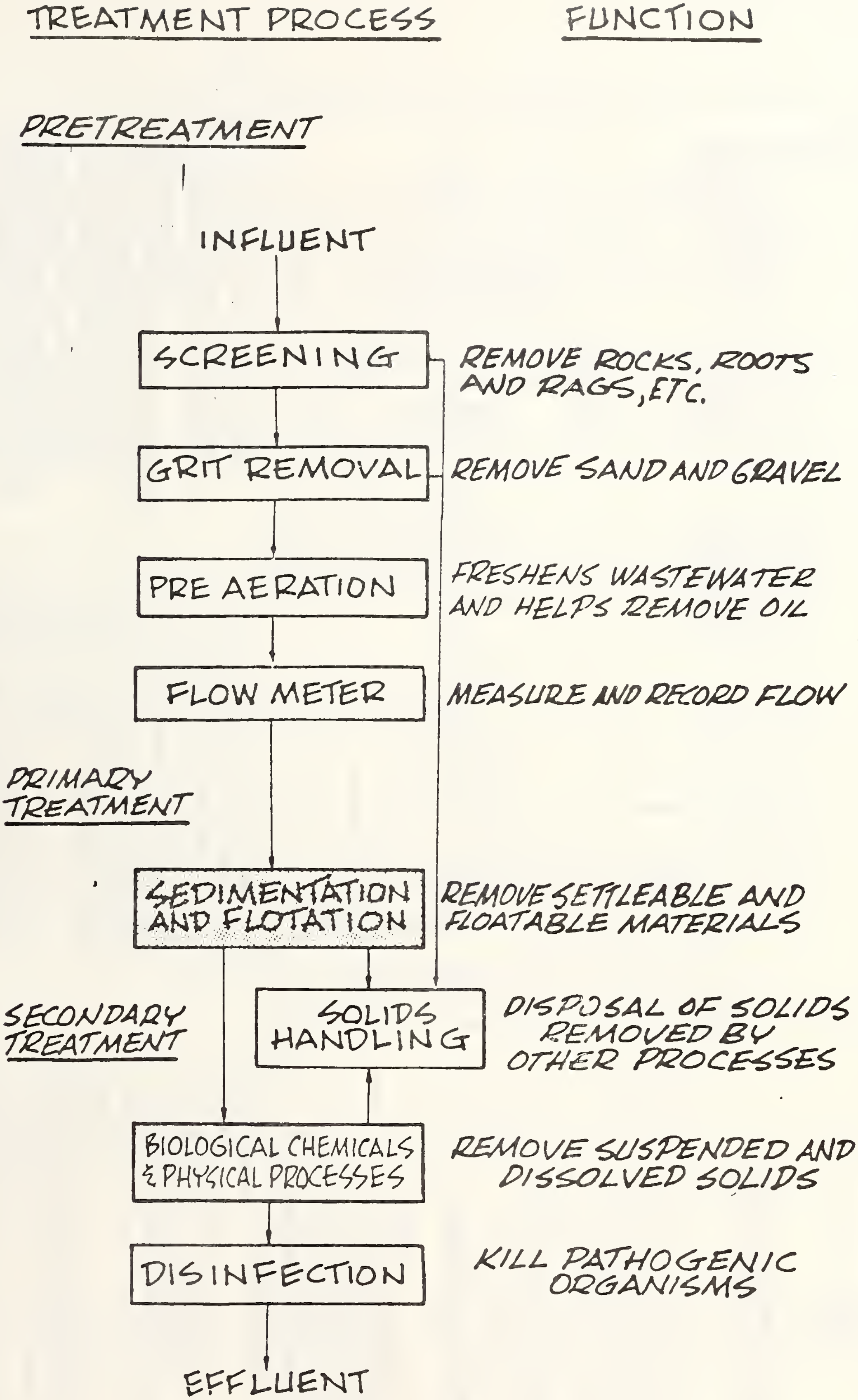
Forestry: Forest harvesting and site preparation cause land disturbances, and streams near these operations can suffer sediment damage which degrades the water quality and harms aquatic life. The only statute that directly relates to the protection of water quality during forestry operation is the regulation which prohibits the disposal of tree tops and debris in watercourses. To minimize the adverse effects of erosion from forestry activities, several management practices such as filters strips, location of roads on contours, and use of water control devices on steep roads, and less intensive site preparation are recommended.

V. CONCLUSION

The primary function of wastewater treatment is to insure that no untreated domestic sewage, industrial waste or by product shall be discharged into any public supply reservoir or any stream that feeds into these public places. Related to this objective is that of protecting our goundwater supplies, which seep into surface waters supplying public reservoirs.

We have seen that upstream activities can and do affect the downstream water quality. Activities that degrade water sources deny the riparian rights of others who have access to and use the water source. Although federal, state, and local regulations have been established for water quality protection, it still remains the civic and moral responsibility of all citizens to assure continued legislation and funding in this direction.

Courtesy of: A. Williams



Flow Diagram of Typical Plant

Collection and Treatment

Solid and liquid waste (waste water) from residential and industrial contributors is collected and transported to the plant through a large network of pipes — the sanitary-sewer system.

Before entering the plant, waste water passes through one of three large pipes called outfall sewers. Two of these outfall sewers carry residential and industrial waste, and the third carries primarily industrial-brewery waste.

Biological organisms require oxygen to break down the wastes — a process referred to as biochemical oxygen demand, or BOD. Brewery waste, however, is particularly high in oxygen demand. Consequently, brewery waste must undergo pretreatment in an aerated lagoon. Air is introduced into the waste water before the brewery waste enters the plant for the normal treatment process.

Once all the waste water is in the plant, the treatment process begins. The waste water flows through one of three mechanically cleaned bar screens which remove debris — such as cans, wood and cloth materials — and protect the system from clogging. These screens can handle up to 30 million gallons of waste water daily.

From the screens, the waste water enters three grit chambers where mechanical rakes collect and deposit the sand and grit onto conveyors to be taken to a landfill. About two tons of sand and grit are collected daily.

Located at the end of each grit chamber is a Parshall Flume — a measuring device which determines the quantity of water entering the plant. The flumes control the pumping rates at the wet wells.

Low-lift pumps, ranging in capacity from 13 to 22 million gallons a day, lift the waste water from the wet wells into primary settling tanks.

The settling tanks — also called clarifiers — separate the liquids and solids entrained in the waste water.

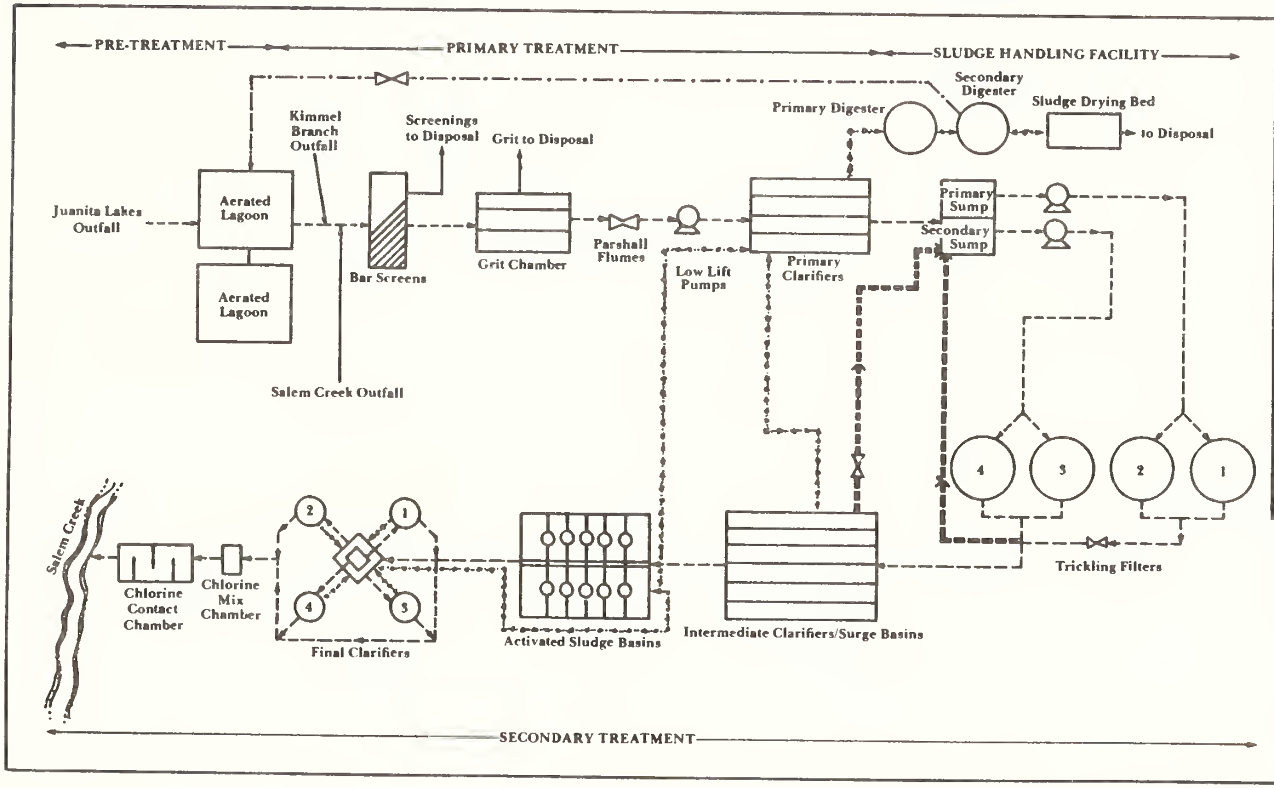
In approximately two hours, separation is completed. During this time, the solid material in the water either floats to the surface or sinks to the bottom and becomes sludge.

From this point, two different treatment processes begin, one for scum and sludge and another for liquid.

Treatment of Liquids

From the settling tanks, the liquid waste flows to another wet well where it is mixed with treated water.

The liquid then is pumped into four biological filters — or trickling filters — where oxygen demand (BOD) is reduced and the consistency of the waste water is stabilized.



SCHEMATIC ILLUSTRATION OF THE ARCHIE ELLEDGE WASTE TREATMENT PLANT

Supernatant
Water
Solids
Recycled Water

VII.

DEMOGRAPHICS

The Level B Study projected population in the Yadkin River Basin from 1970-2010. The following projections were made by correcting the projected 1980 population using the official census of 1980. Projections were made by the N.C. Office of State Budget and Management. The same office made projections for the number of North Carolina households in each county for the year 2,000.

In March 1979, Governor Hunt designated the disaggregations below the county level for environmental planning programs (EPA-Atlanta) as a responsibility of the Department of Natural Resources and Community Development. The percent of population in the basin was made in 1980 for the Level B Study on the assumption that the share of each county would be constant over 1970-2010 subject to standard demographic inclusions.

At the suggestion of the Level B Study person who authorized the original projection, the assumption of the same percent of population made in 1980 for counties not 100% in the Basin was used for the new household projections in the Basin given in the table following.

CORRECTIONS RECEIVED FROM COUNTIES

Forsyth County: City-County Planning Board

Based on an estimated population for the County of 300,600 in the year 2000, and using allocation figures by census tract prepared by the City-County Planning Board for that year, our estimated population for the portion of Forsyth County in the Yadkin Basin in the year 2000 is 277,800, an increase of 55,772 persons.

Dividing that population estimate by our projected average household size of 2.23 in the year 2000 for the County, gives 124,578 total housing units in the Yadkin Basin. Subtracting this figure from the existing units in the Basin yields 36,591 new housing units by the year 2000.

The large increase in housing units compared to population increase is due to the projected decrease in the average household size from the present 2.62 persons per household to our projected figure of 2.23.

Fredrick Luce
Senior Planner, CCPB

Cabarrus County Planning Department indicates their high level projection could indicate a population significantly above the state budget and management projection.

PROJECTED POPULATION GROWTH 1980-2000 IN 18 COUNTIES OF YADKIN-PEE DEE COMMITTE

County	July 1 1980	July 1 1985	April 1 1990	Year 2000 Projected	Per Cent. of Population of County in Basin	Population Projected by Counties within Basin Year 2000	Year 2000 New Households Projected in Basin
Alexander	25,159	28,338	31,797	40,105	28.9	11,590	1,919
Anson	25,600	26,632	27,529	29,208	100.0	29,208	1,922
Cabarrus	86,125	91,812	97,397	108,925	100.0	108,925	11,090
Caldwell	67,997	73,981	79,954	93,181	8.7	8,106	1,153
Davidson	113,586	122,560	131,602	150,533	100.0	150,533	19,117
Davie	24,760	28,383	32,244	41,986	100.0	41,986	6,959
Forsyth	244,379	258,321	272,864	300,633	94.4	283,797	37,873
Iredell	82,786	87,740	92,853	102,832	100.0	102,832	10,567
Montgomery	22,527	24,284	26,094	30,009	78.4	23,527	3,230
Randolph	92,271	100,470	108,586	126,337	36.6	46,239	6,151
Richmond	45,599	48,387	51,456	57,610	100.0	57,610	6,556
Rowan	99,391	103,399	107,410	114,273	100.0	114,273	8,907
Stanly	48,657	51,299	54,048	59,522	100.0	59,522	5,490
Stokes	33,331	39,601	46,381	64,586	25.4	16,405	3,067
Surry	59,632	63,725	67,770	76,202	98.7	75,211	8,255
Union	70,830	79,909	89,381	112,471	81.8	91,214	12,688
Wilkes	58,871	63,627	68,674	79,308	100.0	79,308	11,330
Yadkin	28,538	30,482	32,510	36,726	100.0	36,726	3,896
Total population projected in 18 counties in hydrologic Basin						1,337,012	160,170
Total projection of other counties with a percentage of population in Basin						54,783	7,414
Total population projection in Yadkin-Pee Dee River Basin						1,391,795	167,762

VIII.

INTRODUCTION TO COUNTY PROFILES

The basic statistics and special features of each county are given together with a map of each county supplied by the N.C. Department of Highways. Major water sources, direction of flow and location of major water source intake and NPDES entry locations are added. The symbols used are:

flow direction
Major Intake Location
Major NPDES Location
Basin division in 8 counties

The first table for each county gives a summary of public water systems by river basin and their capacity. Included are: the number of connections, the number of persons served, the average production in gallons per day, the estimated capacity production in gallons per day, and the source of water as surface or ground (the number of wells is given). The source of the information is the Public Water Supply Data Sheet from the North Carolina Department of Health and Human Resources. The inventory is through December 31, 1981.

The second table, a summary of wastewater treatment facilities, was made from the data sheets of NPDES permits as inventoried May, 1983 with additional information indicating problems in compliance through 1982 from separate data sheets. The computer information was obtained from the NCDNRCD from Raleigh and through the courtesy of the Winston-Salem Regional Office. Various data sheets from 1976 on were examined for historical purposes. Not all information needed is available from the same computer.

The Yadkin-Pee Dee Level B Study projections of water supply and capacity needs in the year 2000 is compared with the capacity given in the December 1, 1981 report. No detailed attempt was made to confirm the progress on indicated needs for pumping and distribution. In the case of wastewater treatment plants, no attempt is made to identify need for additional treatment or collection systems, unless information was volunteered.

County Profile: Alexander

Population: 25,159

28% of county population lives in Yadkin-Pee Dee River Basin

Projected pop. for year 2000: 40,105

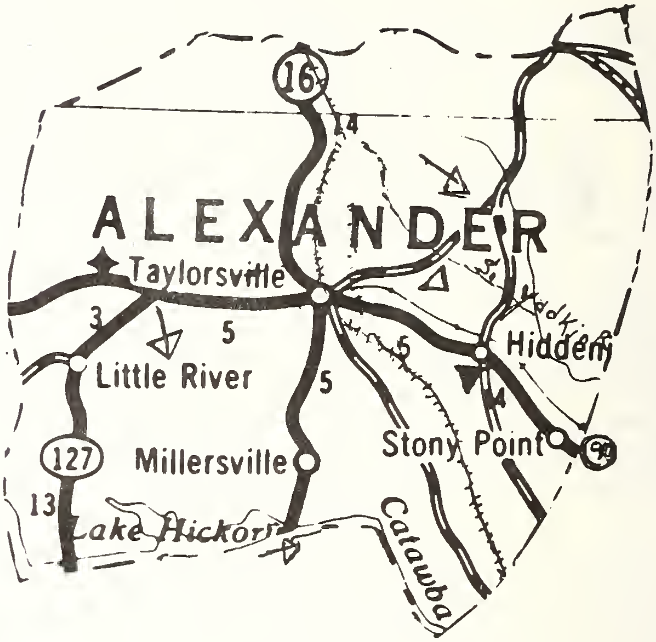
New Households in Basin projected: 1,919

Area: 259 square miles

County Seat: Taylorsville

Major Communities: Hiddenite and Stony Point

Major Recreational Areas: Joe-Little Joe Mountains, Rocky Face Mountain



Alexander County is a foothill county which peaks on the northern boundary in the Brushy Mountains at 2,500 feet elevation. Although most of the county drains southward to the Catawba River, the County seat, Taylorsville, drains into the South Yadkin River which flows southeasterly through the eastern section of the county.

As the major supplier of water in the county, Alexander County Water Corporation utilizes water from the South Yadkin River. Industrialized Taylorsville supplements this source with one of the 30 high yield wells in the county.

Two major wastewater treatment facilities serve Alexander County. The Schneider Mills Plant, handling primarily textile processing waste, discharges into the Muddy Fork Creek and has recently enlarged capacity and upgraded its facility. The other major facility, Taylorsville Wastewater Treatment Plant discharges into Third Creek which flows into Iredell and Rowan Counties and joins into the Yadkin River. All systems are in compliance.

WATER SUPPLY SOURCE AND CAPACITY

County: Alexander

NCDHR May, 1982
*Alexander Co. Sept. 1983

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type * Purchase	No. of Wells
Totals	22	15,223	2,817	1.038	2.000	.843		30
Association*	1							
Alexander Water Corp.		10,000	1,320	1.033	2.000	.500	S	
Municipal	1							
Taylorsville		3,000	858	-	-	.300	S*&G	3
Private and Other	20	2,223	639	.005	-	.043	G	27

ALEXANDER SYSTEMS BY RIVER BASIN

Yadkin Basin	2	13,000	2,178	1.033	2.000	.800	S&G	3
Catawba Basin	20	2,223	639	.005	-	.043	G	27

*Alexander Co. Water Corporation distributes water from its South Yadkin Water Treatment Plant to the town of Taylorsville and Highway 16 South Water District. There are 1,200 meters serving 4,800 persons. The corporation also supplies water to the West Iredell Water Co. which is included in the Iredell County chart. The corporation has applied for FmHA funding for an additional water distribution system, and for a water reservoir on the South Yadkin River to serve it purchasers.

WASTE WATER DISCHARGE NPDES

County: Alexander

Systems and Capacity
NCDNR May, 1983
*Alexander Co. Sept. 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	12	2	1.471*		1,200
Public Totals	4		.430		
Municipal Taylorsville WWTP	1		.400		
County-Public Schools	3		.030		
Private-Indus.	5	2			
Schneider Mills, Inc.		Maj.	.500		
*Hollyfarms-Hiddenite		Maj.	*.471		
3 Others			.037		
Private-Domestic	3		.003		

*Alexander County Administrator, L. Roger, informs that the Hollyfarms Hiddenite Waste Water Treatment Plant has been closed. The Design Flow Effluent Capacity is therefore 1.000 MGD.

X.

County Profile: Anson

Population: 25,159

100% of county population lives in Yadkin-Pee Dee River Basin

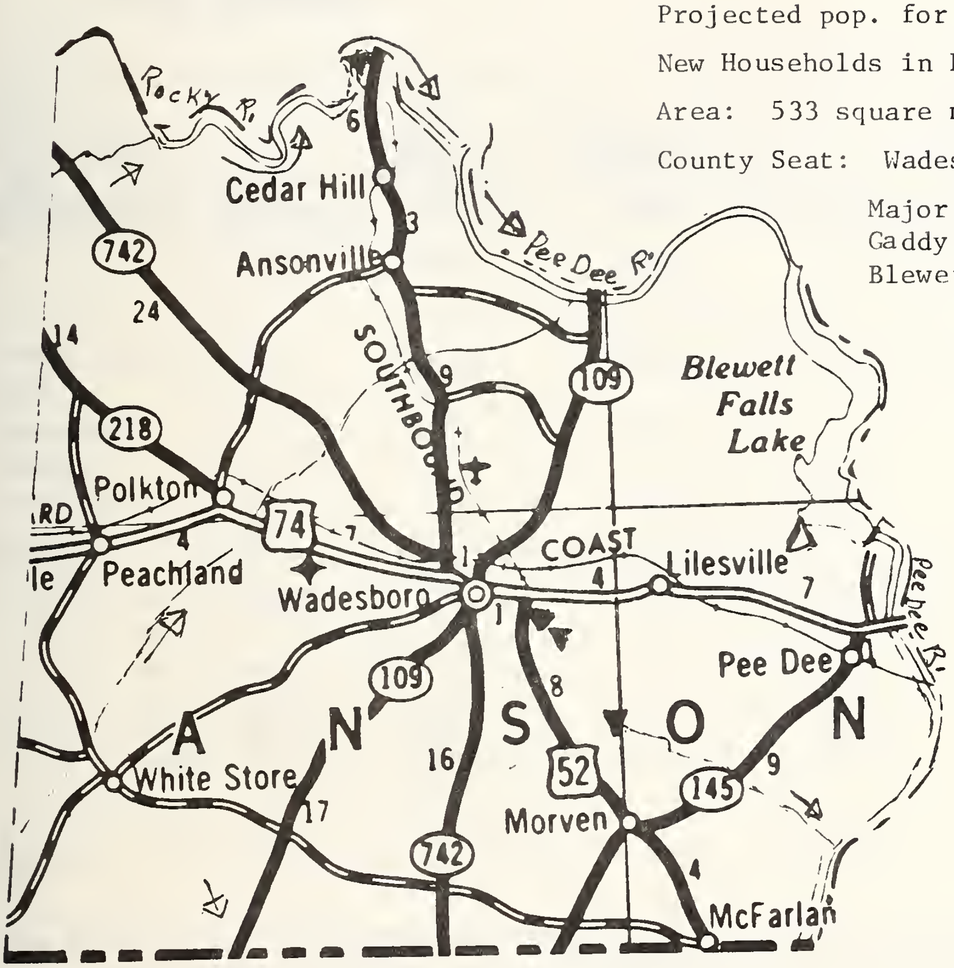
Projected pop. for year 2000: 27,527

New Households in Basin Projected: 1,922

Area: 533 square miles

County Seat: Wadesboro (4,086)

Major Recreational Areas:
Gaddy's Game Refuge, Lake Tillary, Blewett Falls Lake



A county of widely separated small towns, Anson County is a balance of farmland and forests, sandy savannas and piedmont. Three major creeks, Brown Creek, Savanna Creek, and Jones Creek, flow northeastward through the county into the Pee Dee River which along with Blewett Falls Lake forms the eastern boundary of Anson County. The county is bordered on the north by the Rocky River and the southern boundary is the South Carolina State line.

The major source of raw water for Anson County is Blewett Falls Lake on the Yadkin-Pee Dee River. Anson County Water System purchases approximately 4 MGD from Carolina Power and Light Company. The system serves a population of 26,582 which excludes water sales to Union and Richmond Counties. Supplementary water sources include three wells utilized by Lilesville and two wells in Polkton. Industrialized Wadesboro purchases only .38 MGD from the County Water System with the remaining usage, .293 MGD, being drawn from Jones Creek Reservoir. Private-Domestic groundwater sources serve only 97 people in Anson County.

Anson County Wastewater Treatment Plant discharges into the Pee Dee River and is the only major facility in the County.

WATER SUPPLY SOURCE AND CAPACITY

County: Anson *NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type Purchase *	No. of Wells
Totals	11	36,879N.B.	4,994	3.896	9.186	6.611	S&G	3
County	1							
Anson Co. Water System		28,000N.B.	992	3.167	8.000	5.000	S	
Association	1							
N. Anson Water Reserves		1,395	352	-	-	.100	S*	
Municipal-Towns	7							
Lilesville		980	382	.056	.071	.100	S*	
McFarlan		126	41	-	-	-	S*	
Morven		875	275	-	-	.110	S*	
Peachland		550	203	-	-	.100	S*	
Polktown		770	225	-	.115	.100	S*	
Wadesboro		4,086	2,500	.673	1.000	1.100	S&S	
Private-Domestic	2	97	24	-	-	.001	G	3

*This summary is from the Public Water Supply Data Sheet (WANG) of the Division of Health Services. Environmental Health Section-NCDHR ran on March 15, 1982. N.B. This total includes sales to Richmond and Union Counties. The Level B Study gave the existing capacity of the Anson County Water System as 12.00 MGD through contract with CP&L. Wadesboro uses water from Jones Creek Reservoir in addition to purchase.

Anson County Manager Sept., 1983

Totals	11	26,582	5,602	3.896	9.186	6.611	S&G	3

WASTE WATER DISCHARGE NPDES

County: Anson

Systems and Capacity
NCDNR
May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
County Totals	16	3	7.289	3	5602

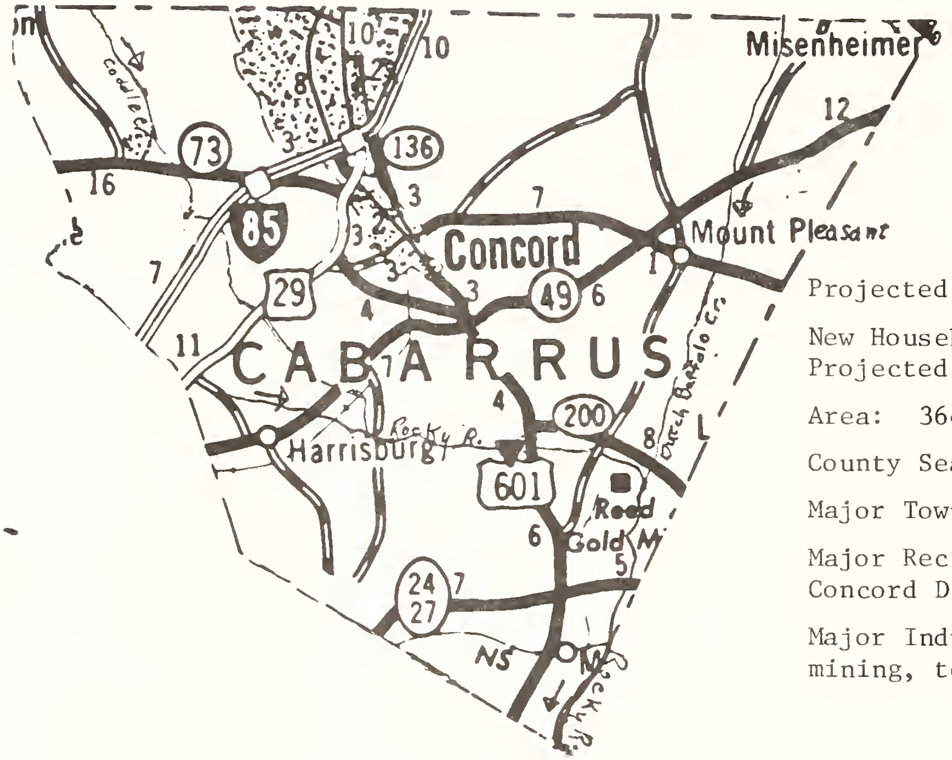
Anson County Manager
Sept., 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
County Totals	12	1	3.576	3	5602
Public					
Anson WWTP	1	1	3.500		
Wansona Pre-Treat.	1		(2.000)	Connection to Anson WWTP	
Other	10		.076	3	

County Profile: Cabarrus

Population: 86,125

100% of county population lives in Yadkin-Pee Dee River Basin



Projected pop. in Year 2000: 115,786

New Households in Basin Projected: 1,090

Area: 364 square miles

County Seat: Concord (16,942)

Major Towns: Kannapolis (34,564)

Major Recreational/Natural Areas: Concord Dike

Major Industry: Manufacturing, textile mining, tobacco processing

Rolling from its highest elevation, 800 feet, in the northwest corner to the Rocky River in the south, Cabarrus County's upland savannas are mildly dissected by several creeks. Although a predominantly rural area, Cabarrus County anticipates rapid population growth especially in the southwest sector where the urban center of Charlotte in Mecklenburg County has drawn commuters to industry, the university, and a major hospital. Interstate I-85 in the county is the only non-stop highway into Charlotte from the highly populated triad area in Piedmont North Carolina; this transportation provides the county with great possibilities for growth.

Cabarrus is one county where future water supplies are of more concern than current supplies. Concord, currently drawing water from Lake Fisher, Lake Concord, and Coddle Creek, plans to complete a reservoir on Coddle Creek by 1985. Mount Pleasant has set a potential impoundment on Dutch Buffalo Creek and increased purchases from Concord and Albemarle as high priorities to supplement their current supply, Dutch Buffalo Creek. Harrisburg draws on two groundwater sources with plans to add a new well of unknown capability. As suppliers to private needs, wells continue to be of some importance in the county; although this importance has dwindled. Kannapolis, centered around Cannon Mills textile industry in the northern part of Cabarrus County, draws from Cannon Lake on Irish Buffalo Creek and another intake on Coddle Creek.

County Profile: Cabarrus continued

Since Cabarrus County is predominantly drained by creeks, lacks a significant elevation decline, and has a watershed division near its western boundary, wastewater treatment has been a challenge to planners in this county. Currently, the only major wastewater treatment facility, in Cabarrus County, in Concord discharges into the Rocky River. Another larger facility, pending approval, is planned to discharge into Dutch Buffalo Creek in the far southeastern corner of the county near Midland just before the creek flows into the Rocky River. The Cannon Mills wastewater treatment facility, a minor plant, is currently complying with regulations.

WATER SUPPLY SOURCE AND CAPACITY

County: Cabarrus

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type* Purchase	No. of Wells
Totals	67	40,887	11,532	4.88	12.42	4.47MGD	S&G	97
Municipal	2	27,300	7,871	4.84	12.34	4.070	S	
Concord		26,000	7,500	4.50	12.00	4.000	S	
Mt. Pleasant		1,300	371	.34	.34	.075	S	
Sanitary Districts	3	3,100	887	.00	.00	.000	*S	
Associations and Other	3	976	463	.00	.00	.083	*S&G	7
Private	57	6,894	1,685	.04	.08	.210	*S&G	81
Yadkin Basin	65	38,270	10,906	4.88	12.42	4.37MGD	S&G	88
Catawba Basin	2	2,627	626	.00	.00	.100	P&G	9

The planning department of Cabarrus County informed us that the county is using 16.2 million gallons per day in their water systems. Should the population projections in Cabarrus exceed estimates, the new reservoir and treatment plant planned by the City of Concord on Coddle Creek to provide an estimated 14 MGD (including release requirements for low flow maintenance) may not be sufficient. Other impoundments are planned.

Cabarrus County has been financing countywide water and sewer lines. Total cost is estimated at $9,960,000 with $7,000,000 from FmHA local funding of $2,097,000, and a state Clean Water Bond grant of $863,000.

WASTE WATER DISCHARGE NPDES

County: Cabarrus

Systems and Capacity
NCDNR
May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	29	1	25.669	3	11,532
Public	10		24.207		
Municipal	3				
Concord-Rocky River WWTP		Maj.	24.000		
Mt. Pleasant WWTP			.144		
Mt. Pleasant WTP			N.S.	1	
State	1		.012		
County-Public Schools	6		.051		
Private-Industrial	9		1.082		
Cannon Mills #1			1.000		
Other & ?	8		.082	2	
Private & Dom.	10		.380		

Mecklenberg County was not included in this study. However, in Eastern Mecklenberg there were 13 NPDES permits cited in the February, 1983 point source maps which are located on creeks of the Rocky River and within the Yadkin-Pee Dee River Basin. Among these is the Mallard Creek WWTP which is a major type with a design flow capacity of 3.000 MGD.

County Profile: Caldwell

Population: 67,997

8.7% of county population lives in Yadkin-Pee Dee River Basin

Projected population for year 2000: 93,181

New Households in Basin Projected: 1,153

Area: 471 square miles

County Seat: Lenoir

Although Caldwell County is not usually included in Yadkin-Pee Dee River studies, the Yadkin River does flow through the northeast section of the county near NC Highway 268. This four-mile stretch of river is particularly fragile and considered a prime recreational attraction for white-water canoeists when the instream flow is adequate.

The major water resource for Caldwell County is the Rhodhiss Lake in the Catawba River Basin. This source, primarily serving Lenoir, is supplemented by 53 wells. One well is in the Yadkin Basin but serves only 26 people.

No major wastewater treatment facilities in the county are located in the Yadkin-Pee Dee River Basin, although six smaller facilities, all but one in compliance, discharge into the Yadkin River. Three major wastewater treatment facilities in the county discharge into the Catawba Basin.

WATER SUPPLY SOURCE AND CAPACITY

County: Caldwell

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type * Purchase	No. of Wells
Yadkin Basin	1	26	10	-	-	-	G	1
Catawba Basin*	37	38,611	11,336	4.70	N.S.	1.56	S&G	53

*Surface Source Catawba River

WASTE WATER DISCHARGE NPDES

County: Caldwell

Systems and Capacity
NCDNR May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	35	3	8.879	5	11,346
Yadkin Basin	6	0	.509	1	10
Industrial	2		.471		
County Schools	3		.033		
Dom.-Camp	1		.055		
Catawba Basin All NPDES Permits	29	3*	7.811	4	11,336

*Lenoir, Granits Falls, Hudson

County Profile: Davidson

Population: 113,162

100% of county population lives in Yadkin-Pee Dee River Basin

Projected pop. for year 2000: 150,533

New Households in Basin Projected: 19,117

Area: 548 square miles

County Seat: Lexington (17,205)

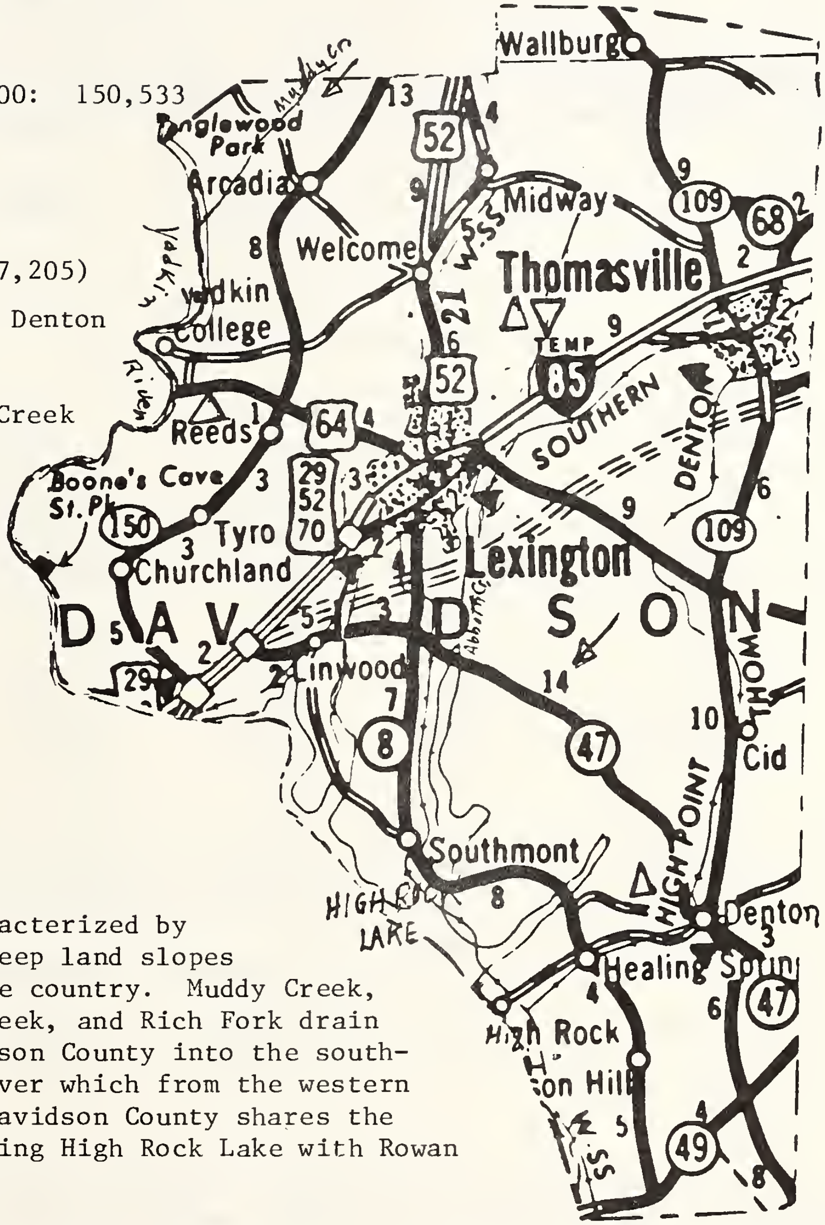
Major Towns: Thomasville, Denton

Major Recreational areas:

High Rock Lake, Beaverdam Creek Slate Beds, Boone's Cave State Park

Major Industry:

Manufacturing



Davidson County is characterized by rolling hills with some steep land slopes in the northern half of the country. Muddy Creek, Swearing Creek, Abbotts Creek, and Rich Fork drain southwesterly across Davidson County into the southeasterly flowing Yadkin River which from the western boundary of the county. Davidson County shares the responsibility of eutrophying High Rock Lake with Rowan County.

The Yadkin River provides most of the water for Davidson County. Davidson Water, Incorporated distributes this water to 55,000 users including some users in the southern part of Forsyth County. Lexington takes a small portion of its water from Old City Lake on Leonard's Creek; but Lake Thom-A-Lex on Abbotts Creek provides the majority of water for Lexington as well as all of Thomasville's water. The Handy Sanitary District and the Town of Denton use the Yadkin River as a water source and plan to expand their filter plant to accomodate their growing industrial needs. High Rock Lake supports a hydroelectric plant. Approximately five hundred people rely upon seven dependable wells for their water in rural Davidson County. Davidson Water, Incorporated supplies Archdale in the Cape Fear Basin.

Wastewater treatment in Davidson County is provided by four major facilities. Three of these discharge into Abbotts Creek. One Lexington plant discharges into Swearing Creek. Both Swearing Creek and Abbotts Creek flow into the sensitive High Rock Lake. Although a smaller facility, the Denton wastewater treatment plant discharges into a branch of Lich Creek which flows into the fragile Uwharrie Creek. Davidson County creeks support many small wastewater treatment facilities. Twenty-five of these smaller plants are industrial and comply with their permitting.

WATER SUPPLY SOURCE AND CAPACITY

County: Davidson

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type* Purchase	No. of Wells
Totals*	11	110,953	35,684	13.495	22.047	11.51 MG	S&G	8
Municipal	3							
Lexington		32,010	8,000	5.00	9.00	5.00	S	
Thomasville		15,000	6,500	3.50	6.00	1.50	S	
Denton		6,000	2,200	.45	1.00	.50	S	
Association	1							
Davidson Water, Inc.		55,000	18,240	4.50	6.00	4.50	S	
Sanitary Dist.	1							
Denton		2,400	600	-	-	-	*G	1
Private Systems	6	543	144	.045	.047	.011	G	7

*Yadkin River Basin Only Source

The design capacity estimated for Davidson County in the Level B Study for the Year 2000 was 22.5 MGD. Plans for additional sources should be addressed before this date.

WASTE WATER DISCHARGE NPDES

County: Davidson

Systems and Capacity
NCDNR May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	72	5	15.701	5	35,684
Public Total	23	5	14.258		
Municipal					
High Point West WWTP		Maj.	4.000		
Thomasville WWTP		Maj.	4.000		
Lexington- Abbotts Cr. WWTP		Maj.	2.630		
Lexington- Swearing Cr. WWTP		Maj.	2.500		
Lexington #1 & 2 WWTP			.247		
Denton WWTP		Maj.	.750		
County Schools	17		.131	*	
Private Ind.	27		1.433	4	
Private Dom.	22		.139	1	

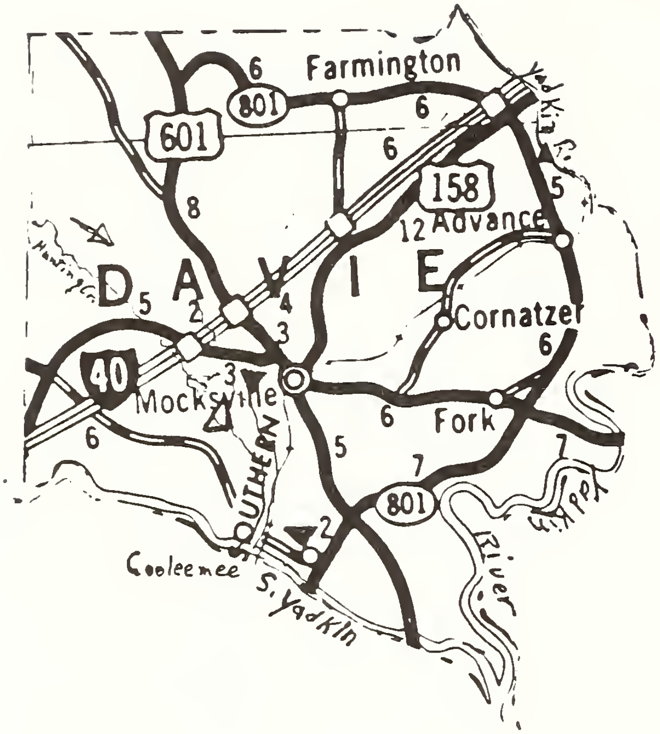
*On September 30, 1982, 11 Davidson County School NPDES were not in compliance, these schools have made corrections and were issued new permits in 1983.

Davidson municipal systems have indicated planned relocation of NPDES sites.

County Profile: Davie

Population: 24,760

100% of county population lives in Yadkin-Pee Dee River Basin



Projected pop. for year 2000: 41,986

New Households in Basin Projected: 6,959

Area: 267 square miles

County Seat: Mocksville

Major Recreational Areas: Yadkin River

The piedmont county, Davie, is a rural farming area. The Yadkin River flows southerly along the county's eastern boundary. The South Yadkin River flows southeasterly along Davie County's southern boundary to join the Yadkin River in a fork which forms the Davie County southeastern corner boundaries. Recent development in the northeastern part of the county, specifically the Bermuda Run development has drawn Davie County into some planning cooperation with Forsyth County.

While streams in Davie County are relatively low-flow, they are ample to supply Mocksville with water from Hunting Creek and Bear Creek.

Two major wastewater treatment facilities serve Davie County. The largest is located just north of Mocksville and discharges into an unnamed branch of Elisha Creek.

The northern rural farming area is still too sparsely settled to support a sewage collection system but early planning for future developments is needed to protect downstream sources of water treatment plants.

WATER SUPPLY SOURCE AND CAPACITY

County: Davie

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type Purchase*	No. of Wells
Totals*	5	14,808	5,310	1.69	6.36	4.42MG	S&G	3
County-Municipal	1							
Cooleemee		10,500	3,400	1.20	4.00	2.70MG	S	
Municipal	1							
Mocksville		4,000	1,800	.46	2.00	1.715MG	S	
Private or Other	3	308	110	.826	.036	000.300	G	3

*Yadkin River Basin Only Source

WASTE WATER DISCHARGE NPDES

County: Davie

NCDNR May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	23	2	4.539	1	5310
Public Totals			3.872		
Municipal					
Cooleemee WWTP		Maj.	3.000		
Mocksville-Dutchman Cr. WWTP			.320		
Mocksville-East WWTP			.125		
Mocksville-West WWTP		Maj.	.100		
Mocksville-Bears Co. WWTP			.192		
Sanitary Dist.					
Bermuda WWTP	2		.400		
State	2		.035		
County-Public Schools	5		.059		
Industrial	3		.661	1	
Domestic	6		.006		

County Profile: Forsyth

94.4% of county population lives in Yadkin-Pee Dee River Basin

Population: 243,683

Projected population for year 2000: 283,797

New Households in Basin Projected: 37,873

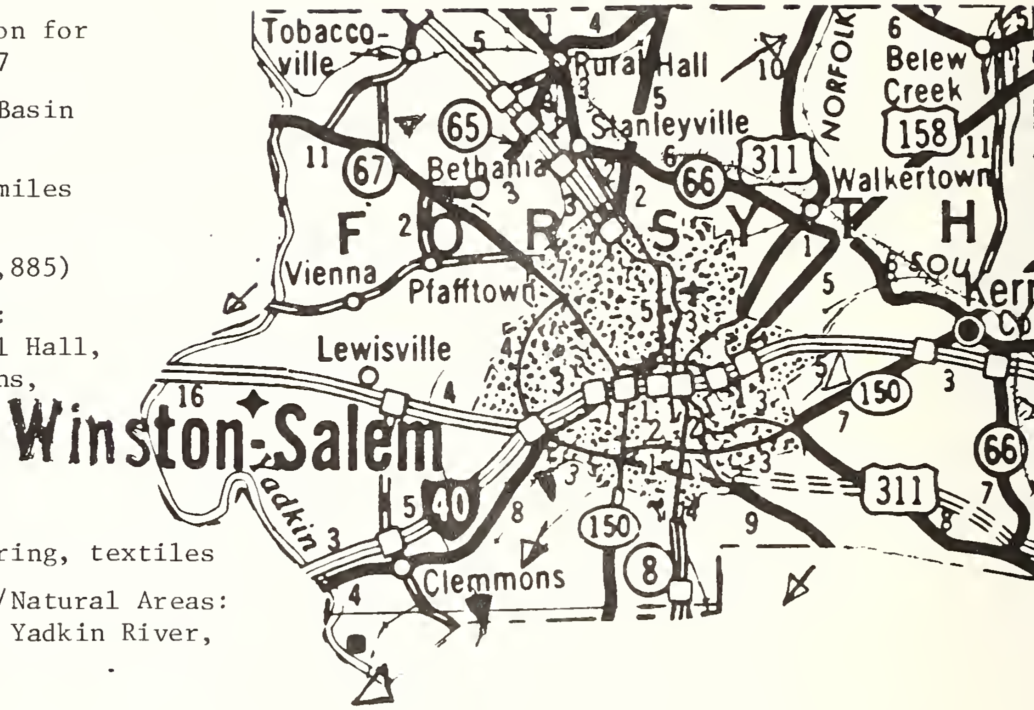
Area: 424 square miles

County Seat: Winston-Salem (131,885)

Major Towns/Cities: Kernersville, Rural Hall, Lewisville, Clemmons, Tobaccoville, Walkertown, Stanleyville

Major Industries: tobacco, manufacturing, textiles

Major Recreational/Natural Areas: Tanglewood Park on Yadkin River, Winston Lake



The gently rolling, piedmont Forsyth County is bordered on the west by the southern flowing Yadkin River. Most of the county is drained by two major creeks: Abbotts Creek and Muddy Creek flowing southwesterly across the county into the Yadkin River. Three drainage patterns exist in Forsyth County. A very small fraction in the southeastern corner drains eastward into the Cape Fear River Basin. The northeastern corner of the county just northeast of Rural Hall, Stanleyville, Walkertown, and Kernersville drains northerly into the Dan-Roanoke River Basin. But, 72.4% of the county' drainage is southward into the Yadkin River. Highly populated Forsyth County and its urbanized Winston-Salem utilize the Yadkin-Pee Dee River Basin's water resources more than any other area.

An ample supply of consistently high-quality water is essential to meet the demands of future population increases in Forsyth County, to attract new industry, and to serve commercial and institutional establishments. Forsyth County is considered to be a water-rich community with ample supplies of raw water even during drought conditions. The county's population is currently served by three municipal systems, three community systems, numerous private systems, and several individual wells. The majority of Forsyth County's population receives its water from the City-County Water System which has two sources of raw water. Salem Lake in eastern Winston-Salem has been the principal source; this water is treated by the Thomas Water Treatment Plant located two miles downhill of the lake near the intersection of Reynold's Park Road and Stadium Drive. The Yadkin River serves as the second principal source. Water is drawn from the Yadkin at the Idols Hydroelectric impoundment and pumped to the R.W. Neilson Water Treatment Plant at the intersection of Frye Bridge Road and Cooper Road in southwestern Forsyth County. This water system will also serve a new R.J. Reynold's Manufacturing Plant being constructed at Tobaccoville. The town of Kernersville currently drawing water from Belews Creek Reservoir and Kerner Creek has started construction on a pipeline into the City-County Water System and plans to be fully on-line in early 1984.

Two smaller water systems in the county do not plan to connect to the City-County Water System: Rural Hall and Walkertown Sanitary District serving Salem Chapel, Belews Creek, and Middle Fork in northeast Forsyth County draw their water from wells and pump it untreated to customers. Walkertown Sanitary District has a back-up connection to the City-County System for emergency purposes.

Two water systems not in the county also supply water to Forsyth County. Northwest Forsyth County is served in part by the King District water system in Stokes County. The King system draws from the Yadkin River and treats it at the King Water Plant located in northwest Forsyth County. A very small portion of southern Forsyth County is served by Davidson Water, Incorporated system drawing on the Yadkin River.

One major wastewater treatment facility currently serves greater Forsyth County. The Archie Elledge Treatment Plant in western Winston-Salem discharges into Salem Creek. A new wastewater treatment facility is currently under construction in southern Forsyth County at the confluence of Muddy and South Fork Creeks flowing into the Yadkin River.

Two special purpose wastewater treatment facilities are operated by the City-County System in Forsyth County. Treating waste from the Gravely Tractor Company, one system discharges into Johnson Creek just south of Clemmons and just upstream from the Yadkin River water source of the City-County Water System. The Bethania Plant treats domestic waste from the Westinghouse Turbine Plant and discharges into Beaver Dam Creek, a tributary to Muddy Creek, just above U.S. Highway 52.

Kernersville operated three wastewater treatment facilities. One discharged into the Cape Fear Basin. Two discharged into the Yadkin-Pee Dee Basin. Consolidation of the Kernersville system with the City-County System has been completed in 1983. A very small treatment plant in Rural Hall discharges into Grassy Creek some four miles upstream from the confluence of Grassy and Mill Creeks and plans to connect to the City-County System in the near future. Four smaller industrial wastewater treatment facilities also operate in Forsyth County and are all in compliance: R.J. Reynolds, R.J. Reynolds Whitaker, Schlitz, and R.J. Archer.

WATER SUPPLY SOURCE AND CAPACITY

As shown in the table of community water systems, Rural Hall and Walkertown Sanitary Districts rely on groundwater for their water supplies, currently withdrawing a combined 0.27 MGD. This amount is expected to double by the year 2000. Also shown in the table, some 57 private suppliers withdraw approximately 0.70 MGD from the groundwater supply.

County: Forsyth

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type* Purchase	No. of Wells
Totals	61	204,136	67,754	39.98	55.32	23.05	S&G	102
Municipal:	3	193,850	64,615	39.15	53.79	22.50	S&G	3
W-S		185,000	62,000	38.00[o]	52.00[o]	21.60	S	
Kernersville		7,200	2,000	1.00	1.50	.90	S*	
Rural Hall		1,650	615	.15	.29	.0?	G	3
Sanitary Dist.	1	1,650	550	.12	.20	.10	G	4
Private	57	8,636	2,587	.70	1.33	.45	G	95

*Purchases some from W-S

While all of the community systems listed are in Forsyth County, some systems are not in the Yadkin Basin. The breakdown by basin is shown below. The great majority of the water resources of the county are associated with the Yadkin Basin.

Systems by River Basin

Yadkin Basin	47	201,676	67,017	39.75	54.94	22.89	S*G	74
Roanoke Basin	14	2,460	735	.23	.38	.16	G	28

The community systems supply water to roughly 84% of Forsyth County. The remaining citizens are served by the 82 public non-community systems, which reportedly serve 14,099 in the county, or by individual wells.

[o]T. W. Griffin, Winston-Salem Utility Superintendent, remarks that the Winston-Salem design production is actually 51 MGD and average production 32 MGD. Additionally, that in the design flow effluent capacity at Archie Elledge is 30 MGD.

WASTE WATER DISCHARGE NPDES

County: Forsyth

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Systems and Capacity NCDNR May, 1983 Estimated Number of Connections
Totals	161	1	42.022	16	67,754
Public	25		36.990	4	
Municipal					
W-S Archie-Elledge WWTP		Maj.	36.000°		
W-S Other	2		.033		
Kernersville WWTP	2		.540		*No longer in operation
Rural Hall WWTP			.200		
County-Forsyth	3		.080		
Public Schools	15		.137		
Federal USAR			N.S		
Industrial	20	minor	3.906	2	
R.J. Reynolds			1.568		
R.J. Whitaker			.846		
Schlitz			.500		
R.J. Archer			.432		
Other	16		.560		
Domestic	116		1.126	10	

*Since July, 1981 Rural Hall has received State and EPA funding to improve their waste treatment system; Kernersville received funding to incorporate its sewage collection system into the Archie Elledge Treatment Plant, and the Winston-Salem City-County System has received most of the funding requested from EPA and the State Clean Water Bond funds. In addition, the City-County Utilities Commission approved the issuance of bonds by R.J. Reynolds to provide additional services for the Tobaccoville Plant.

XVI.

County Profile: Iredell

100% of county population lives in Yadkin-Pee Dee River Basin

Population: 82,786

Projected pop. for year 2000: 102,832

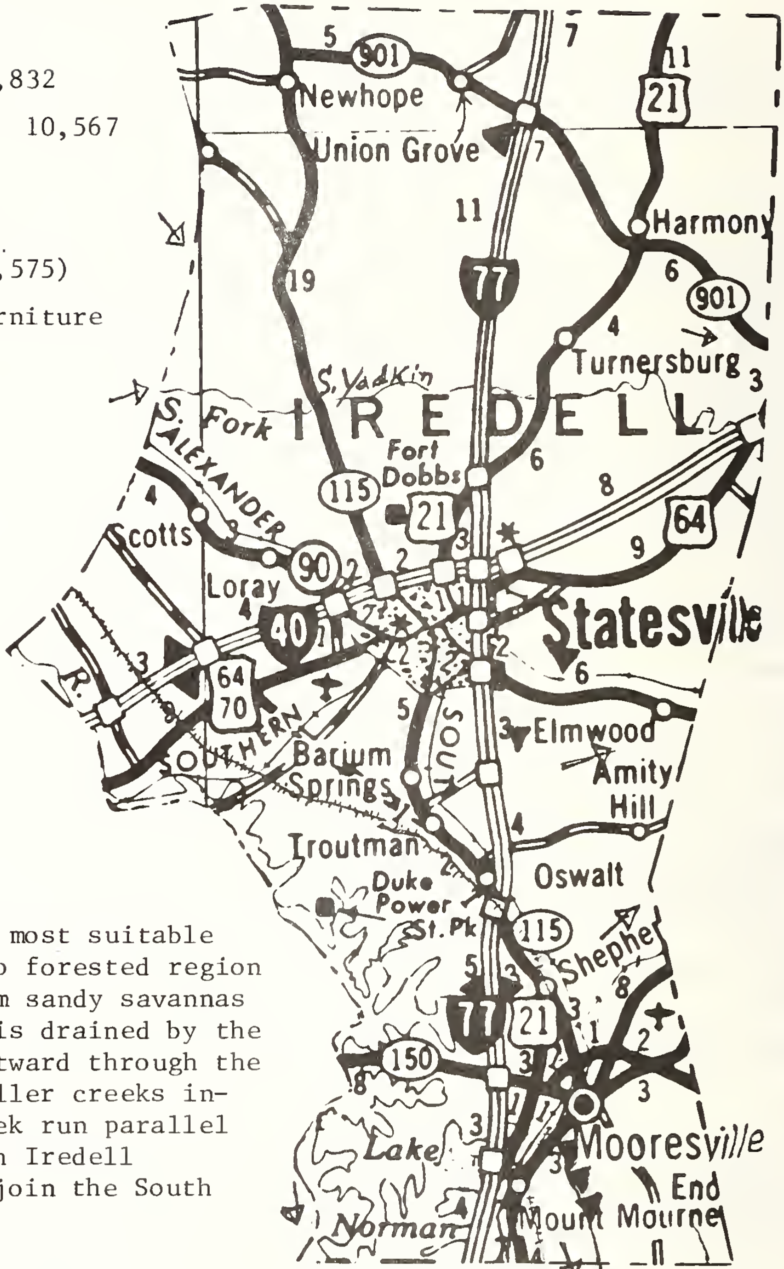
New Households in Basin Projected: 10,567

Area: 691 square miles

County Seat: Statesville (18,622)

Major Communities: Mooresville (8,575)

Major Industries: Textiles and Furniture



Iredell County has fertile soil most suitable for farming, although there is also forested region in the county. The soils vary from sandy savannas to red clay piedmont. The county is drained by the South Yadkin River which flows eastward through the center of the county. Several smaller creeks including Third Creek and Fourth Creek run parallel with the South Yadkin River through Iredell county to Rowan County where they join the South Yadkin River.

The major water resource in Iredell is the South Yadkin River. Statesville and Mooresville are the prime users of this source. Twelve dug or bored wells serve the remaining municipal water users. Complicated drought periods in the county have historically produced erratic ground water levels and unstable well production.

Wastewater treatment in the county is performed by five major facilities which discharge into tributaries to the Yadkin River. Currently, most facilities are in compliance with their permits.

The west Iredell Water Co. is supplied from the water treatment plant of the Alexander County Water Corporation on the South Yadkin River. For some years, they have been seeking funding for a raw water reservoir on the river.

WATER SUPPLY SOURCE AND CAPACITY

County: Iredell

May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type Purchase*	No. of Wells
Totals	53	58,885	14,857	8.486	18.999	8.174	S&G	77
Municipal	5							
Statesville		25,000	7,500	5.500	8.700	4.800	S&G	4
Troutman		1,322	600	.130	.263	.300	S*	
Love Valley		100	25	-	-	.002	G	1
Mooresville		9,000	3,500	2.300	10.000	1.500	S	
Stony Point		1,500	400	-	-	.600	S*	
Sanitary Dis.	2							
Iredell #1 Harmony		12,000	300	.102	-	.2	G	2
Iredell #2 Cool Spring		5,600	1,400	.438	-	.700	G	5
Private and Other	46	4,363	1,132	.016	.036	.072	G	65

IREDELL SYSTEMS BY RIVER BASIN

Yadkin Basin	9	44,344	9,916	6.170	8.963	6.007	S&G	16
Catawba Basin	44	14,541	4,941	2.316	10.039	2.167	S&G	61

WASTE WATER DISCHARGE NPDES

County: Iredell

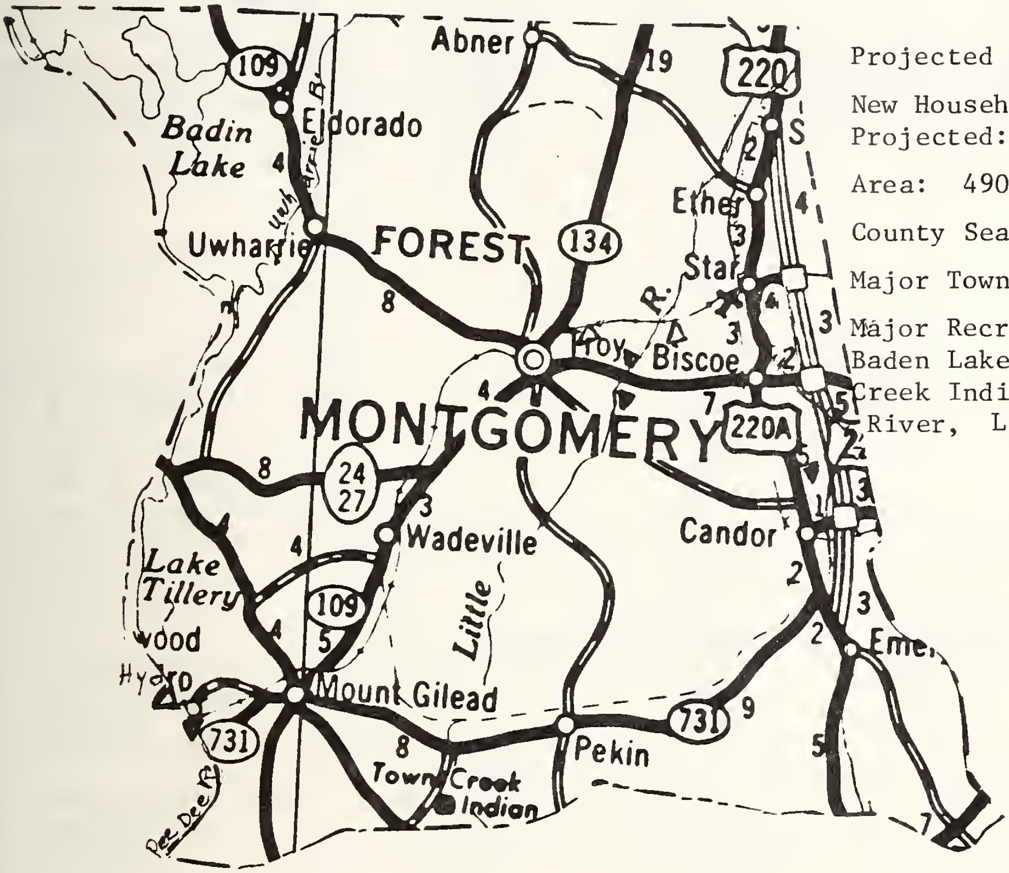
Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
				Systems and Capacity NCDNR May, 1983	
Totals	38	5	20.453	2	14,857
Yadkin Basin Tot.	34	5	20.197	2	14,207
Municipal	6		18.161		
Statesville WWTP			.225		
Statesville 3rd Creek WWTP		Maj.	4.000		
Statesville New 4th Creek WWTP		Maj.	4.000		
Mooresville Ind. WWTP		Maj.	4.000		
Mooresville Domestic WWTP		Maj.	1.750		
Mooresville Rocky River WWTP		Maj.	4.000		
County-Public Schools	10		.107		
State	5		.079		
Industrial	9		1.987	2	
Domestic	4		.049		
Catawba Basin Totals	4	0	.256		650
Public/ Municipal	1				
Troutman WWTP			.220		
Other	3		.036		

XVII.

County Profile: Montgomery

78.4% of county population lives in Yadkin-Pee Dee River Basin

Population: 22,527



Projected pop. in year 2000: 23,527

New Households in Basin Projected: 3,230

Area: 490 square miles

County Seat: Troy

Major Towns: Wadeville

Major Recreational/Natural Areas: Baden Lake, Lake Tillary, Town Creek Indian Reservation, Uwharrie River, Little River

Almost totally embodied in Uwharrie National Forest, Montgomery County provides a wealth of natural wild and scenic areas. The Yadkin-Pee Dee River flows southerly along the western boundary of Montgomery County and through Lake Tillary and Baden Lake. The fragile Uwharrie River cuts across the northwestern corner of the county flowing southwesterly into the Yadkin-Pee Dee River. Several creeks meander across the county on their way to the Yadkin-Pee Dee and Blewett Falls Lake. A ridge area which runs near U.S. Highway 220 divides the county into two watersheds; the upper eastern side of this divide drains into the Deep River Watershed of the Cape Fear System, the lower eastern side drains into the Lumber-River Basin of the Greater Pee-Dee System.

The Montgomery County Water System drawing from Lake Tillary, Denson Creek, and Drowning Creek supplies nearly all of the county's water and most of Richmond County's supply as well. Mount Gilliad and Biscoe supplement their water consumption by drawing on the Little River. On the ridge between watersheds, the town of Star draws on two wells for its water but plans to become a part of the Montgomery system in the future. Star currently supplements its water needs from the Montgomery system.

No major wastewater treatment facilities serve Montgomery County; however, several smaller municipal plants discharging into the Yadkin-Pee Dee River and Little River exist. The Star wastewater treatment facility discharges into the Cape Fear watershed.

WATER SUPPLY SOURCE AND CAPACITY

County: Montgomery

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type * Purchase	No. of Wells
Totals	1	8,834	2,705	2.515	3.422	2.419	S&G	17
County-Municipal	1							
Montgomery		2,500	400	2.367	2.750	1.250	S(3)	
Municipal	3							
Biscoe		1,830	612	-	-	.075	*S(3)	
Mt. Gilead		1,500	618	-	-	.400	*S(3)	
Star		1,000	420	.148	.072	.350	*S(3)&G	2
Private and Others	9	1,223	314	-	-	.344	S&G	15
Town-Candor	1	781	341	-	.300	.175	S	

MONTGOMERY SYSTEMS BY RIVER BASIN

Yadkin Basin	1	7,272	2,364				S&G	17
Lumber Basin	1	781	341	-	.300	.175	S	0

WASTE WATER DISCHARGE NPDES

County: Montgomery

					Systems and Capacity NCDNR May, 1983
Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	16	0	2.774	1	2,705
Yadkin Basin Totals	14	0	2.554		2,364
Public	7		2.514		
Municipal					
Biscoe WTP			.087		
Biscoe WWTP			.600		
Mt. Gilead WTP			.012		
Mt. Gilead WWTP			.850		
Star WWTP			.050		
Troy WTP			.050		
Troy WWTP			.840		
County Schools	4		.025		
Private Indus.	3		.040	1	
Lumber River Basin Municipal-Candor	2	0	.220		341

County Profile: Randolph

Population: 92,271

36.6% of county population lives in Yadkin-Pee Dee River Basin

Projected population in Basin for year 2000: 46,239

Projected population in County for year 2000: 136,337

New Households in Basin: 6,151

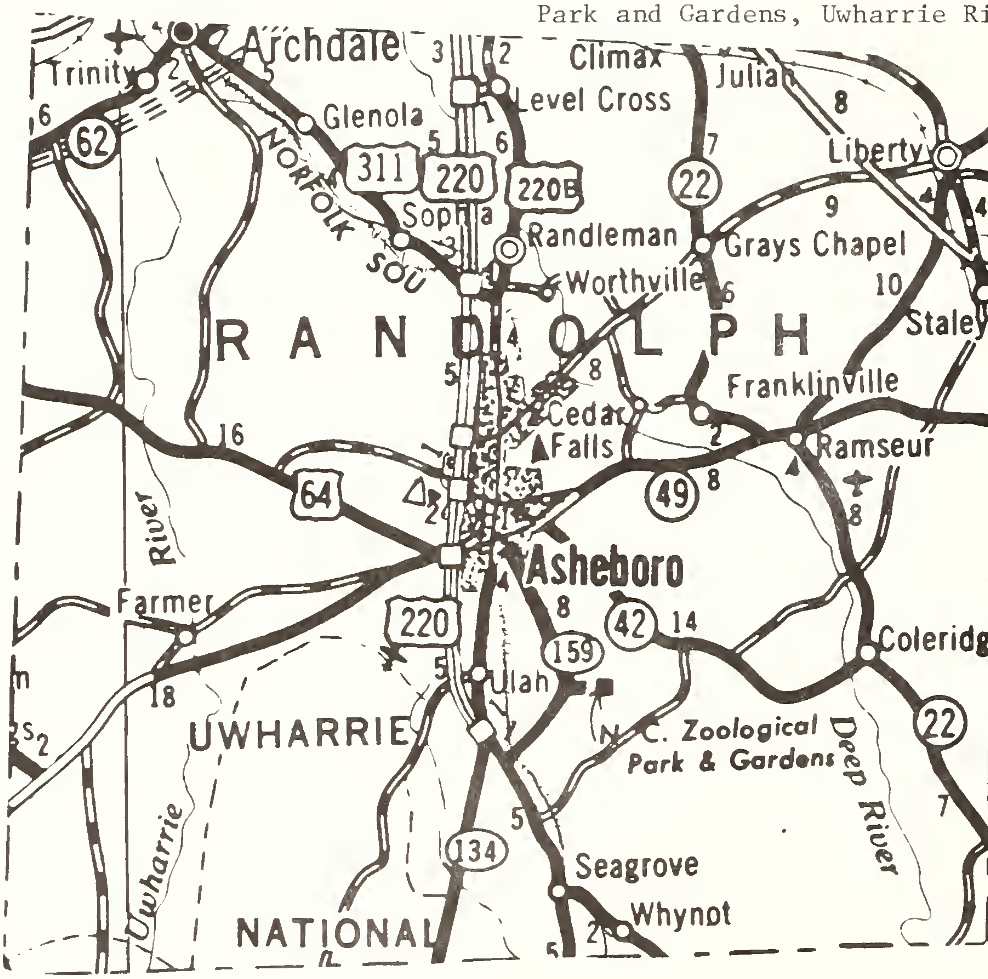
Area:

County Seat: Asheboro

Major Towns: Liberty, Ramseur, Archdale

Major Industry: textiles, agriculture

Major Recreational/Natural Areas: Uwharrie National Forest, North Carolina Zoological Park and Gardens, Uwharrie River



Randolph County lies in a transitional area between soils and river basins. The lower southwest protion between the Uwharrie River and U.S. Highway 220 lies in the Uwharrie National Forest. The North Carolina Zoological Park and Gardens is situated just southwest of Asheboro on the Deep River in Randolph County. The county lies in two major river basins. The northeast corner of the county is drained by the Haw River flowing into the Deep River and ultimately the Cape Fear River Basin. The western protion of Randolph is drained by the Little and Uwharrie River in the Yadkin-Pee Dee River Basin.

The city of Asheboro, lying on the ridge between the two watersheds, obtains its water supply from the Uwharrie tributaries, including Back Creek and tributaries impounded in four lakes. Constructing a new reservoir and pump station on the Uwharrie River as well as increasing the size of the water treatment plant are high priorities for Asheboro. Funding has been granted for a raw water reservoir on Caraway Creek extending between North Carolina State Highway 49 and U.S. Highway 64. Archdale purchases all of its water from Davidson Water, Incorporated in Davidson County.

Three major wastewater treatment facilities serve Randolph County. The largest, in Asheboro, discharges into the Deep River system of the Cape Fear Basin. The other two major systems are in the Cape Fear Basin which is also their water supply source. Asheboro received an EPA grant in September, 1982 to be used to complete and enlarge the city wastewater treatment plant.

WATER SUPPLY SOURCE AND CAPACITY

County: Randolph

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type* Purchase	No. of Wells
Totals	57	41,095	12,882	5.90	10.26	8.65	S&G	88
Municipal	5							
Asheboro		20,000	6,800	3.50	6.00	6.06	S	
Franklinville		836	209	-	-	.30	*S	
Liberty		2,500	930	.37	.44	.78	G	8
Ramseur		3,200	815	.35	.75	.13	S	
Randleman		2,700	1,000	.67	1.50	.63	S	
Associations	1							
Archdale (Davidson)		6,000	1,665	.28	-	.50	*S	
Private	51	5,859	1,463	.44	1.56	.26	G	80

RANDOLPH SYSTEMS BY RIVER BASIN

Yadkin Basin	17	27,856	8,934	3.88	6.35	6.65	S&G	23
Deep Capefear Basin	4	13,239	3,948	1.74	3.91	2.51	S&G	65

WASTE WATER DISCHARGE NPDES

County: Randolph

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
				Systems and Capacity NCDNR May, 1983	
Total Yadkin Basin	16	0	.548	1	160
Public Tot.	9		.239		
Municipal	1				
Asheboro WTP			.150		
County Schools	8		.089		
Private-Ind.	3		.011	1	
Private-Dom.	4		.059		
Total Deep R.	32	3	6.538	2	11,057
Public Tot.	13	3	5.322		
Municipal					
Asheboro WWTP	5	Maj.	4.000		
Ramseur WWTP		Maj.	.300		
Liberty WWTP		Maj.	.400		
Other			.500		
County Schools	8		.072		
Private Ind.	10				
J.P. Stevens Randleman			1.028		
Other	9		.058	2	
Private-Dom.	9		.130		

SUMMARY OF WASTE WATER DISCHARGE BY BASIN IN RANDOLPH CO.

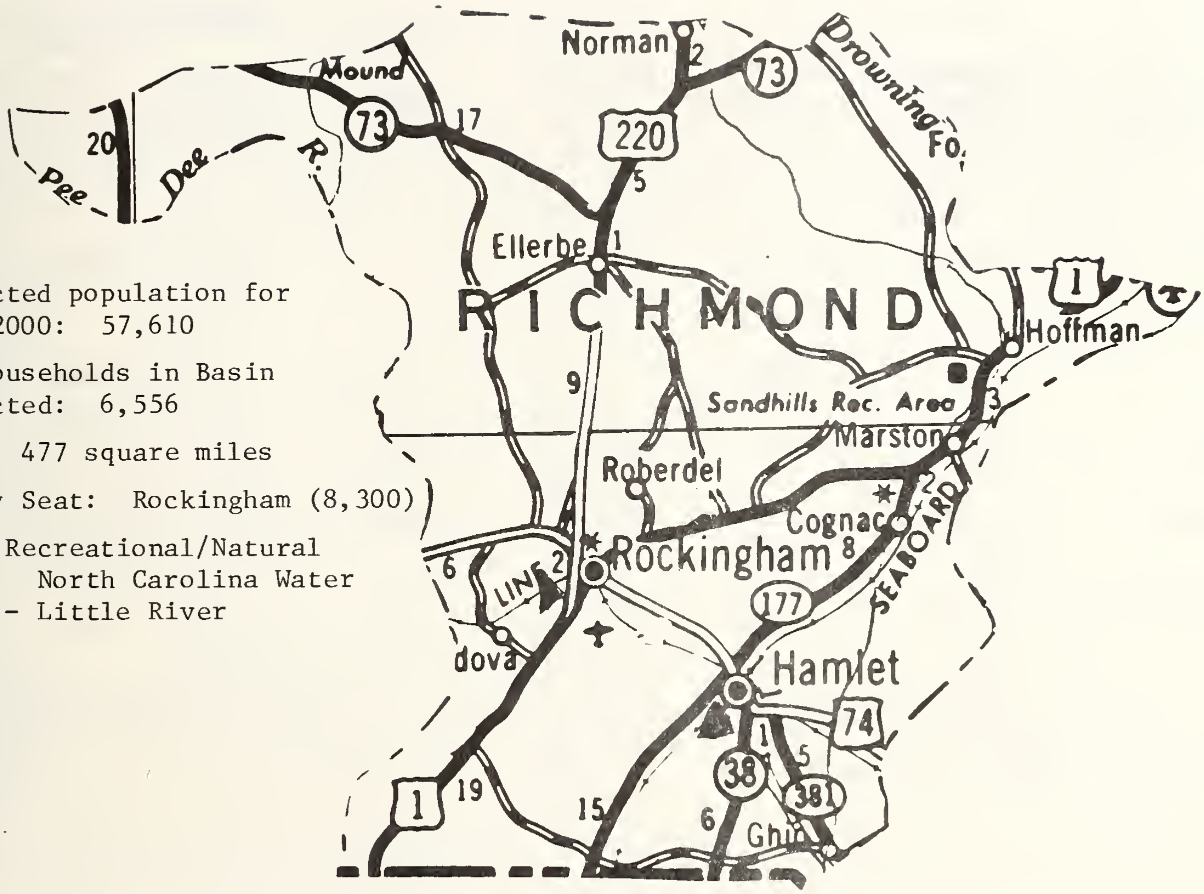
Randolph Co. Totals	48	3	7.086	3	11,217
Yadkin Basin	16	0	.548		160
Deep-Capefear Basin	32	3	6.538		11,057

Archdale, in the Cape Fear Basin, has no water treatment plant and uses septic tanks. It receives its water supply from Davidson Water, Inc. There is no easy solution, but construction is now in progress with the proposed permit to a creek of the Deep River near the proposed Randleman dam area.

County Profile: Richmond

100% of county population lives in Yadkin-Pee Dee River Basin

Population: 45,599



Projected population for year 2000: 57,610

New Households in Basin Projected: 6,556

Area: 477 square miles

County Seat: Rockingham (8,300)

Major Recreational/Natural Areas: North Carolina Water Trail - Little River

The Yadkin-Pee Dee River drains Richmond County as it flows southward at an average annual flow of 5100 million gallons a day and serving as the western boundary of the county. Big Mountain Creek, Rocky Fork Creek, and Little Mountain Creek flow southwesterly across Richmond County into the Yadkin-Pee Dee River just below Blewett Falls Lake. Richmond is a relatively flat, transitional soil area sutiable for some agriculture.

Water is supplied to Richmond County from Montgomery County's copious Lake Tillary and Badin Lake.

Wastewater treatment is handled by two major municipal facilities. The larges, in Rockingham, discharges into Rocky Fork Creek. A smaller major facility in Hamlet discharges into Mark's Creek. A Burlington Industries industrial wastewater treatment facility is also located in Richmond County and is currently in compliance with regulations.

WATER SUPPLY SOURCE AND CAPACITY

County: Richmond

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type * Purchase	No. of Wells
Totals	7	24,269	6,431	3.408	5.630	4.011	S&G	5
County Association	1							
Richmond		8,675	1,850	-	-	2.000	S*(2)	
Private Assoc.	1							
Roberdell Mutual		336	84	-	.029	.056	S*&G	1
Municipal	3							
Rockingham		8,500		2.112	2.500	1.175	S	
Hamlet & E. Rockingham		5,090	4,000	1.296	3.000	.750	S	
Ellerbe		1,220	460	-	-	-	S*	
State-Training School	1	350	25	-	.101	.030	G	3
Private-Domestic	1	98	12	-	-	-	G	1

All sources Yadkin River Basin

WASTE WATER DISCHARGE NPDES

County: Richmond

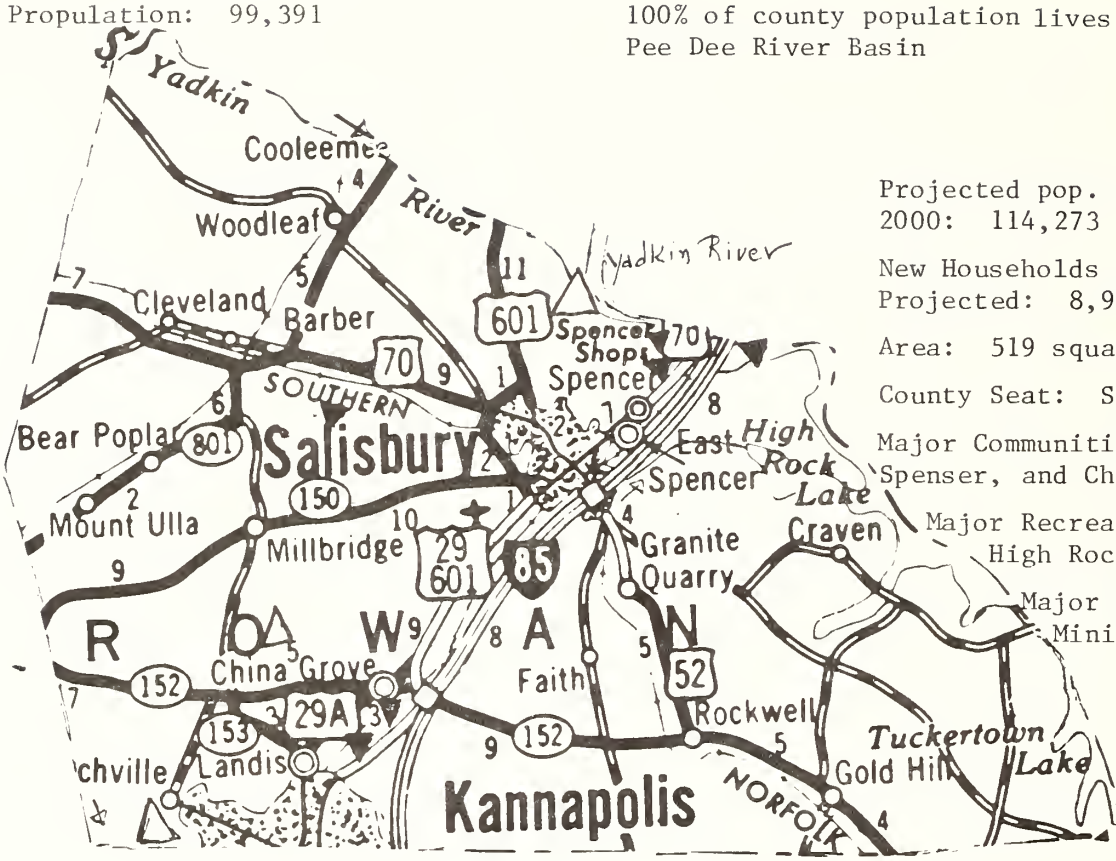
Systems and Capacity
NCDNR May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	17	3	9.132	2	6,431
Public Tot.	9	2	7.992		
Municipal	6				
Ellerbe WWTP			.180		
Hamlet Ind. WWTP		Maj.	1.000		
Hamlet WWTP			.660		
Hamlet WTP			.015		
Rockingham WWTP		Maj.	6.000		
Rockingham WTP			.057		
County-Richmond	1		.018		
State Schools	2		.062		
Industrial	7	1	1.120		
Burlington Ind. Richmond		Maj.	.884		
6 Other			.216	2	
Domestic	1		.020		

County Profile: Rowan

Propulation: 99,391

100% of county population lives in Yadkin-Pee Dee River Basin



Projected pop. for year 2000: 114,273

New Households in Basin Projected: 8,907

Area: 519 square miles

County Seat: Salisbury (22,677)

Major Communities: Kannapolis, Spenser, and China Grove

Major Recreational Areas: High Rock Lake

Major Industries: Mining, Textiles

In the heart of the piedmont, mineral rich Rowan County is where the Yadkin River begins to take a major form. All waters in the county, including Second Creek, Grants Creek, Cooleemee River, and Town Creek, drain into the Yadkin River which flows south-wasterly along the northern boundary of the county to join High Rock Lake and form the eastern boundar of the county. As a popular recreational area and major reservoir, High Rock Lake is rich in water resources but is in a state of eutrophication and under special attention by regulating agencies.

All water sources in Rowan County are within the Yadkin-Pee Dee River Basin. Ninty-two wells supplement surface water sources to serve the entire population.

Seven major wastewater treatment facilities are located in Rowan County. All discharge into tributaries of the Yadkin River before it flows into High Rock Lake. It is important to note that four major plants accounting for nearly one-third of the major wastewater discharge in the county are owned and operated by industry. Two major wastewater treatment facilities are in Salisbury and account for the majority of the county's discharge. Both Salisbury facilities are in compliance discharging into Grants Creek and Towns Creek.

WATER SUPPLY SOURCE AND CAPACITY

County: Rowan

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type Purchase*	No. of Wells
Totals	62	92,108	26,477	18.97	34.77	10.67	S&G	92
Sanitary Dist.-Cannon Mills and Kannapolis	2	40,500	13,029	8.00	15.5	5.0	S*	
Municipal (Sub-Tot.)	10	44,960	12,031	10.97	18.00		S&G	
Salisbury		30,000	8,571	9.50	18.00	3.75	S	
China Grove		2,880	720	-	-	.075	G	6
Cleveland		800	200	-	-	.075	G	2
Faith		400	100	-	-	-	G	2
Granite Quarry		1,560	587	-	-	-	G*	
Spencer		3,500	100	-	-	-	S*	
E. Spencer		2,480	740	-	-	-	S*	
Rockwell		1,340	584	.37	.37	.100	G	7
Landis		1,500	429	1.098	-	1.000	S	
E. Landis		500	-	-	-	.016	G	?
Private-Domestic and Other	50	6,648	1,417	.23	.23	.07	G	75

All Sources Yadkin River Basin

The Level B Study estimated requirements for Rowan County as 32 MGD. The design capacity seems ample. Pumping capacity and delivery systems should be anticipated for new households.

WASTE WATER DISCHARGE NPDES

County: Rowan

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Systems and Capacity NCDNR May, 1983 Estimated Number of Connections
County Tot.	36	7	21.927	2	26,477
Public Subtot.	16		13.727	1	
Municipal	11				
Cleveland WWTP			.090		
Landis WWTP		Maj.	1.250		
Salisbury-Grants Creek WWTP		Maj.	5.000		
Salisbury-Town Creek WWTP		Maj.	5.000		
China Grove			.350		
Granite Quarry			.200		
Landis WTP			.860		
Rockwell North-side #2 WWTP			.040		
Rockwell South-side #1 WWTP			.135		
Salisbury WTP			N.S.	1	
Spencer WWTP			.750		
County					
Heritage House	1		.008		
Public Schools	4		.044		
Industrial	11		8.150		
Cannon Mills		Maj.	.050		
N.C. Finishing		Maj.	4.250		
Fiber Ind. Inc.		Maj.	1.200		
Duke Power-Spencer		Maj.	2.500		
7 Other			.150	1	
Domestic	9		.050		

County Profile: <u>Stanly</u>

Population: 48,657

100% of county population lives in Yadkin-Pee Dee River Basin

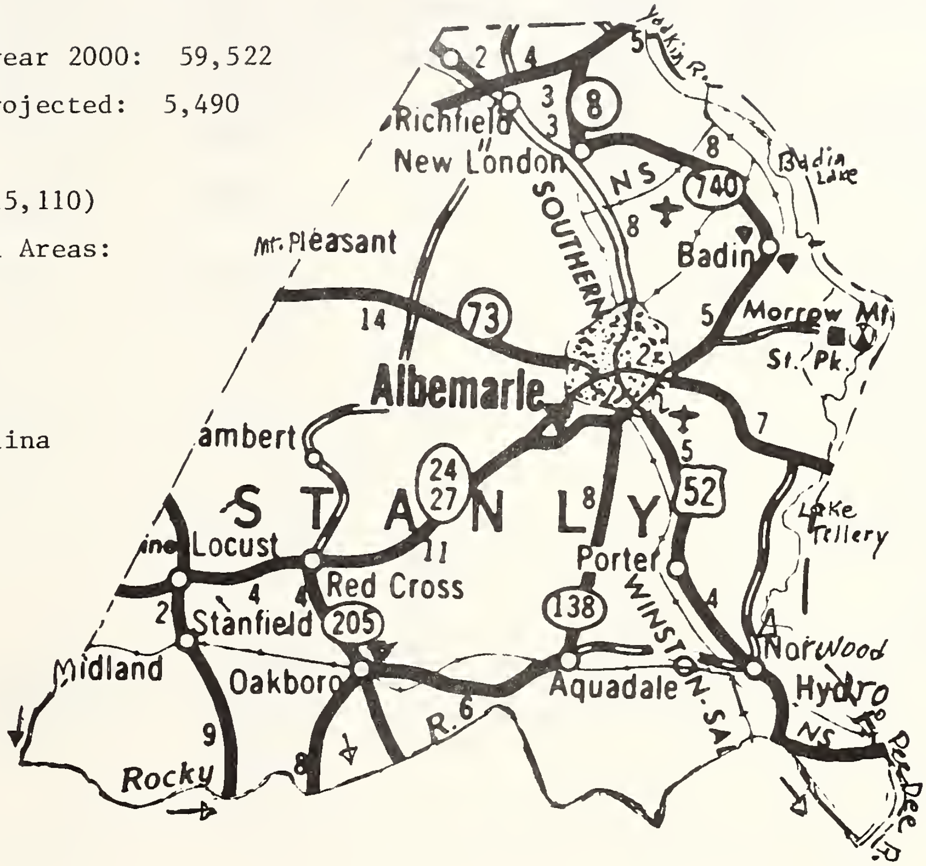
Projected population for year 2000: 59,522

New Households in Basin Projected: 5,490

Area: 398 square miles

County Seat: Albemarle (15,110)

Major Recreational/Natural Areas:
Morrow Mtn. State Park
East Tuckertown Lake
Badin Lake
Lake Tillary
Morgan's Bluff
Yadkin River - North Carolina
Natural Area



Stanly County is bounded by the southern flowing Yadkin River on the east and the southeasterly flowing Rock River on the south. Several creeks drain the county into the Rocky River which joins the Yadkin River at the southeast corner of Stanly County.

The Yadkin River supplies water to Albemarle, Stanly, Oakboro, and outlying rural towns. Norwood draws from Lake Tillary and plans to expand its pumping capacity and treatment facility.

Three major municipal wastewater treatment facilities serve Stanly County; all discharge into the Yadkin River just south of Lake Badin. One other major wastewater treatment facility is in the county; it is owned by Alcoa Aluminum.

WATER SUPPLY SOURCE AND CAPACITY

County: Stanly

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type * Purchase	No. of Wells
Totals	20	31,053	9,536	7.574	12.500			18
Municipal	3							
Albemarle		17,500	5,200	7.190	12.00	7.000	S	
Oakboro		1,500	540	-	-	.110	*S	
Norwood		2,500	714	.384	.500	.588	S	
County	1							
Stanly Co. Utility		5,000	1,700	-	-	1.600	*S	
Association	1							
Pfeiffar-N. Stanly		1,000	786	-	-	1.430	*G	1 (?)
Private-Distributor	1							
Badin Water Supply		1,900	660	-	-	.001	S	
Private-Domestic	14	1,653	436	-	-	.007	G	17

All Sources Yadkin River Basin

WASTE WATER DISCHARGE NPDES

County: Stanly

Systems and Capacity
NCDNR May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	27	4	25.225	1	9,536
Public	18	3	18.081		
Municipal	5				
Albermarle WWTP		Maj.	16.000		
Albermarle WTP			.090		
Norwood WWTP		Maj.	.750		
Norwood WTP			.031		
Oakboro WWTP		Maj.	.500		
Sanitary Dist.	2				
Greater Badin East			.580		
Greater Badin West			.130		
County Schools	11		.080		
Private Ind.	3	1	5.998		
Alcoa Yadkin #1		Maj.	5.120		
Carolina Solite			.864		
Richfield Mfg.			.010		
Private-Dom.	5		.066	1	

County Profile: Stokes

Population: 33,331

25.4% of county population lives in Yadkin-Pee Dee River Basin

Projected population for year 2000: 64,586

New Households in Basin Projected: 3,067

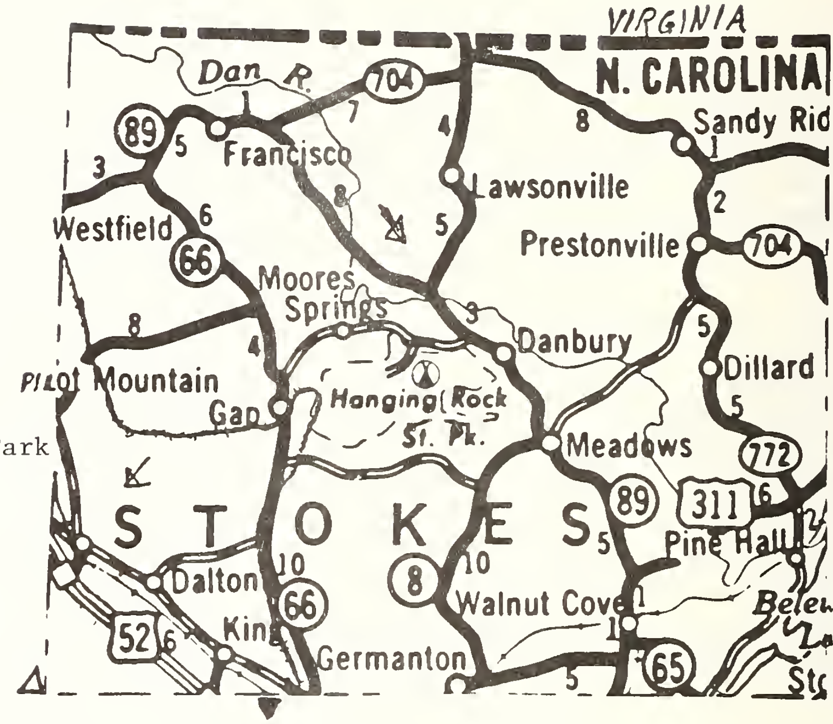
Area: 452 square miles

County Seat: Danbury

Major Towns: King, Danbury, Walnut Cove

Major Recreational/Natural Areas: Hanging Rock State Park

Major Industry: farming



Rural Stokes County foothills roll gently across the country from a mountainous area in the west central part of the country. Although the Dan River drains about 90% of the county, the Little Yadkin and two small Stokes County tributaries drain the southwest corner of the county.

Most of Stokes County's smaller town's water supplies rely on groundwater sources. Wells in Walnut Cove vary from good to erratic. The major water source in Stokes County is in the Yadkin River. The King District Water System draws water just above North Carolina Highway 67 bridge on the Yadkin River and supplies it to King, Pinnacle, part of rural Stokes County, and Tobaccoville; some 12,800 users in all. A new R.J. Reynolds industry currently under construction in Tobaccoville will not use the King system. Instead the new industry will pump its water from the Forsyth County system.

Only one major Stokes County wastewater treatment system, King Wastewater Treatment Plant, discharges into the Yadkin-Pee Dee River Basin. The King sanitary district will discharge its wastewater through the R.J. Reynolds Tobaccoville plant to the new Forsyth Muddy Creek Treatment Plant.

WATER SUPPLY SOURCE AND CAPACITY

County: Stokes

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type Purchase*	No. of Wells
Totals	18	15,425	4,302	.951	3.595	2.90MG	S&G	27 ?
Municipal	2					1.428		
Danbury		159	53	.013	.053	.100	G	2+4 ?
Walnut Cove		1,200	510	.128	.155	.300	G	1+1 ?
Associations	1							
King		12,800	3,400	.750	3.000	1.050	S	
Private and Other	15	1,266	339	.060	.387	.022	G	18

STOKES SYSTEMS BY RIVER BASIN

Yadkin Basin	3	12,892	3,450	.755	3.022	1.051	S&G	2
Dan-Roanoke Basin	15	2,533	852	.206	.573	1.849	G	25 ?

WASTE WATER DISCHARGE NPDES

County: Stokes

Systems and Capacity
NCDNR May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	16	2	6.566		4,302
Yadkin Basin	3	1	1.028		3,402
King Sanitary District WWTP		Maj.	1.000		
County Schools		2	.028		
Dan-Roanoke Basin	13	Maj.	5.538		900

County Profile: <u>Surry</u>

99.9% of county population lives in Yadkin-Pee Dee River Basin

Population: 59,632

Projected pop. for year 2000: 76,202

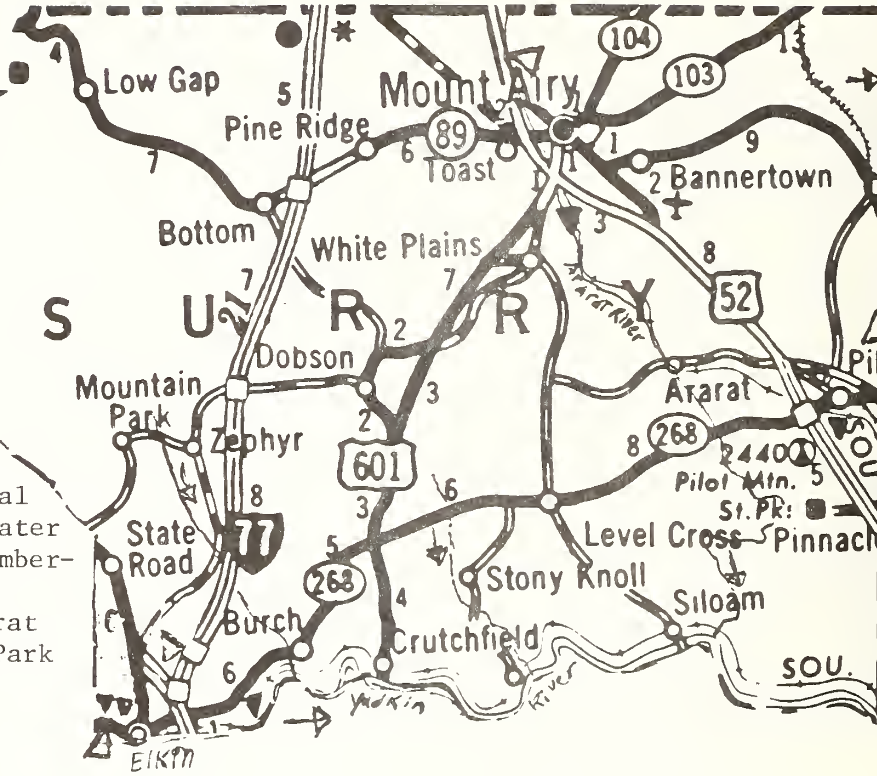
New Households in Basin Projected: 8,255

Area: 539 sq. mi.

County Seat: Dobson

Major Towns: Mount Airy, Pilot Mountain, Elkin

Major Recreational/Natural Areas: North Carolina water trail - Fisher River, Cumberland Knob Park, Mitchell River, Yadkin River, Ararat River, Pilot Mtn. State Park



Mountainous and boldly rolling Surry County is drained by the Fisher River, Ararat River, Mitchell River, Elkin River, and their tributaries which flow southerly across the county into the easterly flowing Yadkin River serving as the county's southern boundary.

Forty-five wells supply water to the majority of people in Surry County. One well serving 66 people is located in the Dan-Roanoke River Basin. Mounty Airy is supplied water by Lovell's Creek. The ample Fisher River supplies Dobson; the town of Elkin draws on the Big Elkin River; and Tom's Creek supplies Pilot Mountain. Future small reservoirs have been suggested at these locations.

While groundwater and clean water supplies are dependable and plentiful in Surry County, the quality of the Yadkin River flowing out of the county has not been up to regulatory standards. High fecal coliform counts, high trace metals, temperatures in excess of recommendations characterize the river's current quality. This situation, however, is changing. The three major wastewater treatment facilities and several smaller facilities in Surry County discharge into the Yadkin River. All are under review. The Pilot Mountain facility is currently under major expansion and improvement. Most treatment systems are in compliance, but the poor quality of the river has concerned the regulators.

WATER SUPPLY SOURCE AND CAPACITY

County: Surry

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type Purchase	No. of Wells
Totals	42	19,863	6,371	5.64	15.43	6.66	S&G	46
Municipal	4							
Dobson		1,176	839	.50	1.50	0.275	S	
Elkins		4,050	1,550	1.00	3.00	2.425	S	
Mt. Airy		8,480	2,423	3.00	8.50	3.000	S	
Pilot Mt.		2,500	625	.80	1.50	0.800	S	
Association	1							
Mt. Airy		60	14	.003	.01	0.001	S&G	1
Private and Other	37	3,597	920	.331	.918	0.158	G	45

SURRY SYSTEMS BY RIVER BASIN

Yadkin Basin	41	19,797	6,370	5.63	15.42	6.66	S&G	44
Dan-Roanoke Basin	1	66	1	5,250gal.	18,000gal.	80gal.	G	1

WASTE WATER DISCHARGE NPDES

County: Surry

Systems and Capacity
NCDNR May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	41	5	13.397	4	6,371
Public Total			8.354	2	
Municipal	7				
Mt. Airy WWTP		Maj.	4.000		
Mt. Airy Dogget WTP			.390	1	
Elkin WWTP		Maj.	1.300		
Elkin Twn Harrell WTP			.600	1	
Elkin WTP			.600		
Pilot Mtn. WWTP		Maj.	.990		
Dobson WWTP			.160		
County-Public Schools*	13		.242		
State	4		.072		
Private-Ind.	9		4.976	2	
Chatham Mfg. Co. Elkin		Maj.	4.000		
Sem. Proctor Silex		Maj.	.158		
7 Other			.818	2	
Private-Dom.	8		.067		

*One public school in Dan River Basin. Other NPDES are into rivers of the Yadkin Basin, including Ararat, Fisher, Little Fisher, Mitchell, and Yadkin.

County Profile: Union

81.8% of county population lives in Yadkin-Pee Dee River Basin

Population: 70,830

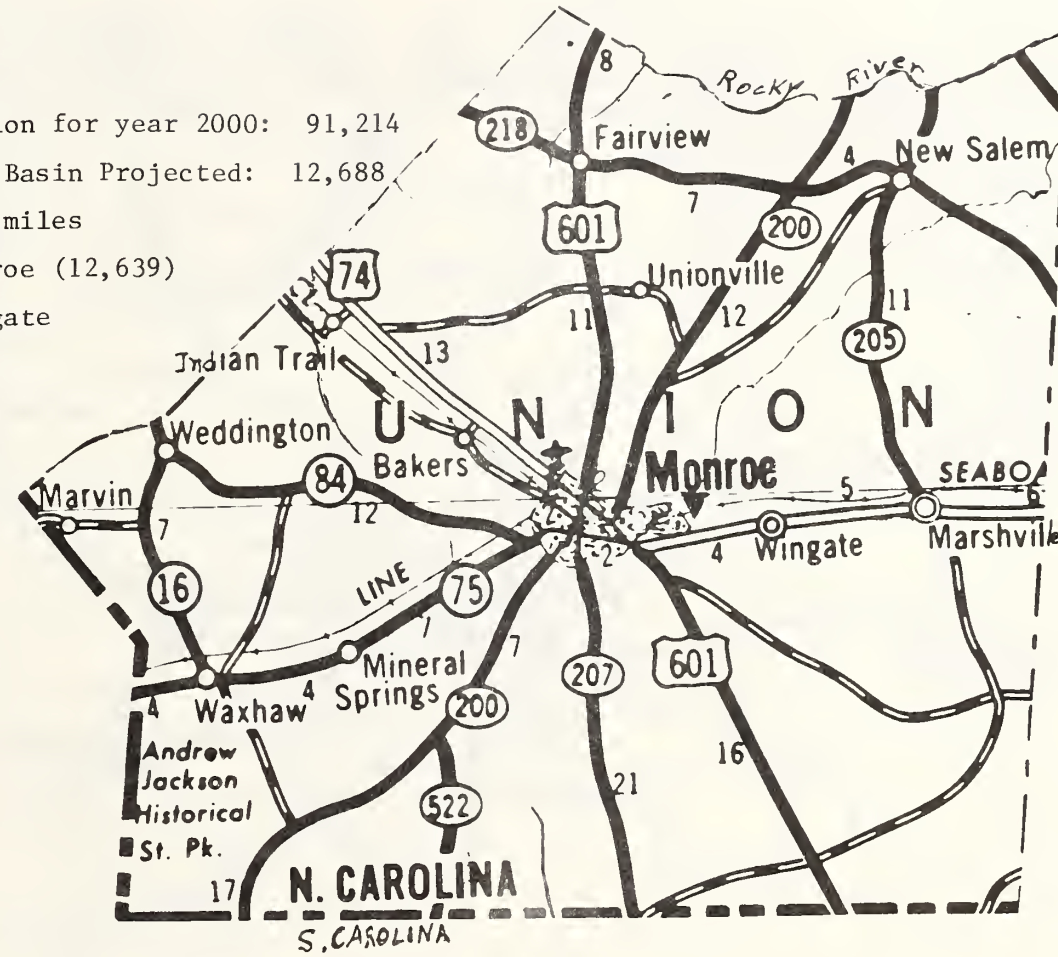
Projected population for year 2000: 91,214

New Households in Basin Projected: 12,688

Area: 639 square miles

County Seat: Monroe (12,639)

Major Towns: Wingate
Marshville



Union County's upland savannas spread southerly from the Rocky River, the northern county line, to the South Carolina state line. The central portion of the county lies in the Yadkin-Pee Dee River Basin and is evenly portioned by several large creeks flowing northeasterly into the Rocky River which flows southeasterly into the Pee Dee River just south of Lake Tillary on the Montgomery and Anson County boundaries.

The Monroe municipal water system drawing from three lakes in the county, Lake Twitty, Monroe, and Lee, provides most of the water for Union County. Marshville in east central Union County purchases water from the Monroe system as well as from Anson County.

Wastewater treatment in Union County is handled by the Monroe facility, the only major facility in the county. This facility discharges into a tributary of Richardson Creek which flows northeasterly into the Rocky River. Several small industrial and private domestic wastewater treatment facilities also serve Union County.

Union County has applied for $4,885,710 for Clean Water funding and had received $578,134 from state grants through December 30, 1982. The county has had difficulty with the proposal that they provide a hazardous waste site.

WATER SUPPLY SOURCE AND CAPACITY

County: Union

NCDHR
May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type * Purchase	No. of Wells
Totals	16	32,482	8,655	6.50	9.00	6.26	S&G	18
Municipal	4	24,700	6,761	6.50	9.00	5.88	S&G	5
Monroe		17,000	5,000	6.20	9.00	5.165	S	
Marshville		3,500	1,000	.30	-	.250	S	
Wingate		2,500	410	-	-	.500	*G	1
Waxhaw		1,700	320	-	-	.075	G	4
County	1							
Union		7,000	1,750	-	-	-	*G	
Private and Other	11	782	195	-	-	.037	G	13

UNION SYSTEMS BY RIVER BASIN

Yadkin Basin	30,782	8,355	6.50	9.00	6.184	S&G	14
Catawba Basin	1,700	320	-	-	.075	G	4

WASTE WATER DISCHARGE NPDES

County: Union

Systems and Capacity
NCDNR May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	39	1	8.731	7	8,335
Public Total	21		7.599	1	
Municipal	3				
Bakers WWTP			.020		
Monroe WTP			N.S.	1	
Monroe WWTP		Maj.	7.000		
County-Crooked Creek	1		.450		
Public Schools	17		.129		
Private-Ind.	13		.662	6	
Private-Dom.	4		.426		
Catawba Basin Waxhaw WWTP	1		.044		320

County Profile: <u>Wilkes</u>

100% of county population lives in Yadkin-Pee Dee River Basin

Population: 58,871

Projected pop. for year 2000: 79,308

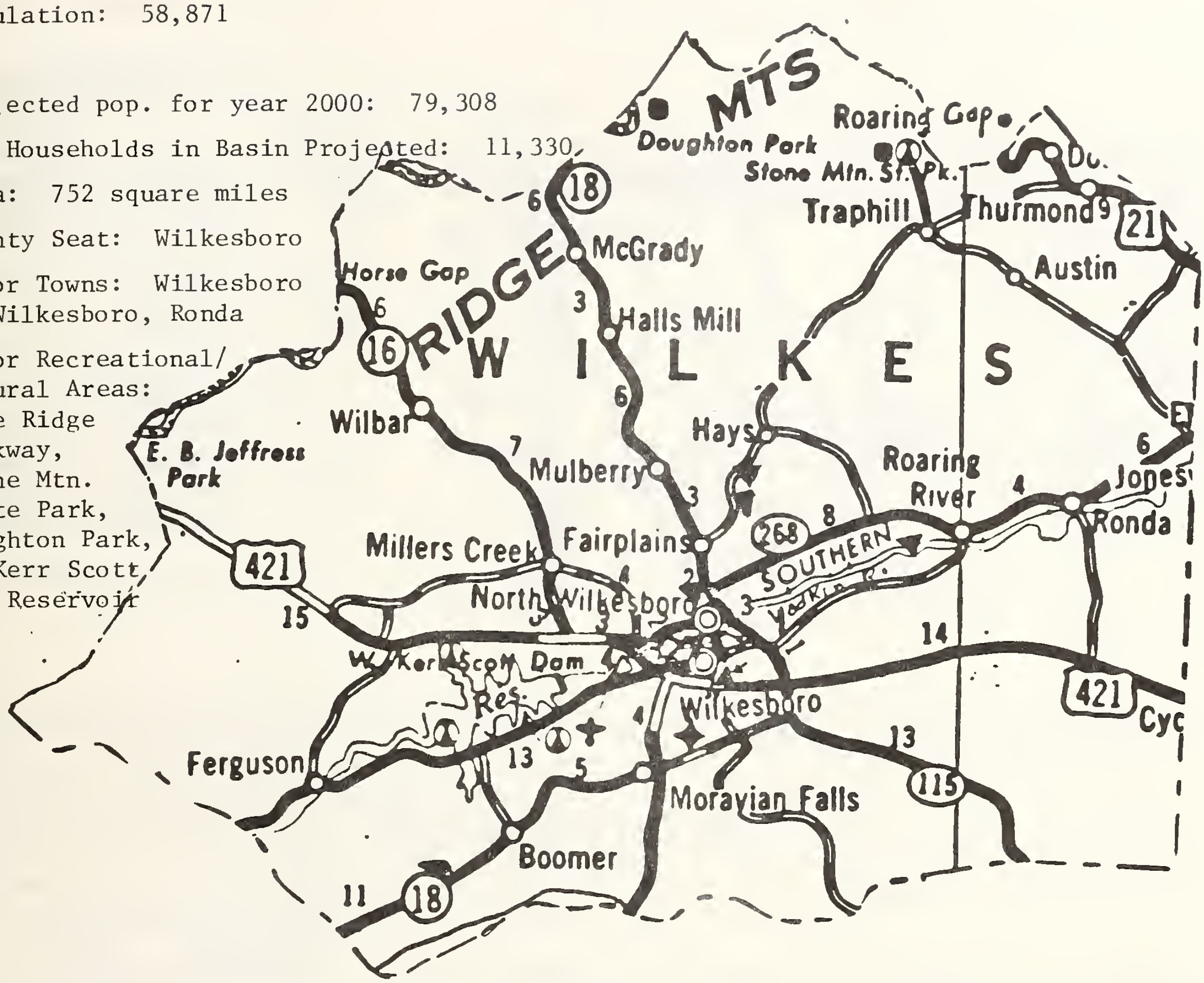
New Households in Basin Projected: 11,330

Area: 752 square miles

County Seat: Wilkesboro

Major Towns: Wilkesboro
N. Wilkesboro, Ronda

Major Recreational/
Natural Areas:
Blue Ridge
Parkway,
Stone Mtn.
State Park,
Doughton Park,
W. Kerr Scott
Dam Reservoir



Nestled in the Blue Ridge Mountains, rural Wilkes County's mountainous beauty provides a good number of recreational areas as well as protected natural environment resource areas. The Yadkin River flows northeasterly across the county diagonally from the southwestern corner of the Wilkes County. Scott Reservoir is located on the Yadkin River in the county. Several large creeks feed into the Yadkin River from the Blue Ridge Mountains. Wilkes County also contains several possible sites for water reservoirs.

The Yadkin River supplies nearly all of Wilkes County's water; although North Wilkesboro draws some water from Reddies River just before it joins the Yadkin River in Wilkesboro. Most major communities in Wilkes County purchase water from the main Wilkesboro system supplementing with only a small portion of water from wells. This small groundwater source may soon be replaced with water from a sanitary district forming west of Wilkesboro on Highway 421.

Two major municipal wastewater treatment plants discharge into the Yadkin River in Wilkes County. Three major industrial wastewater treatment facilities exist in Wilkes County. They discharge into the Roaring River in the east central portion of the county. All major facilities in Wilkes County are currently in compliance.

WATER SUPPLY SOURCE AND CAPACITY

County: Wilkes

NCDHR May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type * Purchase	No. of Wells
Totals*	8	27,669	8,702	5.50	7.80	4.55MG	S&G	7
Municipal	2							
N. Wilkesboro		3,500	1,500	2.00	3.00	1.00MG	S	
Wilkesboro		2,500	900	3.50	4.80	1.90MG	S	
Associations	5					(gallons)		
Hayes		4,200	1,200	-	-	250,000	S*	
Miller Creek		7,175	2,050	-	-	400,000	S*	3
Moravian Falls		2,200	800	-	-	75,000	S	
Mulberry-Fairplains		6,335	1,810	-	-	700,000	S	
N. Wilkesboro		1,704	426	-	-	300,000	G	3
Private	1	54	16	-	-	-	G	1

*Yadkin River Basin Only Source

N.B. A Sanitary District is being formed west of Wilkesboro on U.S. 421 for the purpose of water supply.

WASTE WATER DISCHARGE NPDES

County: Wilkes

Systems and Capacity
NCDNR May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	29	5	7.713	5	8,702
Public Tot.	20		5.301		
Municipal	3				
Wilkesboro WWTP		Maj.	5.000		
N. Wilkesboro WWTP		Maj.	.001		
N. Wilkesboro WTP			.200		
County Schools	12		.090	2	
Federal	5		.010	3	
Industrial	6		2.412		
Abitiba		Maj.	1.000		
Carolina Mirror		Maj.	.575		
Gardner Mirror		Maj.	.180		
3 Other		Maj.	.594		
Domestic	3		.063		

XXVI.

County Profile: Yadkin

100% of county population lives in Yadkin-Pee Dee River Basin

Population: 28,538

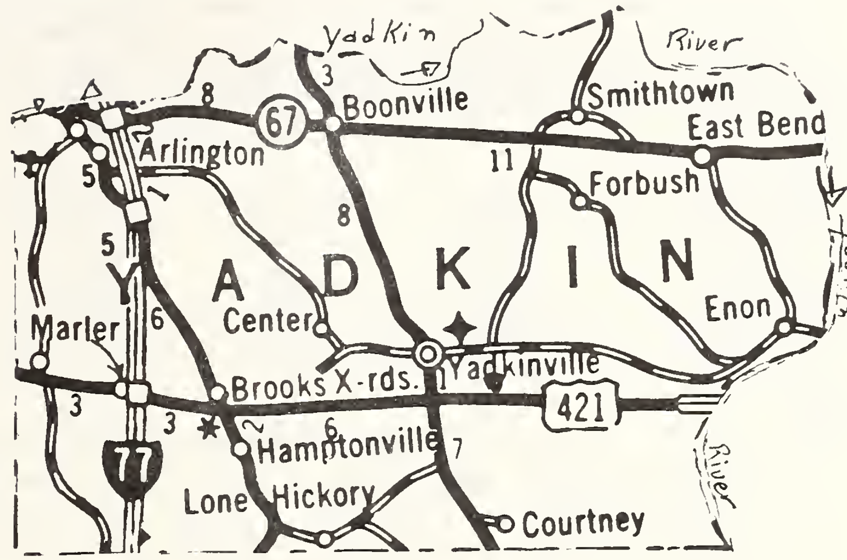
Projected population for year 2000: 36,726

Area: 336 square miles

County Seat: Yadkinville

Major Towns: Boonville, East Bend, Yadkinville, Jonesville, Arlington

Major Recreational Areas: Yadkin River Section, Pilot Mtn. State Park



Flowing eastward, the Yadkin River forms the northern boundary of Yadkin County then the river bends into a southward flow forming the eastern boundary of the county. The Yadkin River in Yadkin County is a very special natural environment and is high priority for designation as a North Carolina Water Trail. The flow rate of the river varies in this region depending upon the release of surplus water from the Kerr Scott Reservoir in Wilkes County. All of Yadkin County is drained by the Yadkin River except the southwest corner of the county.

Only the town of Jonesville in Yadkin County takes its water from the Yadkin River. Ten wells supply water to East Bend, Boonville, and Yadkinville. Yadkinville also draws on the South Deep Creek.

Wastewater treatment in Yadkin County is handled by several small systems discharging into the Yadkin River. Jonesville and Yadkinville have applied for expansion of their treatment plants.

WATER SUPPLY SOURCE AND CAPACITY

County: Yadkin

May, 1982

Community System Type	No.	Population Served	Number of Connections	Average Production MGD	Design Production MGD	Storage Capacity	Source Type Purchase*	No. of Wells
Totals*	9	9.127	3,056	.546	2.249	2.616MGD	S&G	14
Municipal	5					(gallons)		
Yadkinville		3,000	1,000	.150	.829	950,000	S&G	3
Boonville		2,250	750	.053	.170	475,000	G	4
Jonesville		1,700	700	.230	.500	800,000	S	
East Bend		1,050	350	.086	.138	75,000	G	3
Arlington		800	200	-	-	300,000	G*	
Private and Other	4	327	56	.027	.612	15,520	G	4

*Yadkin River Basin Only Source

WASTE WATER DISCHARGE NPDES

County: Yadkin

Systems and Capacity
NCDNR May, 1983

Discharging System Owner	No.	Class Major	Design Flow Effluent Capacity MGD	Compliance Not Stated	Estimated Number of Connections
Totals	14	0	1.045	3	2,457
Public	11	0	.976		
Municipal	4				
Boonville WWTP			.100		
Yadkinville WWTP			.500	?	
Jonesville WWTP			.200		
Jonesville WTP			.100	?	
County Schools	5		.042		
State	2		.034		
Industrial	3	0	.069	1	

XXVII.

TRENDS IN WATER QUALITY CONCERNS IN THE YADKIN-PEE DEE BASIN

Water treatment procedures carefully remove most contaminants and all harmful bacteria through balanced physical, and chemical processes. These procedures are executed under the supervision of professionally licensed water treatment plant operators and laboratory technicians. Since the raw water entering the plant arrives in variable quantities and qualities from several sources, the operator is never completely certain what materials are in the water to be treated.

A whopping and growing percent of all water used in the Basin is from surface sources in which this variability exists.

The same uncertainty applies to the treatment of raw wastewater at wastewater treatment plants. Sanitary sewers and septic tank pumpers deliver variable materials for treatment much of which is accomplished by biological organisms sensitive to heavy metals or biocides.

Water from industrial waste causes much concern because it requires more specialized and specific treatment than domestic wastewater. Industrial pre-treatment is effective in reducing this problem; sometimes recovers expensive materials for reuse, and serves to help industry financially and politically. In Anson County, the Wansono plant is now a pre-treatment plant which connects to the large Anson Wastewater Treatment Plant rather than an NPDES outlet. In Forsyth County several new or modified industrial facilities are recovering valuable materials for re-use giving validity to the slogan "Pollution Prevention Pays."

The Yadkin-Pee Dee River Basin provides no insurmountable water quality problems at the present time. Care must be taken not to create new problems or increase existing problems.

There are scattered areas in the upper Yadkin and Ararrat Rivers where fecal coliform bacteria, sediment, or metals are often in excess. Additional control is possible.

In the central Yadkin area the population pressures are most evident. There are frequent degraded areas in Muddy Creek, Abbotts Creek, and Third and Fourth Creek of the South Yadkin. From above Idol's Dam to Yadkin College on the Yadkin River there are frequent fecal coliform incidents. High Rock Lake has problems. These conditions can all be improved with public insistance.

In the lower Yadkin-Pee Dee area water quality is generally good. Irish Buffalo and some other creeks which feed the Rocky River present some degradation from sewage and industrial discharge. Again, the conditions are not insurmountable.

Multi-county planning units or COG's have been of great value in both planning and identification of financial resources. Planning between COG's for solutions to water quality problems within the Basin should continue, with emphasis given to solutions compatiable with Riparian Rights Doctrine.

Adequate solution to problems of land application of municipal wastewater including sludge application will need particular attention through the year 2000. The increasing size of treatment plants require increased land reservation and careful regard for siting.

XXVIII.

ABBREVIATIONS

Organizations

ASCS	Agricultural Stabilization and Conservation Service
COE	Corps of Engineers
COG	Council of Governments
CP&L	Carolina Power and Light
DEM	Department of Environmental Management
EMC	Environmental Management Commission
EPA	Environmental Protection Agency
FmHA	Farmers Home Administration
NCDHR	NC Department of Human Resources
NCDNRCD	NC Department of Natural Resources and Community Development (also written NRCD)
NPDES	National Pollutant Discharge Elimination System
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SWCD	Soil and Water Conservation Districts
USGS	U. S. Geological Survey
USWRC	U. S. Water Resources Council (also written WRC)

Terms

BMPs	Best Management Practices
cfs	cubic feet per second
G.S.	General Statutes (N.C.)
GW or G	groundwater
m^3	cubic meters
m^3/s	cubic meters per second
mou	memorandum of understanding
MGD	million gallons per day
NPS	nonpoint source
SW or S	surface water
WTP	water treatment plant
WWTP	wastewater treatment plant

GLOSSARY

Activated Sludge: Sludge particles produced in raw or settled wastewater (primary effluent) by the growth of organisms (including zoogleal bacteria) in aeration tanks in the presence of dissolved oxygen. The term "activated" comes from the fact that the particles are teaming with bacteria, fungi, and protozoa.

Aeration: To circulate oxygen through a substance.

Aeration Bay: The same as aeration tank or lagoon. The tank where raw or settled wastewater is mixed with return sludge and aerated.

Aerobic Decomposition: Decomposition and decay of organic material in the presence of "free" or dissolved oxygen.

Algae: Simple rootless plants that grow in bodies of water in relative proportion to the amounts of nutrients available.

Anaerobic: A condition in which "free" or dissolved oxygen is not present in the aquatic environment.

Anaerobic Digestion: Wastewater solids and water (about 5% solids, 95% water) are placed in a large tank where bacteria decompose the solids in the absence of dissolved oxygen. At least two general groups of bacteria act in balance: (1) Saprophytic bacteria break down complex solids to volatile acids, and (2) Methane Fermenters break down the acids to methane, carbon dioxide, and water.

Bacteria: Bacteria are living organisms, microscopic in size, which consist of a single cell. Most bacteria utilize organic matter for their food and produce waste products as the result of their life processes.

Bacterial Culture: In the case of activated sludge, the bacterial culture refers to the group of bacteria classed as Aerobes, and facultative organisms, which covers a wide range of organisms. Most treatment processes in the United States grow facultative organisms which utilize the carbonaceous (carbon compounds) BOD. Facultative organisms can live when oxygen resources are low. When "nitrification" is required, the nitrifying organisms are Obligate Aerobes (require oxygen) and must have at least 0.8 mg/l of dissolved oxygen throughout the whole system to function properly.

Biochemical Oxygen Demand or BOD: The BOD indicates the rate of oxygen utilized by wastewater under controlled conditions of temperature and time.

Chlorine Requirement: The amount of chlorine which must be added to produce the desired result under stated conditions. The result (the purpose of chlorination) may be based on any number of criteria, such as a stipulated coliform density, a specified residual chlorine concentration, the destruction of a chemical constituent, or others. In each case a definite chlorine dosage will be necessary. This dosage is the chlorine requirement.

Clarifier: Settling Tank, Sedimentation Base. A tank or basin in which wastewater is held for a period of time, during which the heavier solids settle to the bottom and the lighter material will float to the water surface.

Coliform: The coliform group of organisms is a bacterial indicator of contamination. This group has one of its primary habitats the intestinal tract of human beings. Coliforms also may be found in the intestinal tract of warm-blooded animals, and in plants, soil, air, and the aquatic environment.

DO: Abbreviation of Dissolved Oxygen. DO is the atmospheric oxygen dissolved in water or wastewater.

Design Capacity: The planned ability to operate effectively in gallons per day.

Disinfection: The process by which pathogenic (disease) organisms are killed. There are several ways to disinfect, but chlorination is the most frequently used method in water and wastewater treatment.

Dissolved Oxygen: Atmospheric oxygen dissolved in water or wastewater, usually abbreviated DO.

Effluent: Wastewater or other liquid--raw, partially or completely treated--flowing from a basin, treatment process, or treatment plant.

Erosion: The wearing away of land by wind or water.

Grit: The heavy mineral material present in wastewater such as sand, eggshells, gravel, and cinders.

Grit Removal: Grit removal is accomplished by providing an enlarged channel which causes the flow velocity to be reduced and allows the heavier grit to settle to the bottom of the channel where it can be removed.

Hazardous waste: Waste materials that are inherently dangerous to handle or dispose of, or can cause injury to living organisms.

Impoundment: A body of water confined by adam, dike, floodgate, or other barrier.

Nonpoint source: A contributing factor to water pollution that can't be traced to a specific spot, including runoff and sedimentation.

Organic Waste: Waste material which comes from animal or vegetable sources. Organic waste generally can be consumed by bacteria and other small organisms. Inorganic wastes are chemical substances of mineral origin and may contain carbon and oxygen, whereas organic wastes contain mainly carbon and hydrogen along with other elements.

Pathogenic Organisms: Bacteria or viruses which can cause disease (typhoid, cholera, dysentery). There are many types of bacteria which do not cause disease and which are not called pathogenic. Many beneficial bacteria are found in wastewater treatment processes actively cleaning up organic wastes.

ph: ph is an expression of the intensity of the alkaline or acidic strength of a water. Mathematically, ph is the logarithm (base 10) of the reciprocal of the hydrogen ion concentration.

$$\text{ph} = \text{Log}\,\frac{1}{(H^{+})}$$

Point Source: A stationary location where pollutants are discharged.

Pollution: Any interference with beneficial reuse of water or failure to meet quality requirements.

Potable water: Water that is safe for drinking and use in cooking.

Preaeration: A preparatory treatment of wastewater consisting of aeration to freshen the wastewater, remove gases, add oxygen, promote flotation of grease, and aid coagulation.

Prechlorination: Chlorination at the headworks of the plant; influent chlorination prior to plant treatment.

Pretreatment: Use of racks, screens, comminutors, and grit removal devices to remove metal, rocks, sand, eggshells, and similar materials which may hinder operation of a treatment plant.

Primary Treatment: A wastewater treatment process consisting of a rectangular of circular tank which allows those substances in wastewater that readily settle or float to be separated from the water being treated.

Raw Wastewater: Plant influent or wastewater before any treatment.

Receiving Water: A stream, river, lake, or ocean into which treated or untreated wastewater is discharged.

Reservoir: Any holding area used to store, regulate, or control water.

Sanitary Sewer: A sewer intended to carry wastewater from homes, business, and industries.

Secondary Treatment: A wastewater treatment process used to convert dissolved or suspended materials into a form more readily separated from the water being treated.

Sewage: The used water and solids from homes that flow to a treatment plant. The preferred term is wastewater. Sewage is an alternate spelling.

Sludge: The settleable solids separated from liquids during processing or deposits on bottoms of streams or other bodies of water.

Sludge Digestion: A process by which organic matter in sludge is gasified, liquefied, mineralized, or converted to a more stable form by anaerobic (more common) or aerobic organisms.

Storm Sewer: A separate sewer that carries runoff from storms, surface drainage, and street wash, but exludes domestic and industrial wastes.

Tertiary Treatment: See Advanced Waste Treatment.

Toxicity: A condition that may exist in wastes that will inhibit or destroy the growth or function of any organism.

Toxic Substances: A chemical or mixture that may present an unreasonable risk of injury to health or the environment.

Trickling Filter: A treatment process in which the wastewater trickles over media that provide the opportunity for the formation of slimes which clarify and oxidize the wastewater.

Trickling Filter Media: Rocks or other durable materials that make up the body of the filter. Synthetic (manufactured) media have been used successfully.

Turbidity: A cloudy condition of the water due to suspended silt or organic matter.

Urban runoff: Storm water from city streets, usually carrying litter, some metals, and organic matter.

Wastewater: The used water and solids from a community that flow to a treatment plant. Storm water, surface water, and groundwater infiltration also may be included in the wastewater that enters a plant. The term sewage usually refers to household wastes, but this word is being replaced by the term wastewater.

Watershed: The land area that drains into a stream. All water in a watershed ultimately comes from rainfall.

Zoogleal Film: A complex population of organisms that form a slime growth on the trickling filter media and break down the organic matter in wastewater. These slimes consist of living organisms feeding on the wastes in wastewater, dead organisms, silt, and other debris. Slime growth is a more common word.

Zoogleal Mass: Jelly-like masses of bacteria found in both the trickling filter and activated sludge processes. These masses may be formed for or function as the protection against predators and for storage of food supplies.

XXX.

BIBLIOGRAPHY

A. Data for Table and Maps

1. Public Water Supply Data Sheet, (Produced on WANG) NC Inventory Document (PWSI.410) as of December 31, 1981, Division of Health Services - Environmental Health Section - Water Supply Branch received May, 1982 NCDHR.

2. NPDES Point Source Locations-Division of Environmental Management, Water Quality Division NCDNRCD, Winston-Salem Office, received February, 1983.

3. Discharge Inventory of Municipal/Non-Municipal facilities by county and facility name. Water Quality Section, Division of Environmental Management. Inventory through May 31, 1983. NCDNRCD, Raleigh.

4. Update North Carolina Population Projections and N.C. 2000, the Local Perspective: Office of State Budget and Management, N.C. Department of Administration, received 1983.

B. Pamphlets

1. Archie Elledge Waste Treatment Plant; published by Office of Public Relations, City of Winston-Salem.

2. -------Is Your Drinking Water Safe?; US EPA March 1977.

3. -------What Everyone Should Know About the Quality of Drinking Water; published by Channing L. Bete Co. 1977.

4. Prentice, W. L. Glossary, a summary of all the words defined in Operation of Wastewater Treatment Plants; and an Environmental Levicon (NCDNR) DEM, Raleigh, North Carolina.

C. Selected Bibliography

1. Carriker, Ray R., Water Law and Rights in the South, (a Bibliography, Southern Rural Development Center, University of Florida, 1982.

2. Gianessi, Leonard P., File Records, the RFF Environmental Data Inventory (REDI) State of North Carolina, Resources for the Future, Inc. 1981.

3. Harned, Douglas and Dann Meyer, Water Quality of the Yadkin-Pee Dee River System, North Carolina. Variability, Pollution Loads, and Long-Term Trends. U.S. Geological Survey open file report 81-643. 1981 (Appendix)

4. Heath, Milton S., Jr., Legal and Administrative Aspects of Water Allocation and Management in N.C., Water Resources Research Institute, UNC. #133, April, 1978.

5. Jackson, N. M., Jr., Public Water Supplies of North Carolina, Part I, Northern Piedmont. United States Department of the Interior, Geological Survey, and North Carolina Office of Water and Air Resources, July, 1972.

6. North Carolina Water Resources Framework Study, Level A, N.C. Department of Natural Resources and Community Development, 1977.

7. N.C. Administrative Code: Title 15: Department of Natural Resources and Community Development Chapter 2: Subchapter 2h Section .0100 and 2b Section .0400, Raleigh, North Carolina.

8. Proceedings; Future Waves: Water Policy in the South, Southern Rural Development Center, Mississippi State, 1983.

9. Public Water Supplies of North Carolina, a summary of water sources, use, treatment and capacity of water supply systems, U.S. Geological Survey, Water Resources Investigations 78-16 (with NCDNRCD) 1978.

10. State and Federal Water Supply Assistance Programs: Office of Water Resources, NCDNRCD, Raleigh, N.C.

11. Water Quality Management Plant, Executive Summary: NCDNRCD, Raleigh, N.C., 1979.

12. Yadkin-Pee Dee River Basin Study: Series 1-14, United States Water Resources Council, State of North Carolina, State of South Carolina; 1979, 1980, 1981.

13. Yadkin-Pee Dee River Basin Study: North Carolina, South Carolina Special Report, Environmental Resources Inventory, U.S.D.A., NCDNRCR and SCNRC, 1980.

APPENDIX

SUBCHAPTER 2H - PROCEDURES FOR PERMITS, APPROVALS

SECTION .0100 - WASTEWATER DISCHARGES TO THE SURFACE WATERS

.0101 PURPOSE

This Regulation implements G.S. 143-215.1 which requires permits for control of sources of water pollution by providing the requirements and procedures for application and issuance of state NPDES permits for a discharge from an outlet, point source, and disposal system discharging to the surface waters of the state (see Environmental Management Commission regulations regarding permits for disposal systems not discharging to the surface waters of the state). This Regulation also contains the requirements and procedures for issuance of state permits for pretreatment facilities.

History Note: Statutory Authority G.S. 143-215.3(a)(1); 143-215.1;
Eff. February 1, 1976.

.0102 SCOPE

This Regulation applies to all persons discharging or proposing to discharge waste to the surface waters of the state; discharging or proposing to discharge waste requiring pretreatment to a treatment works of another.

History Note: Statutory Authority G.S. 143-215.3(a)(1); 143-215.1;
Eff. February 1, 1976.

.0103 DEFINITION OF TERMS

(a) The term "commission" means the Environmental Management Commission of the Department of Natural Resources and Community Development or its successor.

(b) The term "committee" means the NPDES committee of the Environmental Management Commission.

(c) The term "EPA" means the United States Environmental Protection Agency.

(d) The term "NPDES" means the National Pollutant Discharge Elimination System.

(e) The term "director" means the Director of the Division of Environmental Management, Department of Natural Resources and Community Development or his delegate.

i

PERMITS ISSUED BY DIVISION OF ENVIRONMENTAL MANAGEMENT

1. Water Permits - for the construction and/or operation of sewer system, treatment works or disposal systems that do not discharge to the surface waters, including sewer line extensions, sewage pump stations, force mains, waste treatment plants preceeding land application, sludge disposal systems, land application systems, systems for treating and recycling industrial wastewaters, and systems for treating water plant wastes (filter backwash and clarifier underflow).

   Authority: NCGS 143-215.1 and 15 NCAC 2H .0400 or 15 NCAC 2H .0200.

   Also includes septic tank - nitrification line systems having a design capacity greater than 3000 gallons per day.

   Authority: NCGS 130-160 and 143-215.1 and 15 NCAC 2H .0300.

2. Air Permits - for the construction and/or operation of air pollution control devices or air contaminant sources.

   Authority: NCGS 143-215.108 and 143-215.109 and 15 NCAC 2H .0600.

3. NPDES (National Pollutant Discharge Elimination System) Permits - for the discharge of wastewaters to the surface waters of the State.

   Authority: NCGS 143-215.1 and a Memorandum of Understanding between the State and EPA, and 15 NCAC 2H .0100.

4. Pretreatment Permits - for the construction and/or operation of facilities to pretreat industrial wastewaters prior to discharge to a municipal sewerage system for additional treatment.

   Authority: NCGS 143-215.1 and 15 NCAC 2H .0900.

5. Tax Certifications - issued to persons that have received Permits for water or air pollution control devices and allow the permittee to claim certain ad valorem and income tax benefits.

   Authority: NCGS 105-122(d), 105-130.10, 105-147(13), and 105-275(8).

6. Water Quality Certifications - Certify that certain activities for which a Federal permit (usually dredge and fill projects) is required will not contravene water quality standards. The Federal permit cannot be issued in the absence of such certification.

   Authority: NCGS 143-215.3(a)(1) and 143-215.3(c), and 15 NCAC 2H .0500.

7. Well Construction Permits - for the construction of a well or well system having a design capacity of 100,000 gallons per day or more. Permits are also required for construction of wells in certain other specified circumstances.

   Authority: NCGS 87-88 and 15 NCAC 2C.

8. Water Use Permits - for the withdrawal and use of water within designated capacity use areas. (At present, there is only one capacity use area; it includes Beaufort, Pamlico and Washington Counties and portions of Martin, Crave, Carteret, Hyde and Tyrrell Counties.)

   It should be noted that the number of permits issued does not necessarily reflect the number of new discharges or emission source: not only are permits issued for new facilities, they are also issued to reflect modifications or to replace expiring permits previously issued.

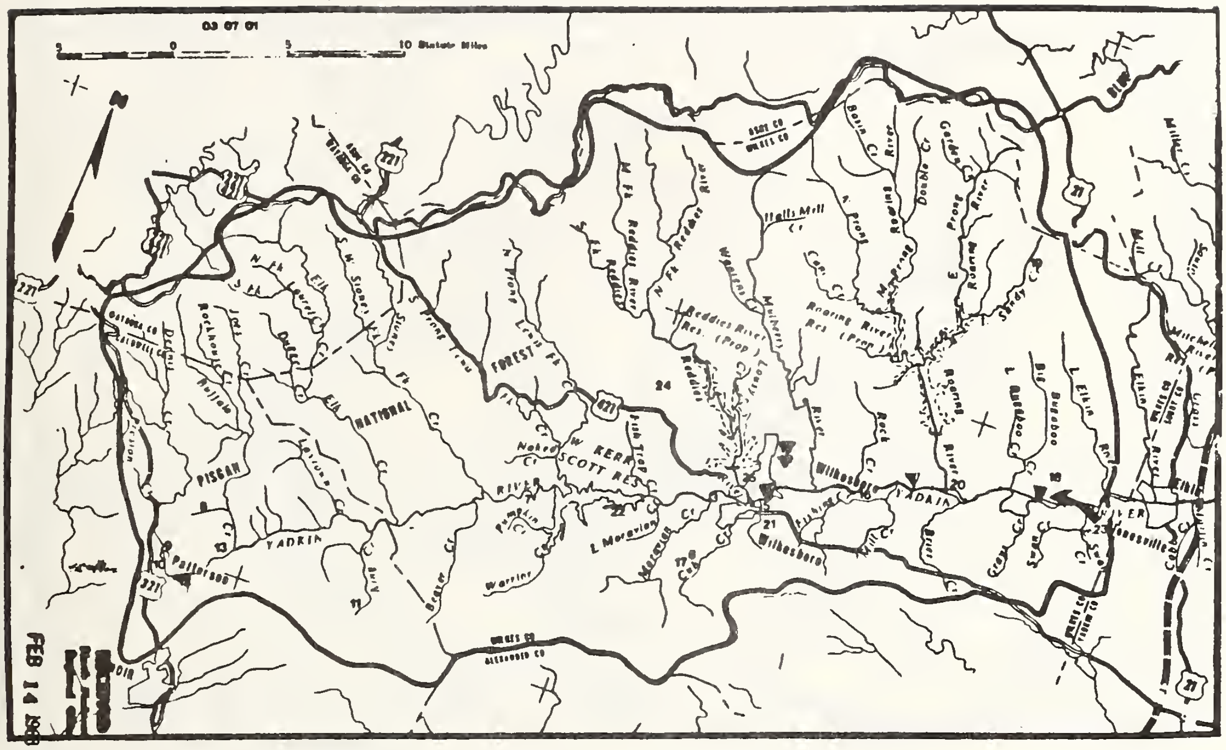
NPDES PERMITS IN THE SUBBASINS OF THE YADKIN-PEE DEE RIVER BASIN

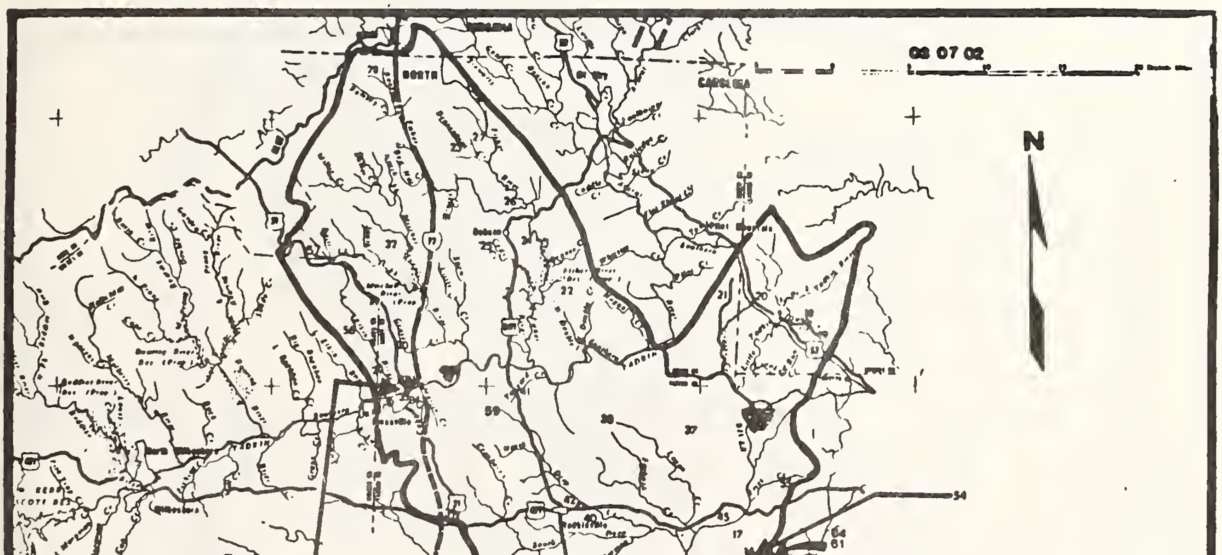
USG Subbasin No.	Major Surface Waters	Basin Counties w/ NPDES Permits	Total Dischargers	NPDES Points
17		18 (+3)	510	535
030701	Upper Yadkin Rivers and W. Kerr Scott Reservoir	Caldwell and Wilkes	25	28
030702	Upper Yadkin and Tributaries to Idolsdam	Yadkin, Wilkes, Stokes, Surry, Forsyth, Davie, and Allegany (1)	66	69
030703	Arrarat River Basin to Upper Yadkin	Surry	22	22
030704	Middle Yadkin, Muddy Creek to Yadkin	Forsyth, Davidson, and Davie (1)	118	132
030705	Davie Creek to Yadkin	Davie	10	11
030706	South Yadkin and Creeks to Yadkin	Alexander, Davie, Rowan, Iredell, and Yadkin (1)	42	42
030707	Abbots Creek to High Rock Lane	Forsyth, Davidson, Randolph, and Guilford (1)	51	51
030708	Creeks to Tuckertown Res. Baden Lake and Lake Tillery and Uwharrie River to Yadkin-Pee Dee	Davidson, Montgomery, and Stanly	25	26
030709	Uwharrie River to Pee Dee	Randolph and Davidson (1)	12	12
0307-10	Pee Dee River and Blewett Falls Lake	Anson and Richmond (1)	8	8
0307-11	Creeks to Rocky River	Iredell, Cabarrus and Mecklenberg (12)	34	34
0307-12	"Lake Concord" and Creeks to Rocky River	Cabarrus, Rowan, Union, Stanly and Mecklenberg (1)	26	26
0307-13	Creeks to Rocky River to Pee Dee below Lake Tillery	Stanly	17	17
0307-14	Creeks to Rocky River to Pee Dee	Union	18	18
0307-15	Little River Creeks to Pee Dee below Lake Tillery	Randolph and Montgomery	10	13

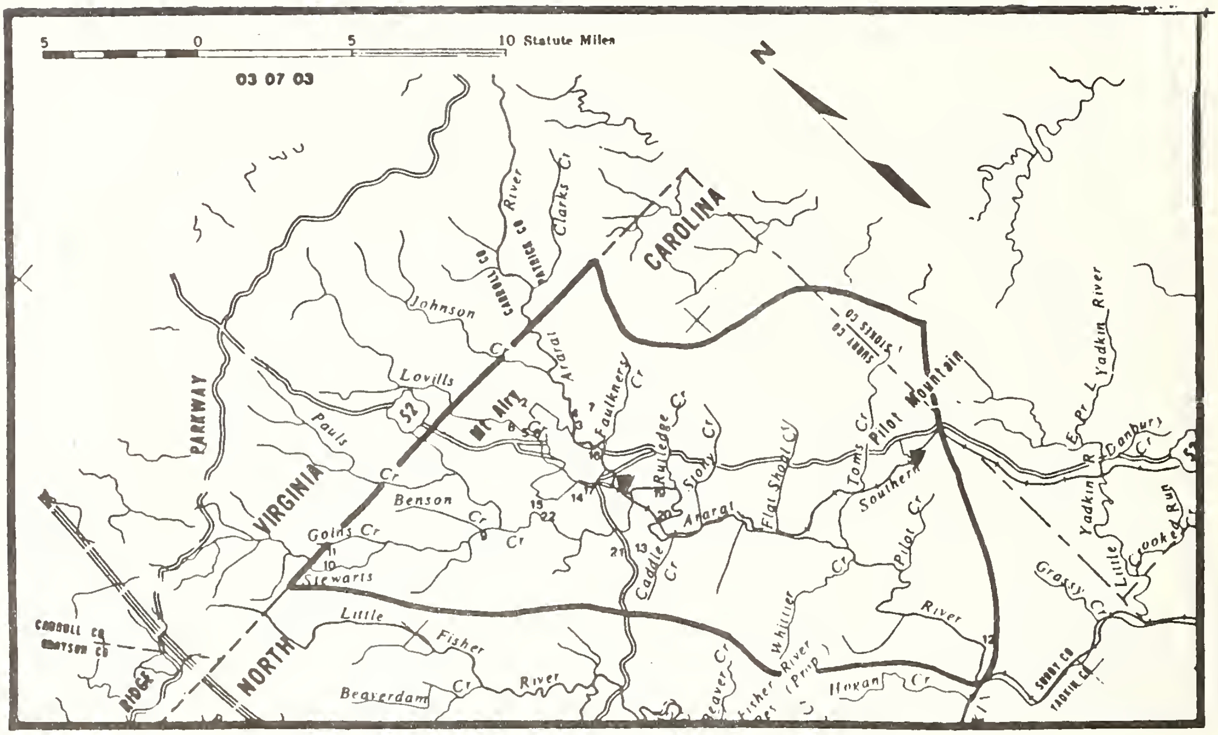
NPDES Permits in Subbasins, Cont.

USG Subbasin No.	Major Surface Waters	Basin Counties w/NPDES Permits	Total Dischargers	NPDES Points
17		18 (+3)	510	535
0307-16	Area Creeks to Pee Dee below Blewett Falls Marks Creek to Pee Dee in S.C.	Richmond and Anson (1)	19	19
0307-17	Jones Creek to Pee Dee below Blewett Falls	Anson	7	7

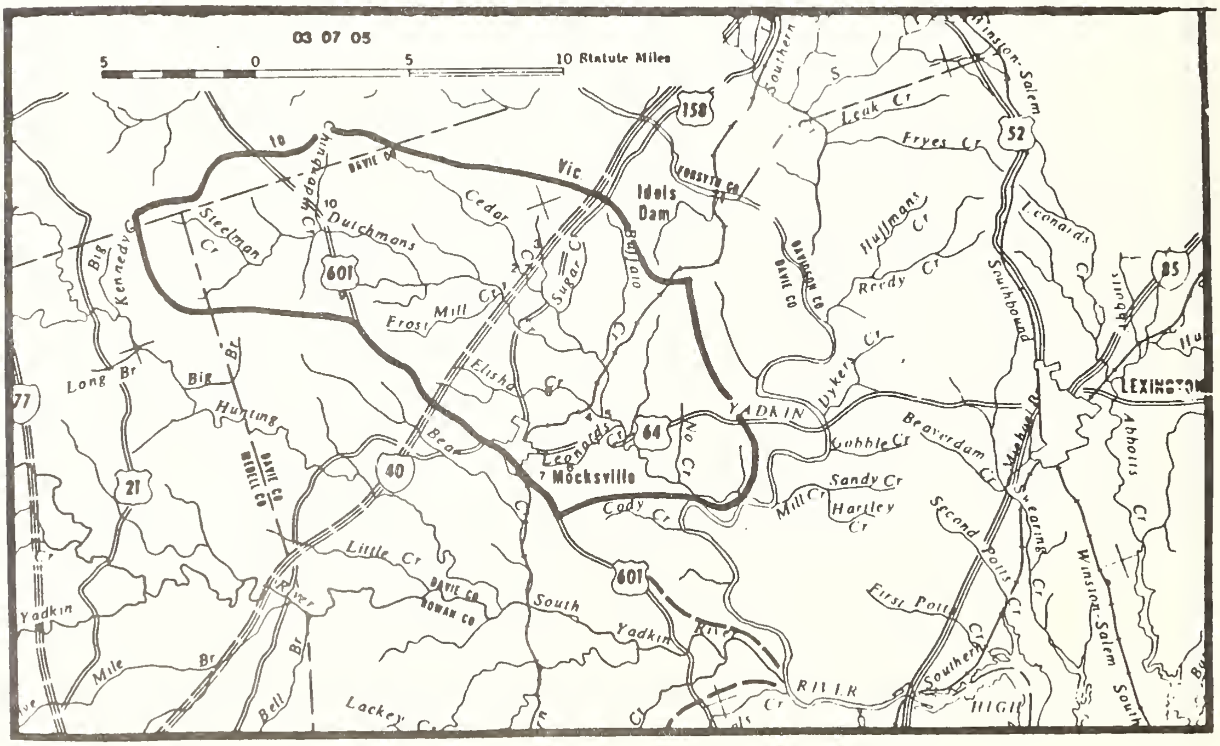
*NCDNRCD 2/14/83

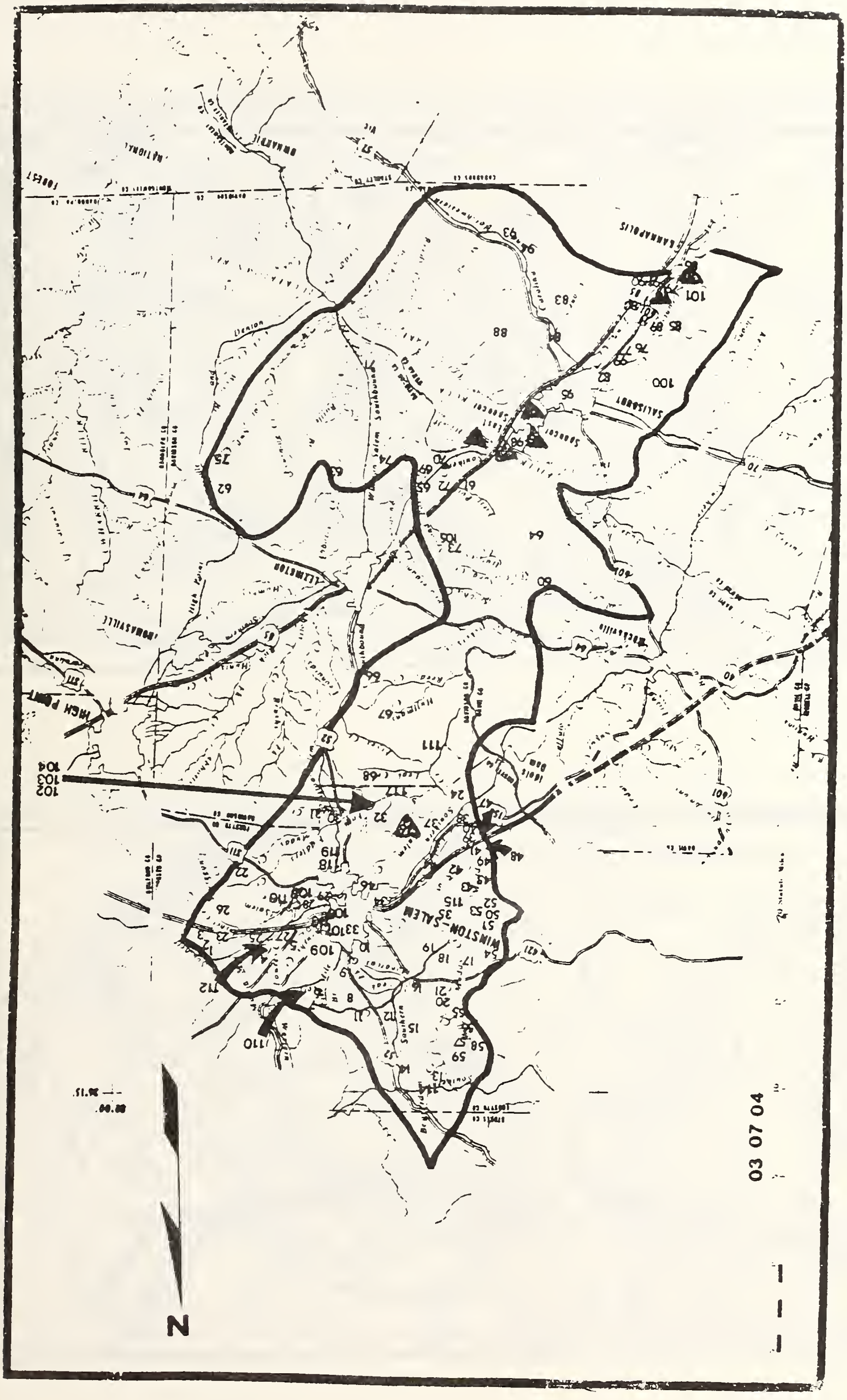

03 07 01
10 Statute Miles
PISGAH
NATIONAL
FOREST
W. KERR SCOTT RES.
YADKIN
RIVER
Wilkesboro
N. Wilkesboro
Patterson
Elkin
Jonesville
Roaring River Res. (Prop.)
Reddies River Res. (Prop.)

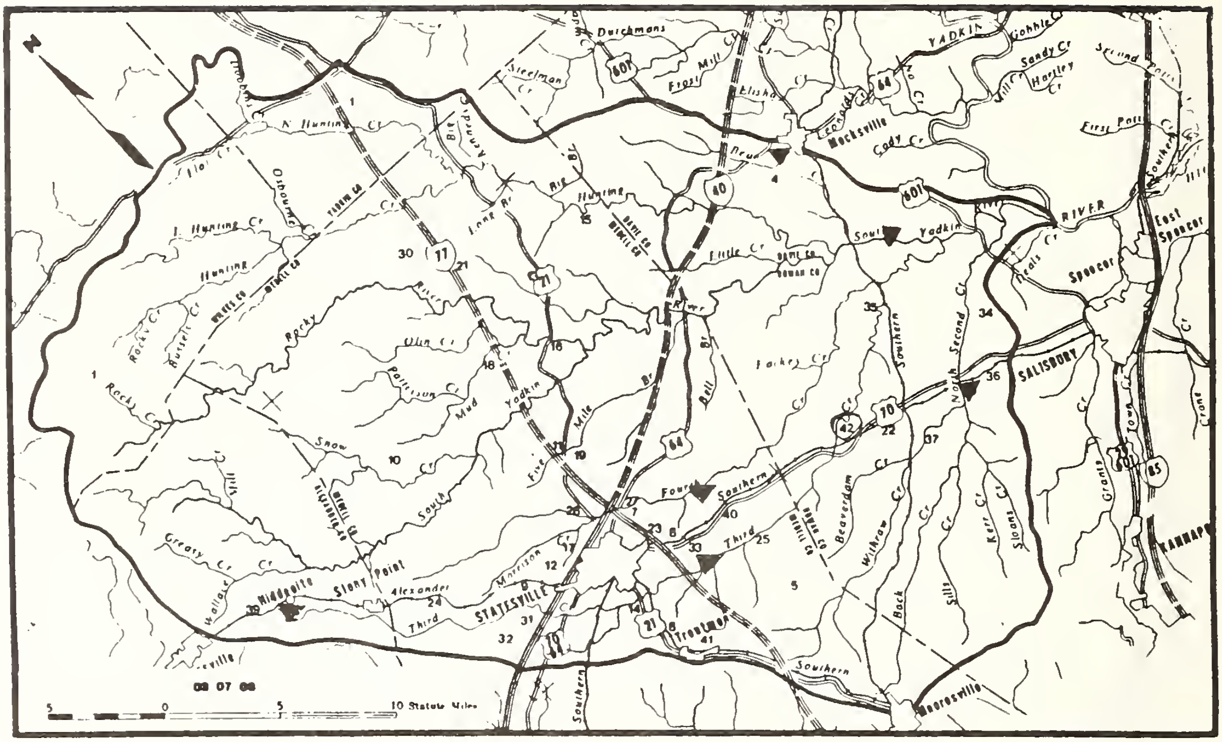

03 07 02
NORTH
CAROLINA
N

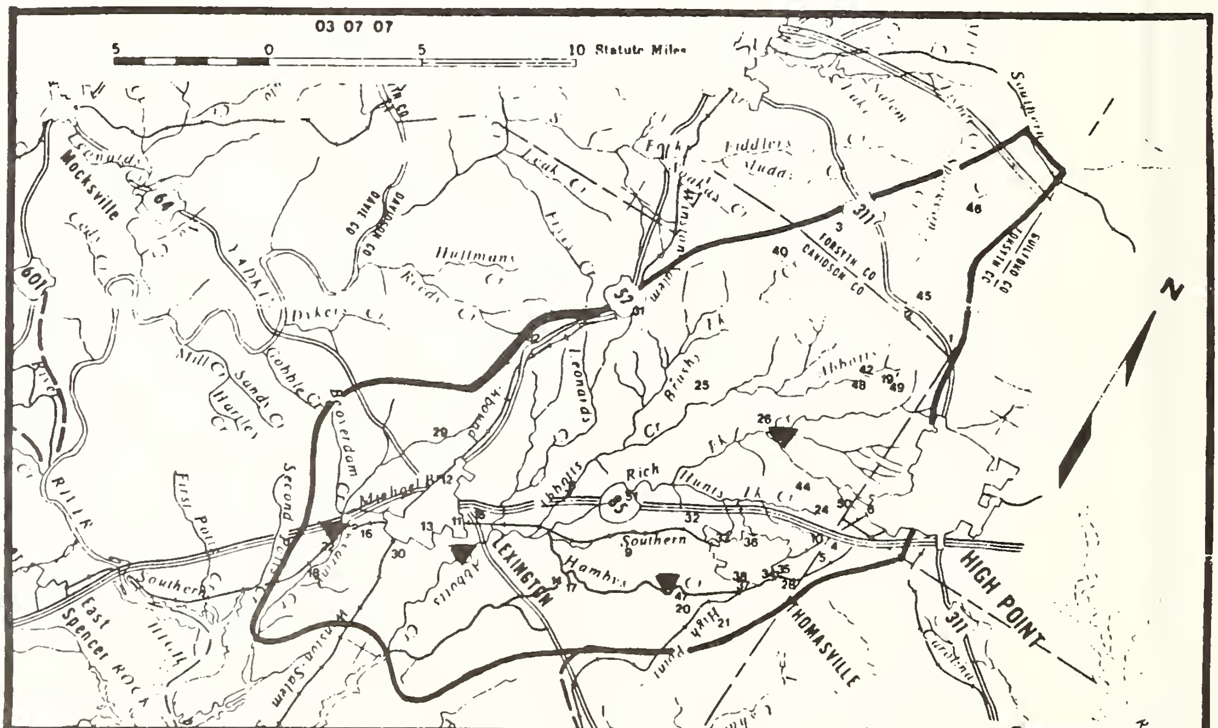

5 0 5 10 Statute Miles
03 07 03
N
CAROLINA
VIRGINIA
NORTH
PARKWAY
RIDGE
Mt Airy
Pilot Mountain
Johnson Cr
Lovills
Pauls Cr
Benson Cr
Goins Cr
Stewarts
Little Fisher River
Beaverdam Cr
Ararat
Faulknery Cr
Rutledge Cr
Stony Cr
Caddle Cr
Flat Shoal Cr
Toms Cr
Southern
Pilot Cr
Whitlier Cr
Hogan Cr
River
Grassy Cr
Little Yadkin R
Danbury
Crooked Run
Clarks Cr
STOKES CO
SURRY CO
YADKIN CO
CARROLL CO
GRAYSON CO
52

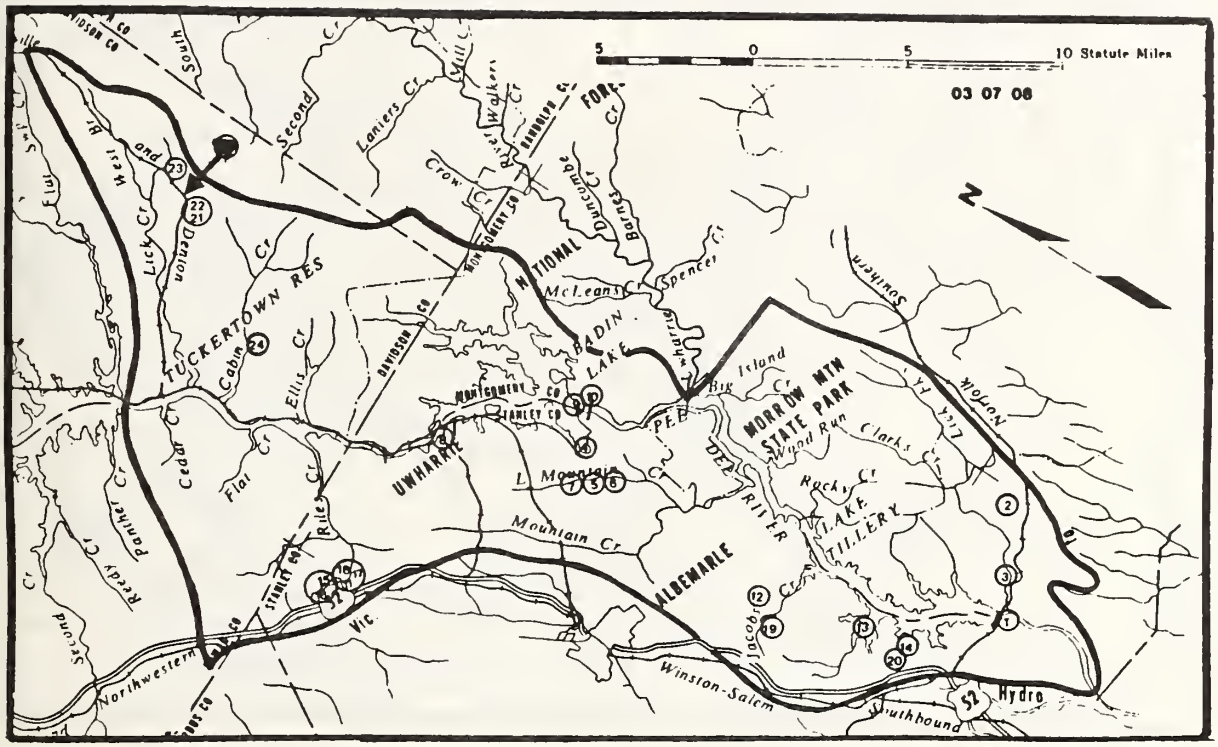
03 07 04


03 07 05
5 0 5 10 Statute Miles
158
52
85
601
64
40
21
77
Winston-Salem
Leak Cr
Fryes Cr
Vic.
Idols Dam
FORSYTH CO
DAVIE CO
DAVIDSON CO
Cedar
Dutchmons
Steelman Cr
Big Kennedy
Frost Mill Cr
Sugar Cr
Elisha Cr
Buffalo
Hullmans Cr
Reedy Cr
Leonards
Dykers Cr
Southbound
Long Br
Big Br
Hunting
Bear
YADKIN
Mocksville
Cody Cr
Gobble Cr
Beaverdam Cr
Sandy Cr
Mill Cr
Hartley Cr
Second Potts Cr
Little Cr
ROWAN CO
IREDELL CO
South
Yadkin River
First Potts
RIVER
HIGH
Lackey Cr
Bell Br
Mile Br
Yadkin
LEXINGTON
Abbotts Cr
Winston-Salem South

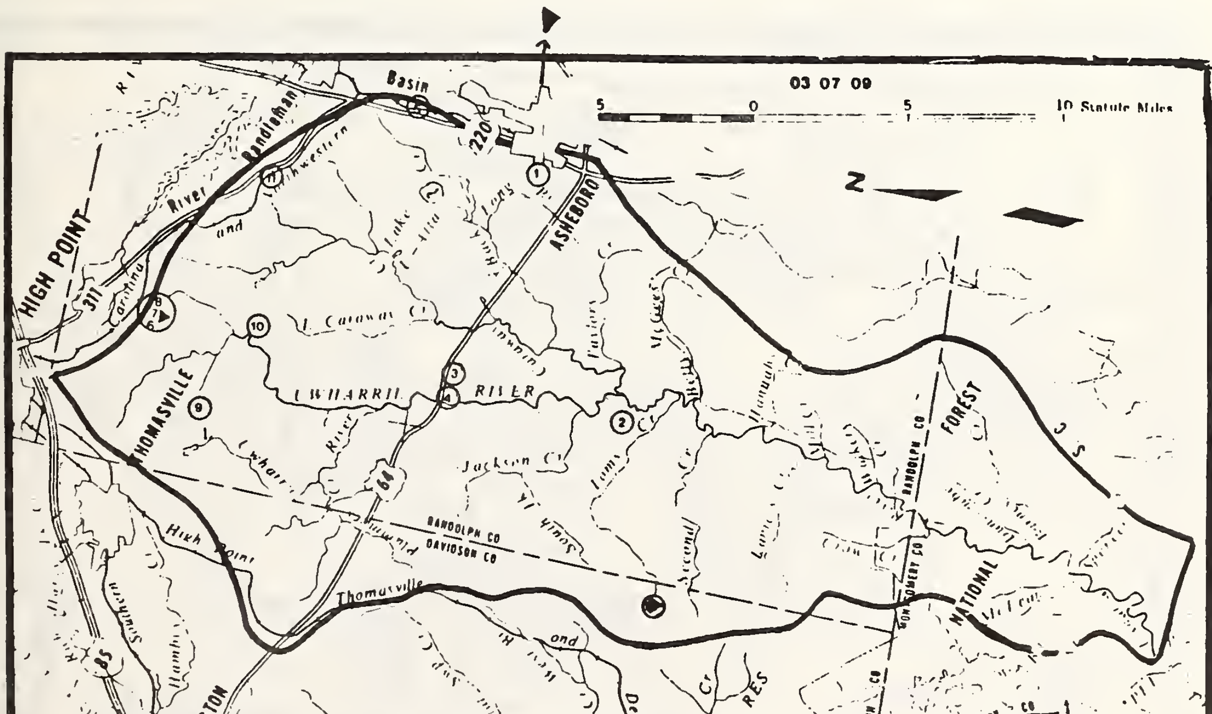

WINSTON-SALEM
HIGH POINT
03 07 04
N


03 07 08
10 Statute Miles
STATESVILLE
Troutman
Mocksville
Spencer
East Spencer
SALISBURY
Mooresville
Middleton
Stony Point


03 07 07
10 Statute Miles
Mocksville
LEXINGTON
THOMASVILLE
HIGH POINT
East Spencer
FORSYTH CO
DAVIDSON CO
GUILFORD CO

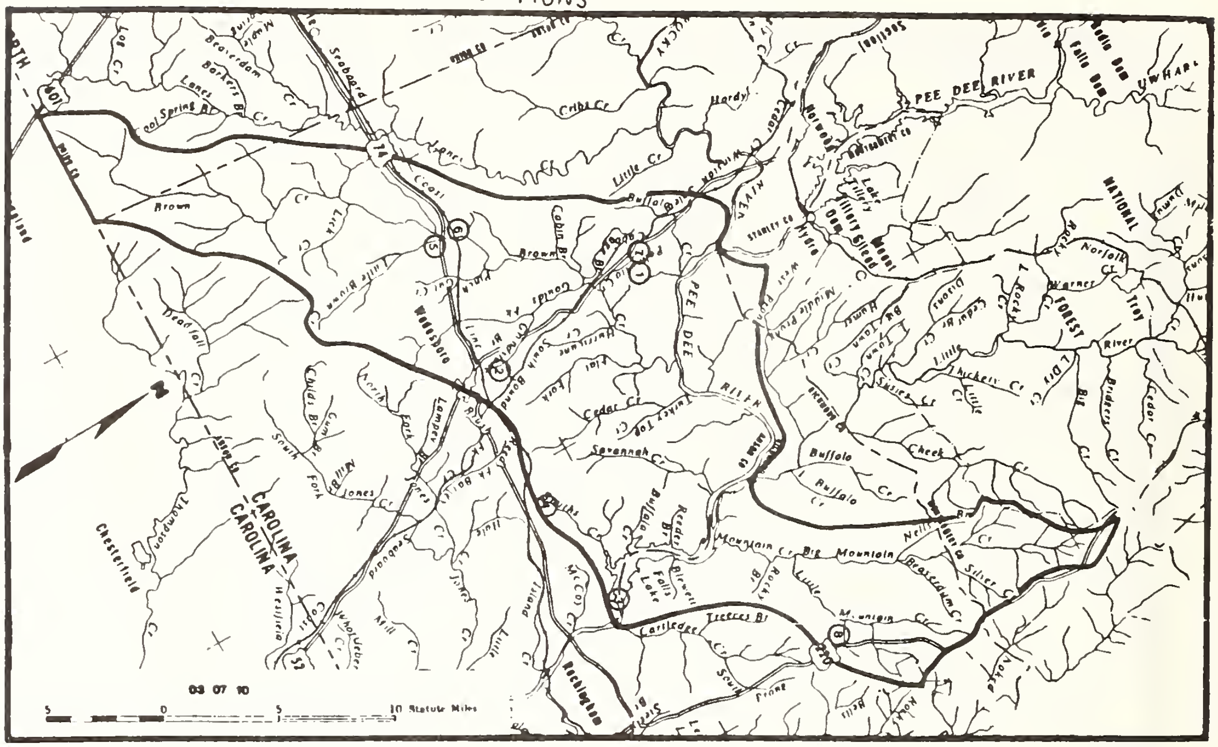


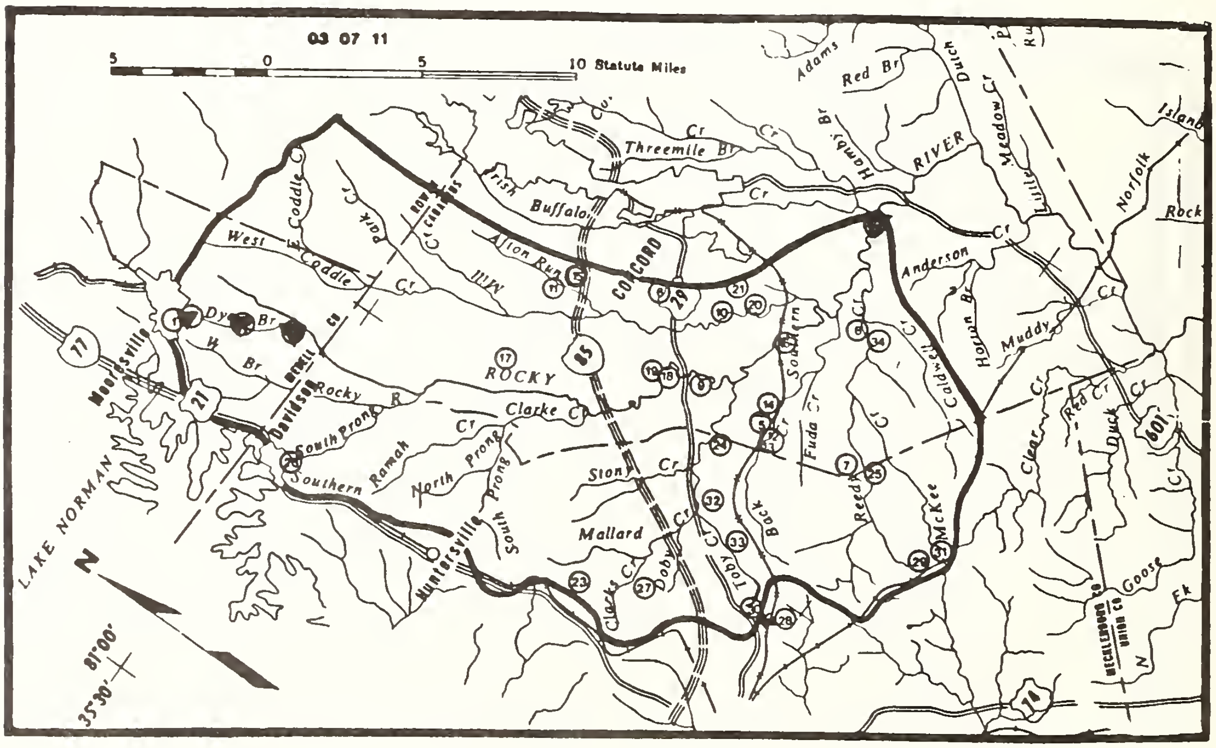
03 07 08
10 Statute Miles
TUCKERTOWN RES
NATIONAL
BADIN LAKE
MORROW MTN STATE PARK
UWHARRIE
ALBEMARLE
LAKE TILLERY
PEE DEE RIVER
Winston-Salem
Northwestern
Hydro

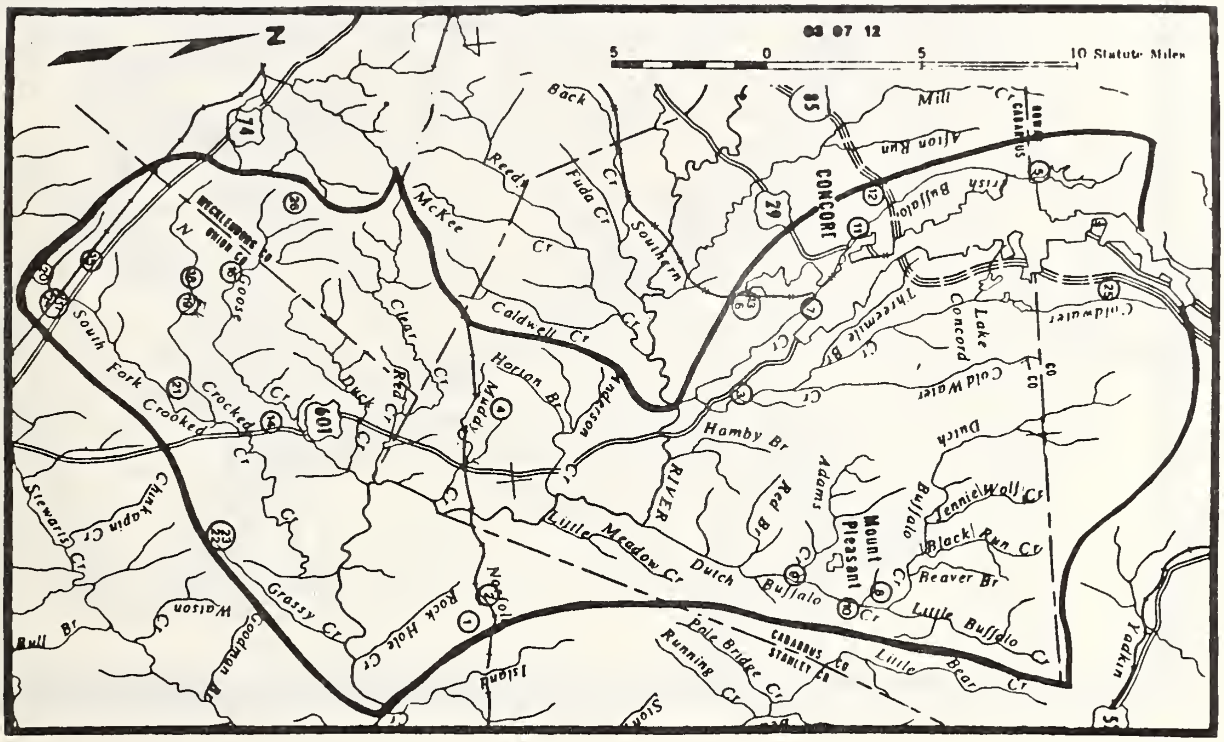


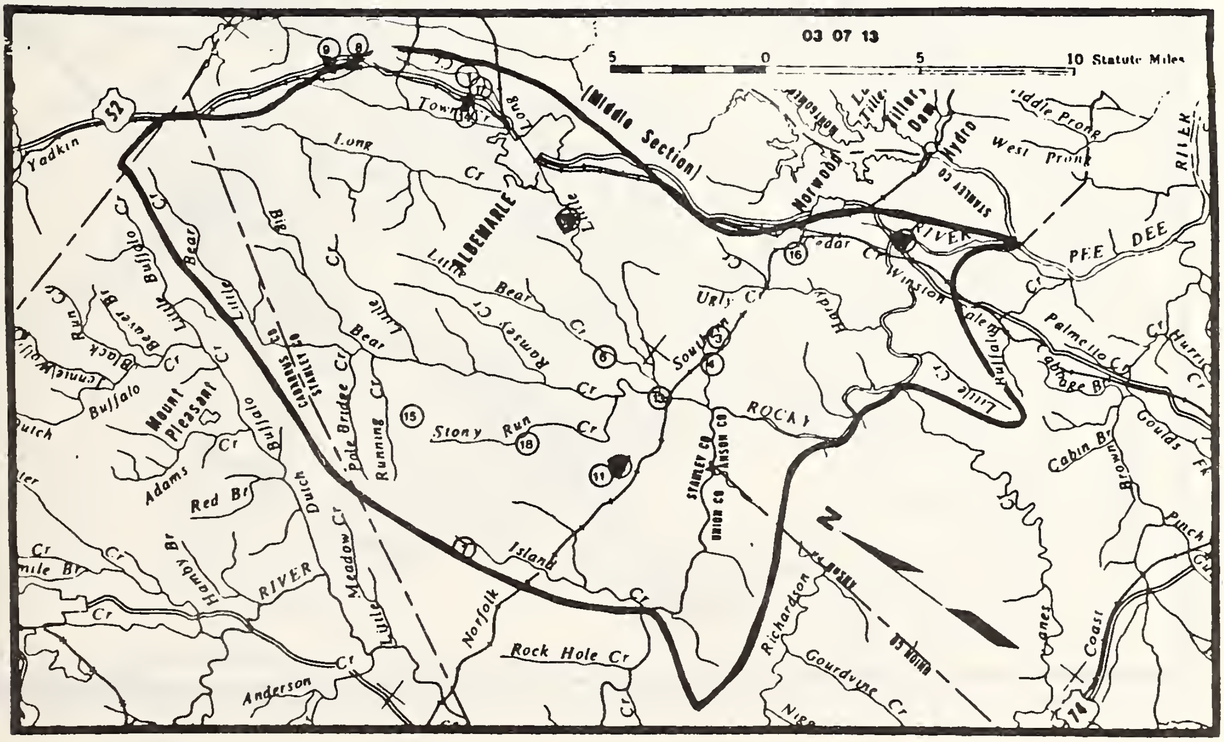
03 07 09
10 Statute Miles
HIGH POINT
THOMASVILLE
ASHEBORO
LEXINGTON
UWHARRIE RIVER
RANDOLPH CO
DAVIDSON CO
NATIONAL
FOREST
Basin

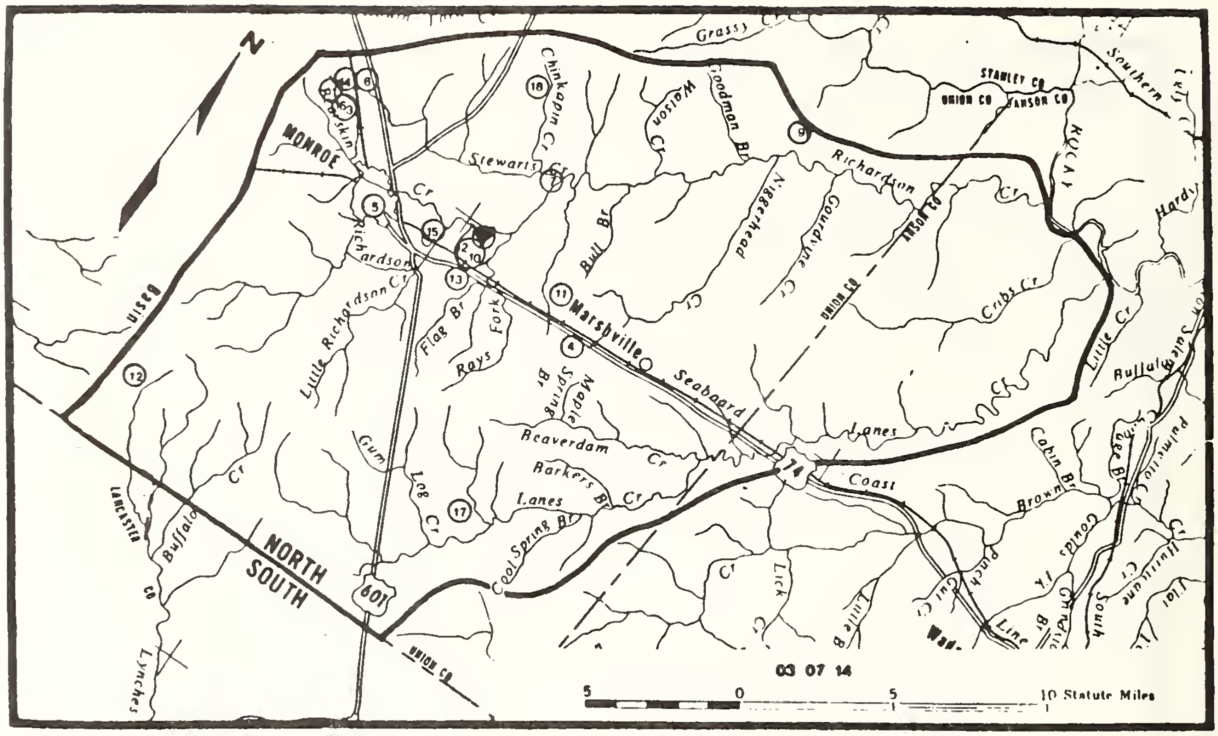
POINT SOURCE LOCATIONS

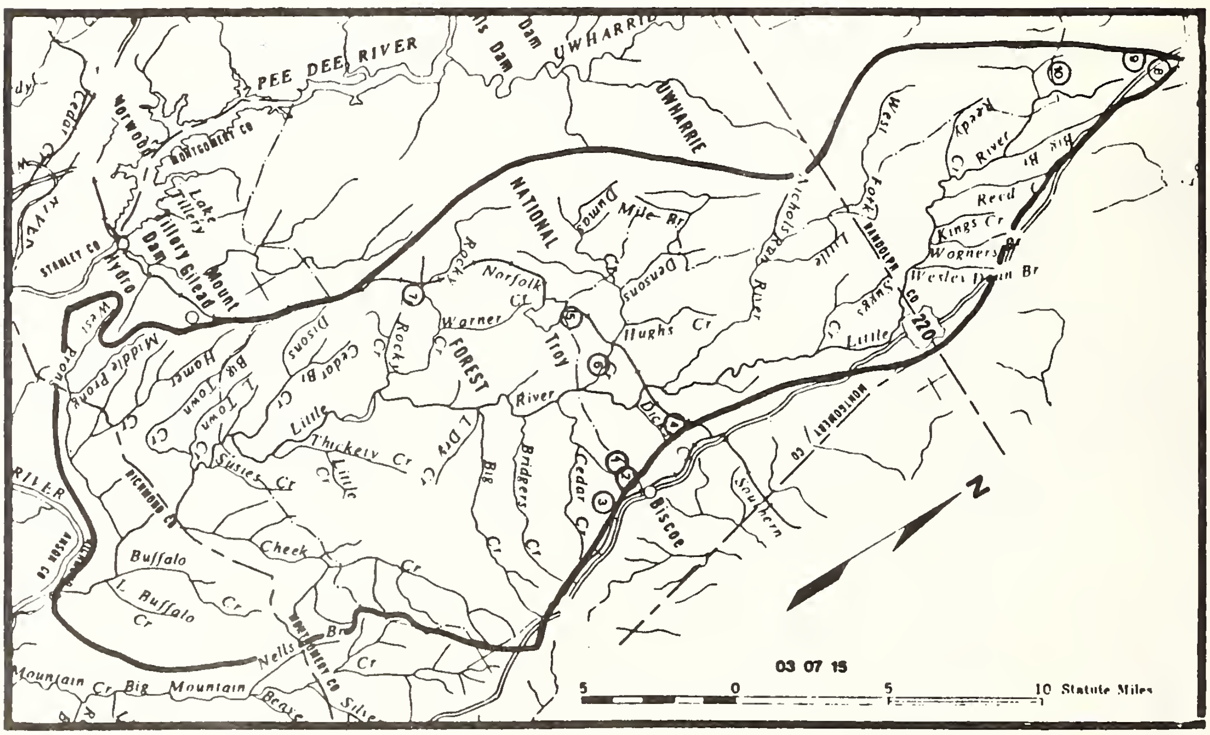


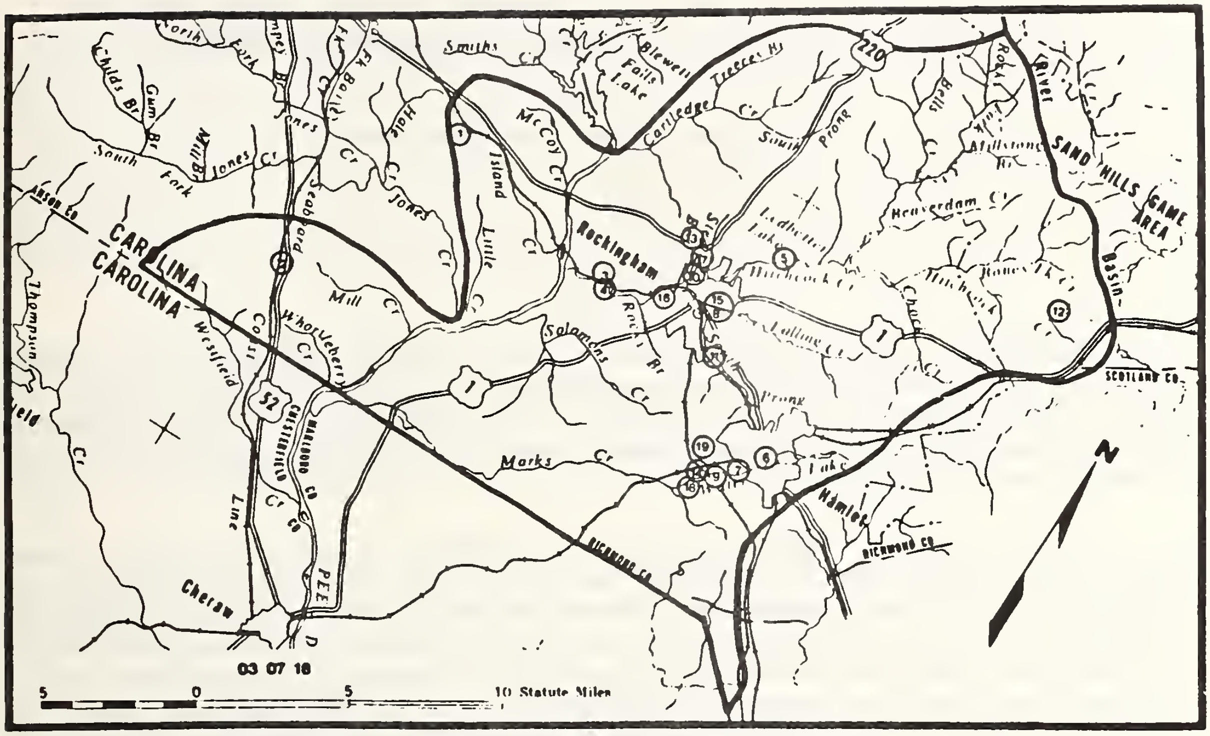



03 07 12
5 0 5 10 Statute Miles
N
CONCORD
Mount Pleasant
RIVER
Little Meadow Cr
Dutch Buffalo Cr
Little Buffalo Cr
Little Bear Cr
Pole Bridge Cr
Running Cr
CABARRUS CO
STANLEY CO
Rock Hole Cr
Grassy Cr
Stewarts Cr
Chinkapin Cr
Watson Cr
Goodman Br
Bull Br
South Fork Crooked
Crooked Cr
Duck Cr
Clear Cr
Red Cr
Muddy
Caldwell Cr
McKee
Back
Reedy
Fuda Cr
Southern
Horton Br
Anderson
Hamby Br
Red Br
Adams
Black Run Cr
Beaver Br
Lake Concord
Threemile Br
Coldwater
Mill Cr
Afton Run
Irish Buffalo
Yadkin
Island
Norfolk
MECKLENBURG CO
UNION CO
Goose Cr
74
85
29
601

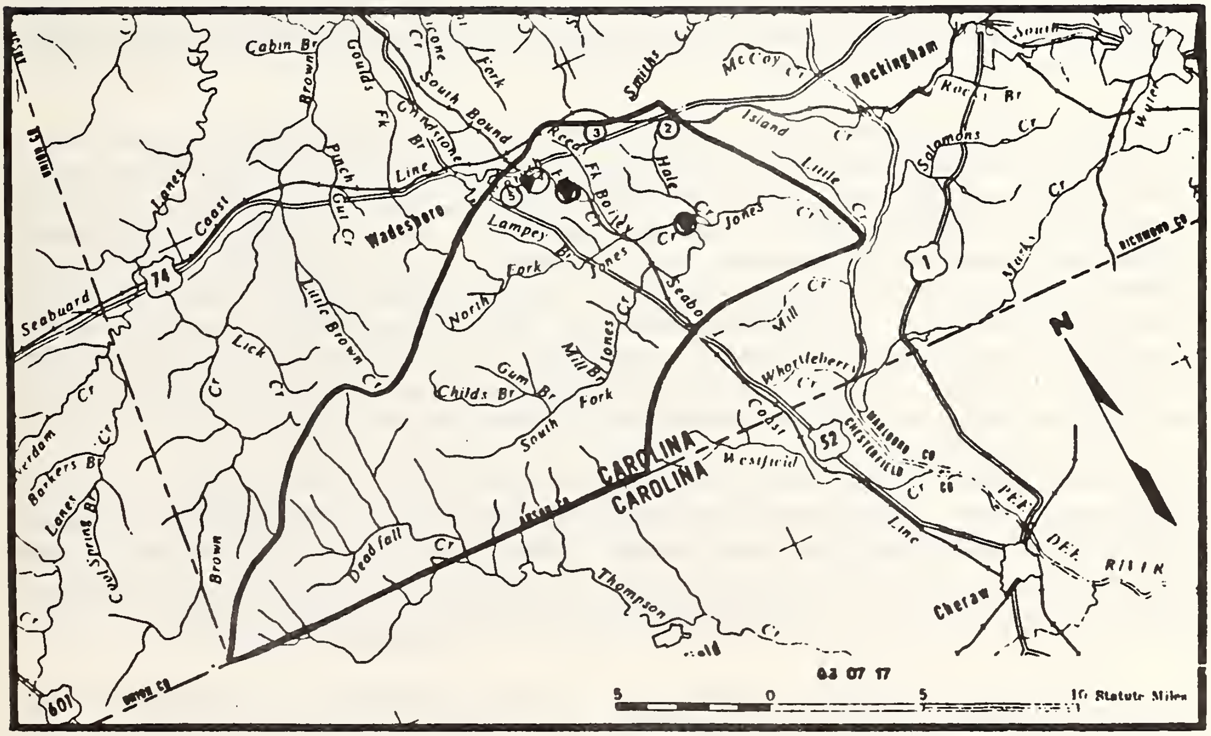

03 07 13
5 0 5 10 Statute Miles
N
(Middle Section)
ALBEMARLE
Tillery Dam
Hydro
West Prong
Middle Prong
Norwood
PEE DEE
RIVER
Yadkin
52
Long Cr
Little Bear Cr
Big Bear Cr
Little Bear Cr
Ramsey Cr
Ugly Cr
Cedar Cr
Southern
Winston
Salem
Palmetto Cr
Cabbage Br
Goulds Fk
Cabin Br
Brown
ROCKY
STANLEY CO
ANSON CO
UNION CO
Stony Run Cr
Running Cr
Pole Bridge Cr
CABARRUS CO
STANLEY CO
Mount Pleasant
Buffalo Cr
Beaver Br
Black Run Cr
Dutch
Adams Cr
Red Br
Hamby Br
RIVER
Little Meadow Cr
Norfolk
Island Cr
Rock Hole Cr
Anderson Cr
Richardson
Gourdvine Cr
Coast
74


MONROE
Marshville
Seaboard
Coast
NORTH
SOUTH
STANLEY CO
UNION CO
ANSON CO
Richardson Cr
Little Richardson Cr
Stewarts Cr
Chinkapin Cr
Goodman Br
Watson Cr
Bull Br
Niggerhead
Gourdvine Cr
Lanes Cr
Beaverdam Cr
Barkers Br
Lanes Cr
Cool Spring Br
Maple Spring Br
Flag Br
Rays Fork
Gum
Log Cr
Buffalo Cr
Lynches
Crabs Cr
Little Cr
Brown
Cabin Br
Basin
74
601
03 07 14
5
0
5
10 Statute Miles


PEE DEE RIVER
UWHARRIE
NATIONAL
FOREST
Norwood
MONTGOMERY CO
STANLEY CO
RICHMOND CO
ANSON CO
Lake Tillery
Tillery Hydro Dam
Mount Gilead
Biscoe
Troy
Little River
West Fork
Little River
Norfolk Cr
Warner Cr
Rocky Cr
Densons
Hughs Cr
Cedar Br Cr
Thickety Cr
Susies Cr
Cheek Cr
Buffalo
L. Buffalo Cr
Big Mountain
Nells Br
Bridgers Cr
Cedar Cr
Big Cr
Reed Cr
Kings Cr
Worners
220
Southern
N
03 07 15
5
0
5
10 Statute Miles



Rockingham
SAND HILLS GAME AREA
CAROLINA
CAROLINA
Hamlet
Cheraw
Marks Cr
Solomons
Mill Cr
Island
Beaverdam Cr
South Fork
Childs Br
Thompson
Westfield
SCOTLAND CO.
RICHMOND CO
CHESTERFIELD
MARLBORO CO
220
52
1
N
03 07 18
10 Statute Miles



Rockingham
Wadesboro
CAROLINA
CAROLINA
Cheraw
Cabin Br
Seaboard
Coast
Line
South Bound
Island
Little
Solomons
Marks
Whortleberry
Westfield
Dead fall Cr
Thompson
Childs Br
Gum Br
South Fork
North Fork
Little Brown Cr
Lick Cr
Barkers Br
RICHMOND CO
CHESTERFIELD
MARLBORO CO
PEE DEE RIVER
74
52
1
601
N
03 07 17
10 Statute Miles

WATER QUALITY OF THE YADKIN-PEE DEE RIVER SYSTEM, NORTH CAROLINA
Variability, pollution loads, and long-term trends

By
Douglas Harned and Dann Meyer

SUMMARY

Assessment of water quality of the Yadkin-Pee Dee River system included an identification of water-quality variation in reference to water-quality criteria, an estimation of the amount of pollution caused by man, and an evaluation of long-term trends in concentrations of major dissolved constituents.

Three stations, Yadkin River at Yadkin College (02116500), Rocky River near Norwood (02126000), and Pee Dee River near Rockingham (02129000), have been sampled with some frequency over the last 25 years. The station at Yadkin College is located downstream from Winston-Salem, a city with a (1970) population of 133,000 (U.S. Bureau of the Census, 1971) and upstream from the extensive system of lakes on the Yadkin River. The station on the Rocky River, a major tributary to the Yadkin-Pee Dee, is located near the confluence of the Rocky River with the Pee Dee River. The station on the Pee Dee River near Rockingham is close to the North Carolina - South Carolina state line.

A network of temporary stations located on small rural streams was used to define essentially unpolluted water quality. The constituent concentrations measured in these streams were extrapolated to the Yadkin-Pee Dee River system in order to estimate baseline loads of the major chemical constituents.

The Yadkin-Pee Dee River system is an important water-supply, and a valuable recreational and ecological resource. The basin is currently (1980) the subject of a large-scale Level B planning study designed to define the problems of and propose options for effective management of water-resources allocation, development, and use. Reports that have been written in various stages of this comprehensive planning effort list: sediment and nonpoint-source pollution, protection of water supplies, optimal operation of hydro-power and flood-control lakes, and pollution control as just a few of the Yadkin-Pee Dee basin problems that must be addressed in future management of the river system.

The Yadkin-Pee Dee River system plays an important role in waste disposal. Much industrial effluent is treated by municipal treatment plants. The total average waste-water input to the Yadkin-Pee Dee River system upstream from Rockingham 325.3 ft^3/s is approximately 29 percent of the 7-day, 10-year minimum flow at that station (1,110 ft^3/s).

Specific conductance shows no extreme values at the Yadkin College and Rockingham stations. However, the large range and relatively high values measured for the Rocky River near Norwood is an indication of pollution.

Dissolved-oxygen values measured at the three stations are lowest for the Pee Dee near Rockingham, probably due mainly to the low dissolved-oxygen levels of water discharged from the bottom of Blewett Falls Lake, which is not far upstream from the station. Diel patterns of dissolved oxygen typically show a dependance on variation of water temperature. In addition, during summer months a midday rise in the dissolved-oxygen concentration is probably due to algal photosynethesis. Short-term declines in dissolved-oxygen concentrations in the Yadkin River at Yadkin College are often associated with the first flush of storm events.

Values for pH show the Yadkin-Pee Dee River system to be slightly acidic in reference to the U.S. Environmental Protection Agency (1976) criteria recommended for the protection of fish populations. Fifty percent of the pH measurements of the Yadkin River at Yadkin College, 20 percent of the measurements for the Rocky River near Norwood, and 30 percent of the Pee Dee River near Rockingham measurements are below 6.5 pH units.

The major cation in the Yadkin-Pee Dee River system is sodium and the predominant anions are bicarbonate and carbonate. As with specific conductance, concentrations of major dissolved constituents are generally highest at Norwood. However, these concentrations are still satisfactory for most uses of the water. Specific conductance can be satisfactorily related to most dissolved-constituent concentrations.

Iron and manganese are the only trace elements that appear in concentrations consistently above levels suggested for domestic water supply. Lead concentrations exceed U.S. Environmental Protection Agency (1976) criteria for domestic water supply in 6 percent of the samples from Yadkin College and 8 percent of the Rockingham samples. All of the samples taken at the Norwood station, 56 percent of the Rockingham samples and 53 percent of the Yadkin College samples exceeded mercury concentrations recommended for the protection of aquatic life.

Suspended sediment is the most significant water-quality problem of the Yadkin-Pee Dee River system. The levels of suspended sediment are high in comparison to levels observed in pristine streams; however, impacts of sediment are so numerous that the effects of these high levels are difficult to quantify. The response of suspended-sediment concentration to storm discharge of the Yadkin River at Yadkin College is double-peaked. The first peak in suspended-sediment concentration represents the hydrologic response of Muddy Creek, a tributary draining the south of Winston-Salem. The second peak in suspended-sediment concentration is the response of the Yadkin River. The Muddy Creek peak occurs prior to the peak in discharge demonstrating what is termed the "first flush" effect. Suspended-sediment response during floodflow has not been recorded in detail at either of the other two stations. The response at Rocky River is rapid and probably similar to Yadkin College. The changes in discharge at Rockingham are nearly paralleled by changes in sediment concentration, due to the large basin area and the lakes upstream.

Suspended and total lead concentrations behave similarly to suspended-sediment concentrations during storm events. Only dissolved arsenic and dissolved selenium show dilution during storm events. Total nutrient concentrations tend to increase during stormflows, while dissolved nutrient concentrations tend to decrease.

High nutrient concentrations in the river system provide a rich medium for algal growth. Eutrophication is currently a problem in the Yadkin-Pee Dee lakes, particularly High Rock Lake. Approximate nutrient and sediment balances of the lake system indicate that the lakes serve as a sink for sediment, ammonia nitrogen, and phosphorus. The ammonia reduction between input to, and output from the lake system is due primarily to oxidation to other nitrogen species. The phosphorus reduction is probably due to consumption by algae, and precipitation with sediment. The predominance of evidence indicates that phosphorus is limiting.

Algal data indicate that organic pollution has been increasing since 1975. Algal diversity indices and genus identification show the river system to be moderately eutrophic. In the Yadkin River at Yadkin College diatoms and blue-green algae dominate the phytoplankton assemblage. Diatoms dominate the assemblage observed for the Pee Dee River near Rockingham. The reduced occurrence of blue-green algae indicates that the water is less eutrophic at Rockingham than at Yadkin College.

Fecal coliform and fecal streptococci bacteria occasionally peak above the U.S. Environmental Protection Agency (1976) criterion levels recommended for body contact. The ratio of the fecal coliform count to the fecal stroptococci count for the Pee Dee River near Rockingham indicates that fecal contamination at this point in the river is primarily of non-human origin.

An approximation of pollution in the Yadkin-Pee Dee River system was determined by subtracting estimated baseline constituent loads from measured total loads. In order to evaluate baseline loads from the baseline water-quality network, an estimate of the proportions of base flow and high flow that make up the total flow is needed. For the Yadkin River at Yadkin College base flow was estimated to be 54 percent with high flow 46 percent of the total volume of flow. At the Rocky River near Norwood the base-flow component of the total annual discharge was 26 percent with a corresponding high-flow component of 74 percent. Meaningful estimates were not possible for the Pee Dee River near Rockingham because of the upstream lakes, so the proportions of high and base flow were each assumed to be 50 percent of the total flow.

Pollution makes up approximately 59 percent of the total dissolved-solids load of the Yadkin River at Yadkin College, 43 percent for the Rocky River near Norwood, and 29 percent for the Pee Dee River near Rockingham. However, on the basis of loads per square mile of drainage area, Rocky River near Norwood has the greatest mean total load and mean pollution load.

Dramatic, statistically significant trends are evident in major dissolved ionic constituent concentrations at all three stations. The trends over time seen in dissolved sodium and chloride are typical of the overall pattern of water-quality change. The pattern shows increasing concentration with time, with a leveling off and decline in the mid to late 1970's. The pattern shows the most extreme rise and fall for Rocky River results, while the decrease is less pronounced for the Pee Dee River near Rockingham and least apparent with Yadkin River at Yadkin College results.

These trend patterns suggest that something happened in the mid 1970's to bring about an improvement in the long-term deterioration of water-quality of the Yadkin-Pee Dee River and the Rocky River. This time period corresponds to general improvement of waste-water treatment and changes in industrial processing aimed at reducing pollution in the basin. Processes used in municipal waste-water treatment do not normally reduce dissolved-constituent concentrations. Therefore the reductions in concentrations seen in the Rocky and Yadkin Rivers are probably due to changes in industrial processing. One change that may account for the reduction is the recent conversion at textile mills from processing of primarily cotton fabrics to synthetic fabrics.

The trend of dissolved sulfate shows a relatively steady increase in concentration over time. Increases in sulfate and nitrate concentration are probably largely a result of the increasing acidity of precipitation with time. The acids carried by rain and other precipitation are made up predominatly of sulfur and nitrogen compounds. Decreasing trends in pH with time in the Yadkin-Pee Dee River system illustrate the large-scale effect of the increasing acidity of precipitation.

A dramatic decrease in weighted sediment concentration over time has occurred in the Yadkin River at Yadkin College. This decrease is probably due to agricultural land-use changes that have occurred in the basin, and to improved erosion-control.

Relations between water-quality and population provide rough means of predicting future water quality. However, projections made with these simplistic relations must be used with care.

The ongoing collection of water-quality data by the U.S. Geological Survey and other agencies reflects the growing awareness of the need to accurately assess the water quality of the Yadkin-Pee Dee River system on a continuing basis. Growing environmental awareness and improved laboratory techniques have promoted accurate identification and routine monitoring of of many important trace materials in water, including man-made substances only recently created. These data, along with the framework provided by improved data-analysis techniques, will be invaluable in future assessments of the water quality of the Yadkin-Pee Dee River system.

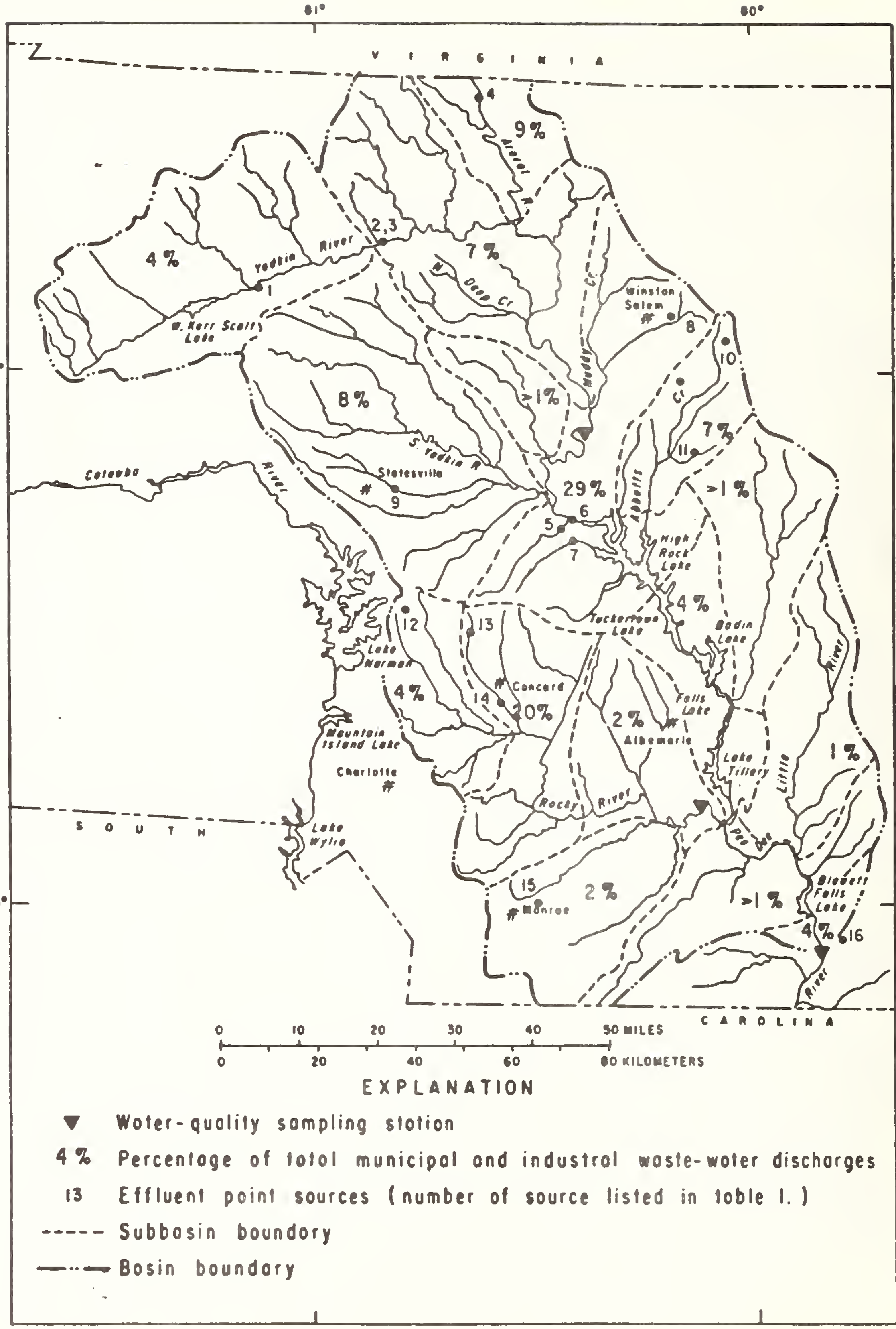


Figure --Percent of total industrial and municipal point-source waste-water discharge originating in each Yadkin-Pee Dee subbasin.

LAND APPLICATION OF MUNICIPAL WASTEWATER: AN ALTERNATIVE FOR RESOLVING POINT SOURCE POLLUTION

Donald J. Epp*

During the past decade of environmental concern, conventional methods of treating municipal sewage have been found wanting. In the jargon of the Water Pollution Control Act, municipal sewage plants using secondary treatment and discharging the effluent into a stream or lake are frequently found to be point sources of pollution. In some cases the biochemical oxygen demand (BOD) levels of the effluent are judged to be too high for the receiving waters, but more frequently the nitrogen and phosphorous levels cause excessive rates of eutrophication of the lake or stream.

Disposing of the effluent is not the only problem facing municipal treatment plant operators. Primary and secondary treatment produce sludge that must be placed somewhere. In the past, the city dump or a vacant field frequently sufficed. Bigger coastal cities dumped it into the ocean. A few communities incinerated it. All of these methods have been found to pose hazards and have either been eliminated or severely restricted as options.

In the search for alternative ways to treat sewage and to find acceptable ways for disposing of effluent and sludge, we have come to realize that it is very expensive. If we must rely on chemical-physical techniques for removing nitrogen and phosphorous from the effluent, treatment costs will skyrocket. Landfills that meet the requirements for disposal of sludges are scarce and transportation to acceptable locations is expensive. It is against this backdrop of expensive technological alternatives that managers have rediscovered the original waste disposal technique -- land application. Research has been needed to develop ways of applying wastewater (both effluent and sludge) to the land to insure that harmful effects do not occur and to determine the economic feasibility of this alternative. This paper reviews briefly some of the research conducted at The Pennsylvania State University and elsewhere which suggests that land application is a realistic alternative for many communities.

LAND APPLICATION OF EFFLUENT

The pollutants of most concern in effluent from secondary treatment plants are plant nutrients, specifically nitrogen and phosphorous. These nutrients stimulate the growth of acquatic plants and algae, in many cases leading to reduced levels of dissolved oxygen in the receiving stream or lake. This in turn can cause fish to die and result in serious odor problems. The very substances which are pollutants in the water, however, are valuable when applied to cropland or forests. Results from the Penn State Wastewater Demonstration Project illustrate the response of several important agricultural crops to different levels of effluent application (Table 1).

* *Professor of Agricultural Economics, Assistant Director of the Institute for Research on Land and Water Resources, The Pennsylvania State University*

The results in Table 1 also illustrate part of the management problem when applying effluent to crops. As more effluent is applied, more nutrients are applied and yields increase. But, some crops cannot tolerate high levels of water application and yields are hurt. Both corn grain and corn silage yields increase up to irrigation rates of 2.0 inches per week but fall at higher rates of irrigation. Thus, the manager must select crops that remove nutrients from the water as they move through the soil, produce crops which may be sold to offset at least some of the costs, and accept wastewater application for most, if not all, of the year.

Several models have been developed to assist managers in choosing crop and irrigation systems for effluent application. In a study at Penn State, we examined the costs of various cropping systems for a treatment plant discharging 3 million gallons per day (mgd) of effluent. This would serve a community of 25,000 to 30,000 people. Under climatic and soil conditions found in central Pennsylvania and using crops tested at the Penn State Wastewater Project, we found that producing reed canarygrass, silage and irrigating year around gave the lowest annual cost. It would take 309 acres of reed canarygrass to handle the effluent if 2.5 inches were applied each week. Other crops, such as corn, grain or silage, produce greater crop values, but effluent can only be applied for about 7 months of the year. Additional storage must be built to hold the effluent when it cannot be applied and additional land must be obtained to apply the stored effluent the following season.

Several restrictions were applied to this optimization program to examine their effects on costs. A two-inch application restriction was considered as was an irrigation season limited to 285 days per year. The latter restriction coincides with the EPA recommendation for land application systems in central Pennsylvania. In every case the system was restricted such that nitrate concentrations in the perculant below the root zone are projected to be less than 10 parts per million, the standard for drinking water.

The results of examining these restrictions are shown in Table 2. Reed, canarygrass silage was the crop producing the least cost solution in all cases. When the application rate was constrained to 2 inches per week, the number of acres used increased by 78 and the annual cost increased $43,000. Limiting the irrigation season to 285 days but permitting irrigation rates up to 2.5 inches per week created the need for a still larger system (396 acres) and incurred costs of $131,000 per year above the basic situation.

While the results shown by these studies apply to northern conditions, similar results can be expected for the South. Costs can be expected to be substantially below other alternatives for small to medium sized treatment plants and costs will be reduced if the cropping system chosen permits year-around application of effluents at high rates of application. It is expensive to store effluent because one must build the storage facility and build a bigger application area.

LAND APPLICATION OF SLUDGE

The sludge from municipal wastewater treatment can be very dangerous or very valuable as a soil additive depending on the nature of the sewage treated. Many of the nutrients and all of the organic matter in the wastewater that is not digested in the treatment process goes into the sludge. These ingredients are useful when applied to farmland. The sludge also contains any heavy metals and many of the organic chemical pollutants in the sewage. These constituants must be carefully controlled in determining where sludge can be applied.

The easiest sludge to consider for farmland application is that coming from systems that serve exclusively residential communities. Most of the seriously contaminated sludges result from treatment of industrial wastes, although copper and lead may be found in sludges from residential areas.

Farmers in many parts of the nation use municipal sewage sludge as a source of plant nutrients and to increase the organic matter in the soil. A recent study in Pennsylvania showed that typical sludge was worth about $10 per ton of dry matter. This value assumed an average dairy farm in central Pennsylvania and price relationships as experienced around 1980. It was also assumed that the sludge was applied to the field by the sewage treatment authority at a time convenient for farm operations. These conditions were found to be typical of current practices in Pennsylvania, but may not hold for conditions where large numbers of sewer authorities wish to apply sludge to farmland. If a liquid sludge was applied that contained nine percent nitrogen (dry matter basis), the value of the sludge to the farmer

increased to a little over $21 per ton of dry matter. This sludge represents near the maximum nitrogen content available in sludge.

The Pennsylvania study assumed a sludge with extremely low levels of heavy metals and organic contaminants. This is the type of sludge now applied to farmland in Pennsylvania and it eliminates the need to consider loading limits for various contaminants. If sludges from a wider range of treatment plants is to be considered for farmland application, care must be taken that various heavy metals and organic compounds are controlled. Soil scientists and other researchers on the health aspects of these contaminants have formed a regional research committee in the Northeast to develop recommendations about annual and lifetime loading limits for various constituents. These limits will serve to reduce the damage to plant production and marketability that would result from excessive application of the potentially harmful constituents in sludge. Since these recommended limits vary greatly for regions with different soils and climate, I anticipate that similar recommendations will be developed for each region of the country.

Another use of municipal sludge that is gaining in popularity is for the revegetation of disturbed sites. The most widely known use of this type is for revegetating strip mined areas, but the technique may also be used along new highway construction, shopping center or industrial sites where it may be difficult to establish a vegetative cover. The advantage of these sites for sludge disposal is that the vegetation grown usually does not enter the human food chain. In such cases the loading limit for some heavy metals and organics can be increased. Thus, sludges that may not be suitable for farmland application can be used on disturbed sites intended for forest or other non-food uses.

COMMUNITY ACCEPTANCE OF LAND APPLICATION

One of the biggest obstacles to land application of effluent or sludge is gaining the acceptance of people in the receiving area. The concerns of citizens in the area generally fall into four broad categories.

Most people recognize that raw sewage is a health hazard because of disease organisms present. Thus, the first major category of concern is with the health hazard sludge or effluent application might present for the community. Many people do not realize that what is applied to the land is not raw sewage but rather the residual after substantial treatment to kill disease organisms. A combination of educational programs and safety precautions, including buffer zones and monitoring can usually overcome the objections due to disease.

The second category is related to the first but is more difficult to counter. People are usually concerned about hazardous contaminants in the sludge or effluent that may have long lasting effects on the quality of the land or water in the area. Although the general public may not have a scientific knowledge of heavy metals and organics, most people know that these substances can cause terrible health problems that can affect a large area. Furthermore, many people realize that the health effects may take a long time to appear but once they do, it may be impossible to clean up the contaminated soil and water. Rather than run that risk, people would rather not have sludges and effluent spread in their communities.

This source of concern is a legitimate one because sludges can contain heavy metals and organic pollutants that will cause long term damage. At the same time we know that few, if any, sludges are completely free from all possible contaminants. We also know that small amounts of these contaminants are present in many sludges but that no harmful effects have been noted from long-term exposure to such low concentrations of the pollutants. Wise management of wastewater requires that sludges with very low concentrations of heavy metals and organics be considered for land application under careful controls. The problem for discussion and education is to determine the acceptable level of risk and manage the sludge application in such a manner as to satisfy everyone that care is being exercised.

A third concern about land application, especially of sludge, is the hauling of sludge to the application site. During application periods large tank trucks or dump trucks may be traveling rural roads. This increased traffic of heavy trucks may be objectionable to some people. On certain road surfaces it may cause extra dust and noise. If the hauling is not done carefully, sludge may be spilled on the road, creating unsightly and sometimes dangerous conditions. Most of these problems can be resolved with planning and careful operations. Hauling routes and times can be planned to minimize congestion and conflict with other road users. Well maintained equipment and operators trained to be sensitive to prevention of noise and spillage can usually prevent serious objections.

The final broad concern frequently expressed about effluent irrigation proposals is their impact on local tax revenues and services. Some proposals for land application of effluent have called for thousands of acres in public ownership. What would this do to tax revenues of schools and local governments?

Researchers at Penn State University examined a proposed land application program to determine its impact on revenues and expenditures of local governments and school districts. The plan called for over 15,000 acres of land in 5 sites to be devoted to irrigation. The people living on the land would be relocated, allowing some roads to be closed. The study examined the effect on revenues of schools and governments from public acquisition of the land and the likely effects on expenditures if the people who moved off of the land located within the same municipality or school district.

The results of this study are shown in Table 3. Most of the impact is borne by one school district, although one of the municipalities had a comparable percentage impact on net revenues. Smaller projects involving less than 1,000 acres probably would have a negligible effect on local governments and schools. An area of that size could serve a community of 50,000 people in most areas of the U.S.

It must be remembered that land application programs provide benefits to the local area as well as problems and concerns. The most obvious benefit is the reduced cost of sewage treatment services. This not only benefits the residents of the city or town served, but may be attractive to certain industries. A study of sewage treatment for poultry processing plants showed that they could obtain substantial savings by jointly treating their wastewater with the local community. From Table 4 it can be seen that a small poultry plant could expect to spend 157.9 cents per thousand gallons of wastewater treated if it treats only its own wastes. By joining with a city of 20,000, it could reduce costs by more than 50 percent. A large plant could save about 30 percent. The municipality would also save by joining with the poultry plant. Savings in sewage treatment costs can make a community attractive to industries with large volumes of sewage to treat. Such a plant would provide employment opportunities for people from the surrounding areas as well as the town or city served by the sewer.

Sludge applied to farmland provides plant nutrients at much lower cost than commercial fertilizers. Sludges applied as part of a revegetation program for strip mined or other disturbed sites helps to reclaim and beautify the area.

Another advantage for the local area is the cleaner streams that result from applying the effluent to the land. In addition, the perculating water will add to the groundwater available. In some regions, this is a significant advantage. The effluent spray sites also provide long-term open space. In addition to a scenic attraction, they may be opened to public hunting or other compatable recreational uses.

In summary, land application programs for sludge and effluent application can provide significant benefits to the application area. The challenge is to devise programs that balance the disadvantages with benefits so that both the users and the sewer system and the residents of the application area realize a benefit.