

# WATER RESOURCES RESEARCH INSTITUTE

OF THE UNIVERSITY OF NORTH CAROLINA

Number 237

August-September 1986

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## SPECIAL

### N. C. Farmers Becoming Better Water Managers

by Tom Byrd, Dept. of Agricultural Communications, NCSU

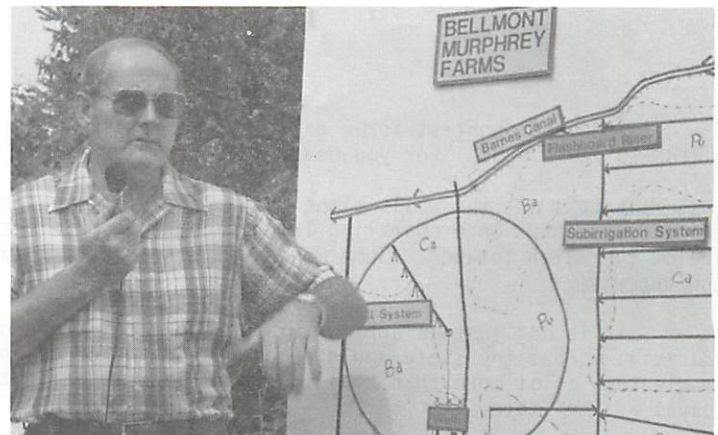
Edgecombe County farmer Bellmont Murphrey is a pioneer in a new agricultural practice that is spreading like crabgrass across the Coastal Plain and Tidewater.

The practice is controlled drainage, and it could have a big impact on North Carolina's future water supply.

Like generations of eastern North Carolina farmers before him, Murphrey needed ditches to keep his crops from drowning in wet weather. But these same ditches were "draining his crops to death" during drought.

Murphrey's solution was to build a control device on his main ditch that would permit the release of water during periods of high rainfall and the conservation of water at other times. Then as a further step, he installed a pump on an adjacent stream to refill the ditches during periods of drought. Thus, water can flow from the ditches as well as to them in a process called "reverse drainage" or "subsurface irrigation."

Since he installed his water management system in 1968, Murphrey says it has consistently helped him to produce high corn yields. He was the county's corn-growing champ in 1985 with a 180-bushel average on his 70-acre field. His 1986 crop looks equally good despite weeks of drought in the area.



Bellmont Murphrey explains the water management system on his Edgecombe County farm.

"As far as we know, Bellmont was the first farmer in North Carolina to use controlled drainage with sub-irrigation successfully," said Robert Evans, an extension biological

and agricultural engineer at North Carolina State University. As late as 1980, only three systems were known to exist in the state. These were Belmont's and two research systems, involving a total of about 200 acres. Today, water is being managed by this method on at least 3,000 acres, Evans estimates.

Farmers have actually installed controlled drainage systems on about 30,000 acres but have combined controlled drainage with sub-irrigation on only about 3,000 acres. About half of the controlled drainage systems have been installed in the last 18 months, Evans said. They are becoming particularly popular in the Albemarle area. One farmer there, the late George Wood of Camden, had installed 18 "flashboard risers" to control the water leaving his farm. Just recently, a group of farmers in Bladen County decided to install a controlled drainage system on the 400-acre Lyon Swamp watershed.

Interest in improved water management is being prompted by both economics and environmental concerns, said Evans. It will increase yields, especially on corn, peanut and vegetable crops. It will reduce agricultural pollutants getting into streams, help regulate freshwater intrusion into estuaries, improve wildlife habitats and help maintain the water table level.

One study, for example, by Dr. Wendell Gilliam, a soil scientist at NCSU, showed 25 percent fewer nitrates leaving a watershed with controlled drainage.

Evans said the financial crunch in agriculture has increased interest in controlled drainage because it offers a lot of benefits and is relatively inexpensive. On the other hand, the crunch has slowed the adoption of sub-irrigation because of the expense.

Murphrey was fortunate because he had a nearby stream, suitable soil type and a good system of lateral ditches when he installed his system. As a result, he only spent about \$50 per acre. On the other hand, the Jack H. Winslow Farms, Inc., Rt. 1, Palmyra, reported spending \$650 per acre in 1984 to install a system of deep wells and drain lines for sub-irrigation.

Of the 6 million acres of cropland in North Carolina, Evans estimates that about 2.3 million acres could benefit from controlled drainage and about one million could benefit from both controlled drainage and sub-irrigation.

As a result of about 15 years of research, agricultural engineers with the U. S. Department of Agriculture and N. C. State University feel that they have sound information on which soils will benefit and how systems for each soil type should be designed and managed. This information has been summarized in a guidebook on water table management for Eastern North Carolina. A copy of this guide can be found in local offices of the Agricultural Extension Service and Soil Conservation Service.

*(Editor's Note: The Water Resources Research Institute and the Agricultural Research Service have supported and continue to support research on agricultural water management. Currently, WRRRI is supporting Dr. Robert O. Evans and Dr. R. Wayne Skaggs of the Department of Biological and Agricultural Engineering, and Dr. J. W. Gilliam of the Department of Soil Science at North Carolina State University in a research project to evaluate, at seven agricultural sites in the coastal region, Best Water Management Practices. Each site is being evaluated on the basis of water conservation and utilization, drainage volume and drainage water quality and seepage volume, and quality of groundwater.)*

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## EDITORIAL

### Water Policy in Leaky Bucket

*The News and Observer*

In these drought-stricken days, no one is likely to get a smile by repeating what American writer Rowland Howard said 110 years ago: "For you never miss the water until the well runs dry."

But it's not the wells alone that are drying up as North Carolina combats the kiln-like heat and aridity of a record drought. Once sparkling irrigation ponds have become mud flats. Levels in some city reservoirs have dropped below the water intakes. Some municipal boards have adopted mandatory conservation and are trying to borrow water from neighbors.

This is not just an agricultural drought but a hydrologic drought. A steady, soaking rainfall of several days' duration across the state would be a godsend for crops and forests, for lakes, rivers and irrigation ponds. But it would take a lot more than that to erase rainfall deficits and replenish aquifers--underground water supplies--in many parts of the state.

The elements once again warn the state of its dangerous lag in long-term plans for water conservation, storage and preservation. In 1980, a committee headed by former House Speaker Carl Stewart urged that a comprehensive study be made of long-range water needs. Such a study in New Jersey took six years and cost \$1.2 million.

North Carolina's hydrologic system is more complicated than New Jersey's. But no similar effort has been made here, though the state has had droughts of varied severity in the past six years. Meantime, increases in population, watershed development, irrigation and industrial growth are creating more severe problems in water supply and distribution.

A combination of heavy drawdown and drought have dropped underground water levels to the danger point at many places. This includes a number of counties in the Northeast that depend upon a key aquifer shared with Virginia. Surface water already inadequately stored in many places is threatened, too, by growth and pollution in watersheds.

Water experts warned five years ago that three major river basins--the Neuse, the Cape Fear and the Catawba-Broad--were approaching the limits of supply to the populations in their upper reaches. In 1982, with more than 10,000 new wells being drilled each year in the state, there was talk of the need for a strict management plan for aquifers. Capacity-use statutes could be used to stop excessive drawdown wherever it occurs, but no new capacity-use areas have been designated in recent years.

For the most part, a hodgepodge of decisions by local agencies governs the impoundment and use of water. The state Office of Water Resources has done useful studies on river basins and future water needs. But the expertise of the OWR and the anti-pollution powers of the Environmental Management Commission don't give the state a large enough role in water policy.

State government, then, is far behind schedule in looking after future water needs. Both executive and legislative branches should need no further proof of the necessity of a long-range study. The mud flats that once were creeks and ponds, and the dry holes that once were wells, offer mute testimony that adequate, clean and fairly distributed water supplies no longer can be taken for granted.

**KEY PROVISIONS OF NEW SAFE DRINKING WATER ACT**

The new Safe Drinking Water Act Amendments were signed into law by President Reagan

on June 19. The amendments are expected to have a significant impact on water utilities, which must comply with increased treatment and monitoring requirements.

Provisions of the amendments include:

- EPA is required to set binding standards within three years for 83 drinking water contaminants. These include volatile organic chemicals, synthetic organic chemicals, inorganics, microbials, radionuclides, and disinfection by-products. More contaminants are to be added to the list at least every three years.
- EPA's enforcement powers for water supplies in non-compliance have been strengthened. Maximum civil penalties have increased to \$25,000 and maximum criminal penalties to \$50,000 per day of violation.
- A new federal groundwater protection program will be created. States must develop plans, subject to approval by EPA, to protect well fields for sources of public drinking water.
- EPA within three years will require disinfection for all public water utilities.
- Procedures for setting drinking water standards will be simplified.
- The use of lead pipe, solder, or flux will be forbidden in the installation or repair of public water systems or any plumbing system providing water for human consumption.

In order to execute EPA's responsibilities under the amendments, Congress authorized \$170 million for fiscal 1987.

The EPA Office of Drinking Water, directed by Michael Cook, will administer the drinking water and underground injection control provisions of the act. The Office of Ground-Water Protection, directed by Marian Mlay, will administer sole source aquifer and wellhead protection provisions.

**SAFE DRINKING WATER ACT LIKELY TO INCREASE WATER COST**

According to the American Water Works Association, the new Safe Drinking Water Act will have a significant impact

on the nation's 200,000 public water utilities. The Association's publication, MAINSTREAM, says that the new treatment and monitoring requirements are likely to force up the cost of water.

Utilities will be forced to increase monitoring not only to comply with standards for the 83 contaminants the bill specifies for Environmental Protection Agency regulation but also to detect the presence and levels of hundreds of unregulated contaminants EPA will be considering for addition to its contaminants list. The law requires EPA to upgrade its contaminants list at least every three years.

According to MAINSTREAM, increased monitoring will mean increased operating costs for utilities.

New, more stringent standards for regulated contaminants--particularly those for radionuclides and disinfection by-products--may make it necessary for some utilities to install additional facilities, and some systems not currently using filtration and disinfection processes may have to implement them.

Construction for either reason would necessitate major capital outlays.

While the costs of compliance will be high for those systems which fall short of the new standards, the cost of noncompliance could also be significant. The new law also embodies more powerful enforcement measures and higher noncompliance penalties.

**DROUGHT, HEAT STRAIN UTILITIES PROMPT CONSERVATION MEASURES**

As temperatures hovered in the mid-nineties and dry conditions continued over most of North Carolina in July, electric

utilities strained to meet demand and water authorities in many locations instituted mandatory conservation measures.

Both Carolina Power and Light Company and Duke Power Company recorded successive new highs for electrical demand during a three-day period in the second week of July. Record demand was also reported by electrical utilities in South Carolina, Virginia and Georgia. In some areas served by TVA hydroelectric dams, service was reduced by falling lake levels. TVA reported that in June generation for all TVA dams was only 56 percent of normal.

Duke Power reported that in the first six months of this year its 25 hydroelectric plants generated only 48 percent

of the electricity they normally generate. The company's rainfall records for its Gatawba River, SC, station show the first six months of the year were the driest since record keeping started in 1933.

As levels in many town and city reservoirs dropped, various water authorities began imposing mandatory water conservation measures. By July 10, the Orange Water and Sewer Authority, which has grappled with water problems in Chapel Hill and Carrboro for years, had taken action which led to the imposition of second-stage mandatory conservation measures, and the Authority was anticipating the necessity of third-stage measures.

In late July Lake Orange, one of three Orange County Reservoirs along the Eno River, was 25 inches below the spillway. (See photo back page.) Authorities were releasing water to help maintain some streamflow in the Eno to support wildlife and dilute effluent from the Hillsborough treatment plant.

#### A Typical Conservation Program

Typically, conservation measures to deal with water shortages are recommended by local water managers to city councils or county commissions which then impose the measures by proclamation. Conservation plans usually consist of several stages, beginning with voluntary conservation and moving through mandatory measures of increasing severity.

For instance, the City of Durham code specifies a six-stage program to deal with water shortages, with the first stage being an on-going information campaign to reduce waste. Each succeeding stage includes continuation of measures in the previous stage.

The second stage is voluntary conservation, which recommends limiting water use for such things as washing cars, outside watering and washdowns, clothes washers and dishwashers, and water-cooled air conditioners.

Stage three is moderate mandatory conservation which imposes limits on use for outside watering, in swimming pools and fountains, and for outside washing; forbids serving of water in restaurants except upon request; and requires use of disposable and biodegradable dishes. When the city is under mandatory restrictions, it is unlawful not to comply with announced measures.

Stage four, severe mandatory conservation, forbids watering lawns, limits the hours for watering shrubs and gardens, forbids filling swimming pools, forbids non-essential use of water in commercial and public operations, forbids use of non-recycling water-cooled air conditioners and other equipment except for health and safety purposes, and forbids vehicle washing except at places where at least 50 percent of the water is recycled or private well water is used.

Stage five, stringent mandatory conservation, closes swimming pools, bans vehicle washing, bans all use of water outside except for emergencies and bans use of evaporative air conditioners except during business hours.

Stage six is rationing. At this stage, all industrial uses of water are banned, fire trucks are required to use raw water and all other uses of water are limited to those necessary to meet minimum health and safety needs.

An official of the Orange Water and Sewer Authority called the summer drought the worst in this century, and an official of the N. C. Water Resources Division said that the public had not given the drought the attention it deserved and predicted the development of a "serious situation" if water usage did not drop.

#### **DROUGHT IMPACTS STATE'S AGRICULTURE**

Katie Perry, Agricultural Meteorologist with the N. C. Agricultural Extension Service, said in early July that the drought affecting the Piedmont and Mountain regions of the state came at one of the worst times possible for agriculture. As early crops struggled to survive and bear, later plantings of soybeans and sorghum were having trouble germinating.

According to Extension Horticulturalist George Hughes, unusually cool weather early in May delayed planting of many vegetable crops, and dry weather set in as early spring plants began to germinate and grow. In many places, stands have been poor, foretelling reduced yields.

In addition, Ron Jarett, Extension Crop Specialist at N. C. State University, said that small grains were severely impacted by the April and May drought. Yields of barley were reduced 40 to 50 percent with heavier losses in the southeastern counties with lighter soils. Income from small grains of barley, wheat, oats and rye was \$90 million in 1985. In 1986, with decreases in prices, acreages and yields, the income is expected to be in the \$50 to \$60 million range.

The *Raleigh News and Observer* quoted Extension Crop Specialist W. K. Collins as saying that feed corn production in the Piedmont might be down by 40 percent this year. Chatham County Agricultural Agent Richard Bradley was quoted as saying that Chatham County corn was too dry for use even as silage.

The N. C. Crop and Livestock Reporting Service said in mid-July that reports from all 100 N. C. counties showed 41 percent of the state's corn crop and 27 percent of the soybeans already rated poor.

Cattle producers who are selling early because they can't feed their herds are losing an average of \$100 per cow, and according to the *Raleigh News and Observer*, cattle sales are up 40 to 50 percent at two of the state's major livestock markets indicating potentially huge losses by beef producers. The state's poultry producers are also feeling the impact of the severe heat, and USDA predicts consumers will notice the effects of the drought most in the supermarket price and size of broiler chickens and turkeys.

#### Piedmont, Mountains Hit Worst

The National Weather Service's Palmer Index shows extreme drought conditions in the Piedmont and Mountains. According to Dave Epperson, Extension Climatologist, the index is a "budget" which takes into account moisture lost through plant processes (evapotranspiration), water that is not absorbed by the soil (runoff), water loss from soil, field capacity of the soil, rainfall amount, and the potential for all these factors.

According to Bruno Mangum of the state SCS office, 54 counties had requested Federal Disaster Assistance because of the drought by mid-July. A USDA team visited a dairy farm in Orange County on July 22 to gather facts for making recommendations concerning Federal Disaster Assistance.

"We certainly expect more applications if the drought continues," said Mangum, "but I'm not sure it's going to do the counties much good. To get FHA loans they have to show a 30 percent cash loss of all cash crops, and tobacco may offset losses in other crops."

Tobacco, which is somewhat heat resistant, generally brings higher prices than other crops and accounts for a large percentage of agricultural cash income in many counties.

Generally, farmers and producers in the Coastal Plain have escaped the severely dry conditions that threaten crops and livestock in the Piedmont and Mountains, but even in the East there are spots unblest by significant rainfall.

"Some parts of the state, like Wilmington, are in great shape," Mrs. Perry said. "There, they're only a half inch below normal rainfall."

"Then, there are places where the drought has been extreme. Salisbury may be the worst. They've received only 16 percent of their normal rainfall since March 1.

"In general, for the agricultural season beginning in March the state is at less than 50 percent of normal rainfall."

According to Epperson, last year in January through June, the state had gotten an average of 3.83 inches of rainfall per month. January through June of this year the average was 2.15 inches.

*(Editor's Note: As this newsletter goes to press, good rains were being received in many areas of the State. But for many of the agricultural crops, like corn, the rains were too late to materially influence yields.)*

**ENVIRONMENTAL MANAGEMENT COMMISSION ADOPTS REGULATIONS FOR PEAT MINING**

After more than a decade of debate, state regulations for the discharge of water from peat mining were

approved in July by the N. C. Environmental Management Commission. NPDES permits can now be issued for periods of up to five years provided the water quality standards and water use requirements are met.

The question of whether to permit mining of peat in eastern North Carolina wetlands has been debated since the mid-70s.

The largest peat deposits are found in the pocosin wetlands of the Albemarle-Pamlico peninsula, which is surrounded by the largest single estuarine system on the Atlantic coast. The system is highly productive for North Carolina fishermen, but it is also highly sensitive to reduced water salinity, nutrient overenrichment and bacterial contamination thought to be caused by development and agriculture in the wetlands. Many feel that peat mining will exacerbate these conditions and that it should not be allowed.

On the other hand, there are those who feel that the energy source the peat represents should be exploited and that mining the peat will expose underlying fertile mineral soils which can then be used for crop and timber production.

Because of uncertainty about the effects of peat mining, permits for full-scale operations could not be issued until the Environmental Management Commission adopted regulations regarding the environmental effects of mining. The regulations adopted in July will essentially require that peat mining operations have no more effect on fish nursery areas than the mining sites would if natural vegetation were there.

Research conducted at a First Colony Farms pilot peat mine in 1984 showed that storm runoff from the mine site was 5-10 times higher than from vegetated sites, that the highly erodible surface of the mine produced heavy silt in the runoff, and that concentrations of nitrogen and phosphorus were higher than from naturally vegetated sites. The law mandates runoff controls which closely approximate levels which would be expected if the site were allowed to vegetate naturally to maturity, even if that means improvement of existing conditions. It also requires reclamation of the site.

A point of concern not laid to rest by the regulations is the effect of agricultural operations that may occupy the mining sites when mining is complete. NPDES permits can control activities such as agriculture at such sites only for the period of time mining is occurring. Once mining stops, further controls may be required to protect water quality.

**DIVISION OF ENVIRONMENTAL MANAGEMENT PRODUCES REPORT ON FLUORIDE IN SURFACE WATER**

A report released by the N. C. Division of Environmental Management in June offers a detailed assess-

ment of what is known about the freshwater toxicity of fluoride. The report is a result of a process begun by DEM to review N. C. water quality standards for toxicants. It is the most complete review of fluoride's freshwater toxicity to date.

North Carolina presently has a freshwater standard for fluoride of 1.8 mg/l, which was adopted in 1979. Natural background levels of fluoride in this state's waters are low. Sources of fluoride pollution include discharges from mines in the Appalachian Mountains, where hydrofluoric acid is used to separate feldspar from mica. A potential future source is the microelectronics industry, which uses hydrofluoric acid to etch microchips.

Fluoride is clearly toxic to aquatic life in high enough concentrations. In general, according to the report, fish are most sensitive followed (in order) by invertebrates, amphibians, plankton, and bacteria. There is considerable variability among species. The literature review revealed acutely toxic levels ranging from 925 mg/l of fluoride for the mosquito fish (*Gambusia affinis*), which is relatively tolerant of pollution, to 20 mg/l for brown trout fry. Fluoride toxicity is also dependent on hardness, temperature, pH, chloride, copper, and other contaminant levels in the water.

No change in the N. C. freshwater quality standard for fluoride is recommended in the report because available data do not meet minimum EPA recommendations for water quality standard calculations. Additional studies to provide chronic (and selected acute) data would be necessary in order to calculate a revised standard.

The report, North Carolina Water Quality Standards Documentation: Toxicity of Fluoride to Freshwater Biota, is Report No. 86-01 from the Division of Environmental Management, N. C. Department of Natural Resources and Community Development, P. O. Box 27687, Raleigh, NC 27611.

**EPA REPORT REVEALS PESTICIDES-IN-GROUNDWATER INFORMATION DEFICIT**

The Environmental Protection Agency's "Pesticides in Ground Water: Background Document" (May 1986, 72

pages) reports the findings of a review of existing information and scientific knowledge about pesticide contamination of groundwater.

Conducted by EPA's Working Group on Pesticides in Ground Water, the review covered literature, reports and documentation that might help assess the extent of pesticide contamination, its causes, its potential health impacts and the statutory authorities and programs available to help address the problem.

About pesticide contamination of groundwater, the authors of the report conclude, "We do not know how widespread the problem is nationwide. We have trouble determining where, how long, and how much particular pesticides have been used. We can locate only generally where soil and rock will permit movement of pesticides to groundwater. We can make crude estimates, at best, about how long pesticides will persist underground and in what direction they will move."

With so little information about contamination and the potential for contamination, the report says, "...it is difficult to estimate potential human exposures to contaminated groundwater."

In general, the report concludes that there is a critical need for more information in every area affecting the issue from the hydrogeology of various areas of the nation to toxicity data relating to pesticides.

The report reveals a complex array of federal statutory authorities and programs that might, directly or indirectly, affect the pesticide-in-groundwater issue.

A companion report issued at the same time reveals similar fragmentation of regulatory responsibility among the states and suggests that this has led to fragmented efforts to deal with the problem.

The spread of regulatory authority among state agencies that the report, "State Program Briefs: Pesticides in Ground Water," (May 1986, 93 pages) calls typical is descriptive of the situation in North Carolina: Control over pesticides is vested in the state agriculture department, while waste regulations are found in the state environmental management agency and responsibility for assuring safe drinking water is with the state health department.

The North Carolina brief shows no current monitoring for pesticides in groundwater but reveals that monitoring for aldicarb and EDB, two pesticides found in groundwater in a number of other states, has been done in the past, with negative results.

Copies of the reports are available from the EPA Office of Ground Water Protection (WH-550G), 401 M St., SW, Washington, DC 20460. Telephone (202) 382-7077.

**SERVICES, RESEARCH ADDRESS RADON CONCERNS** The Research Triangle Institute in Research Triangle Park, NC, is handling a number of activities the Environmental Protection Agency has initiated in response to the discovery of high levels of the radioactive gas radon in homes in certain areas of the country. In addition to conducting focus group meetings for citizens in the affected areas, RTI is designing the survey instrument for EPA's national survey of radon levels in residential dwellings.

RTI is also operating EPA's Radon Technical Information Service, which features a telephone hot-line for people who want to know more about the radon problem. According to Dr. Edward Howard of RTI, the service is designed to meet the information needs of a wide range of people, including homeowners, architects, builders and staff at laboratories that test for the presence of radon. Through the service, laboratories may request information about participating in EPA's radon/radon progeny proficiency measurement program and citizens may request EPA brochures on the radon problem and a list of laboratories that can provide accurate measurements of indoor air radon and radon progeny levels.

The technical information service can be reached by calling (800) 334-8571, Extension 7131 from outside North Carolina. Inside North Carolina, the service can be reached by calling (919) 541-7131.

EPA publications Citizen's Guide to Radon - What It is and What to Do About It and Radon Reduction - A Homeowner's Guide may also be obtained by contacting EPA's Public Information Center at (800) 828-4445.

Citizens who wish information on radon hazards in North Carolina may also contact the Radiation Protection Service

of the Division of Facility Services, N. C. Department of Human Resources. (919) 733-4283

In a related North Carolina Water Resources Research Institute-sponsored study, James E. Watson, Jr., and Douglas J. Crawford-Brown of UNC-Chapel Hill's Department of Environmental Sciences and Engineering are working to develop a model for predicting the occurrence of radon concentrations in North Carolina groundwater. While high concentrations of radon gas in homes in certain parts of the U. S. pose an acute and significant problem for a small population, the most widespread health threat posed by radon comes from concentrations in drinking water. According to Watson, some North Carolinians may be more at risk from radon in drinking water than residents of other states because of unusually high concentrations in many of the state's small groundwater supplies. Watson and Crawford-Brown's research is aimed at speeding up the identification of areas in North Carolina where radon in groundwater poses a high risk to the population.

**BUNCOMBE COUNTY ADOPTS EROSION CONTROL ORDINANCE** The Buncombe County Board of Commissioners has unanimously approved a county erosion and sedimentation control ordinance. The ordinance took effect on August 1, 1986, making Buncombe County the 36th unit of government in North Carolina to adopt a sediment and erosion control program. Under this program persons conducting land disturbing activities must install erosion control measures necessary to prevent offsite sedimentation damage to streams and adjoining property. The ordinance will require a land-disturbing permit for activities which grade one-half acre or more. Agricultural and forestry activities are exempt from the ordinance's requirements.

The ordinance was prepared by a county task force composed of developers, realtors, planners, county officials, and other interest groups. Technical assistance was provided by Bill Eaker of the Land-of-Sky Regional Council's Environmental and Energy Planning Section and by the N. C. Department of Natural Resources and Community Development Land Quality Section.

Support for the ordinance was overwhelming as no opposition was presented during public hearings. Many organizations voiced their support including the Homebuilders Association of Greater Asheville, Buncombe County Soil and Water Conservation District, League of Women Voters of Asheville-Buncombe County, French Broad River Foundation, Trout Unlimited, WNC Muskie Club and others.

. . . *Skylines*

**INNOVATIVE WASTEWATER SYSTEM SAVES MONEY-- PERFORMS BETTER** The Town of Bethel, after considerable effort, appears to have a win-win situation with its recently approved wastewater treatment system. Approved by the Environmental Management Commission, the facility will be a hydraulically controlled release system (HCR). Faced with an expensive sand filter system, the town needed a more cost-effective facility if it was to be able to afford to upgrade its community wastewater treatment. In the new system, wastewater will go through an existing seven-acre treatment lagoon plus a new 17-acre treatment/storage lagoon and a half acre of sand filters before treated effluent is discharged to Contetoe Creek in Pitt County.

The new treatment system is designed to have less impact on the receiving waters in the Contetoe Creek. It will contribute 20 percent less BOD to the stream and will meet a 20-percent better dissolved oxygen requirement: 6 mg/l versus 5 mg/l for the sand filter system. In addition, the system will cost 45 percent less to

construct and 23 percent less to operate and maintain, and is technically easier to operate and maintain.

With a larger reserve storage capacity, it will not have to release treated wastewater during critical low-flow situations in the summer months. Storage is adequate, and the receiving stream flow is great enough so that the minimum rate of river water to effluent will always be 11:1 or better.

Moreover, the Town of Bethel will receive a 10-percent bonus from EPA because the system qualifies as an innovative system. And, since the system is fully guaranteed by the federal government, if water quality is not protected, at the end of a two-year period the sand filters could be added at 100 percent federal expense.

The HCR technology is not suitable for all communities because of size, receiving stream flows and other factors. But, for the Town of Bethel, it is affordable and cost-effective.

**SCS IN NORTH CAROLINA HAS MAJOR LEADERSHIP CHANGES**

Two of the Soil Conservation Service's top positions in North Carolina have new personnel,

as the State Conservationist in North Carolina, Coy Garrett, goes to head up the SCS program in Texas, and Deputy State Conservationist, George Norris, fills the top position in Virginia.

North Carolina's new State Conservationist is Bobbye Jack Jones, who formerly held that position in Delaware. Jones began his career in Oklahoma as a soil conservationist. From the area conservationist's position, he transferred to Virginia to assume the position of assistant state conservationist for operations and later became their deputy state conservationist. From the deputy state conservationist's position, he was selected for the position of state conservationist for Delaware.

Cecil Settle is North Carolina's new Deputy State Conservationist. Settle recently served as legislative assistant in Washington, DC, and has served SCS in Alabama and Tennessee.

**SKAGGS RECEIVES USDA SUPERIOR SERVICE AWARD**

The U. S. Department of Agriculture (USDA) has presented the Superior Service Award to

Dr. R. Wayne Skaggs, William Neal Reynolds Professor of Biological and Agricultural Engineering at North Carolina State University. He was honored for his "research to develop water management systems for specific soil, crop and climatological conditions, resulting in increased yields, profits and more efficient use of water."

In addition to grant assistance provided by the USDA Agricultural Research Service, the Water Resources Research Institute and the N. C. Agricultural Research Service have supported Dr. Skaggs' research in water management in numerous research projects including work to develop the water management model DRAINMOD, studies of hydrologic impacts of peat mining and most recently a study of stormwater infiltration ponds in the coastal region.

**OVERCASH SELECTED IN EPA DISTINGUISHED VISITING SCIENTIST PROGRAM**

The U. S. Environmental Protection Agency's Office of Research and Development has announced the

participants in its Distinguished Visiting Scientists Program for 1986. The winners are all internationally known scientists and engineers who specialize in environmental research and will be working in EPA laboratories throughout the country.

One of the winners is Dr. Michael Overcash, who is an environmental engineer from North Carolina State University. He will be working with EPA's Hazardous Waste Research Laboratory in Cincinnati studying engineering methods for source reduction of toxic and hazardous wastes. In Cincinnati he will work on identifying optimum balances between hazardous waste treatment and source reduction in various industries for selected hazardous pollutants.

The scientists and engineers were picked from an international field of applicants who competed for the opportunity to do research under grants awarded by ORD. They will work in EPA laboratories for up to three years.

**NEW INSTITUTE REPORTS**

*Stormwater Management in Urban Collector Streams* by H. Rooney

Malcom, Department of Civil Engineering, N. C. State University.

This research was designed to give City of Charlotte officials information to help them develop a stormwater management program to solve flooding and streambank degradation problems of urban collector streams (those having 20-acre to one-square-mile watersheds).

The investigators evaluated the effectiveness of the following specific instruments the city currently uses in stormwater management and made recommendations for changes where changes appeared to be needed:

- The flood-plain restriction of the city's subdivision ordinance, which prohibits construction below the elevation of the 20-year flood, plus two feet. The investigators found that in all cases analyzed the elevation specified is close to and slightly above the elevation of the 100-year flood.
- The detention provision of the zoning ordinance. Investigations revealed that it is possible under the ordinance to design and install permissible detention facilities that do not meet design objectives of the detention requirement and that there is no incentive for supplying extra detention on sites where such is clearly possible. A recommendation was made that the provision be substantially revised, chiefly to institute a development fee which can be earned back by developers who install effective detention facilities and to provide for the city to pay developers for detention facilities which are effective beyond the design objective. It was also recommended that the exclusion of small sites from coverage by the ordinance be eliminated and that single-family developments be covered by the ordinance.
- The city's Stormwater Impoundment Design Manual. Investigators recommended its updating in respect to hydrograph formulation and hydraulic analytical procedures.
- Storm-drainage repair policy. The investigators prepared a set of level-of-service (or maintenance) descriptors and estimated the cost of maintaining the streams at (1) current level, (2) improved levels, (3) increased standard design storm level.

The investigators recommended that to develop an effective stormwater management program for urban collector streams, the city should take a comprehensive approach. They considered the administrative structure for such an approach as well as the application of the concept of a stormwater utility.

The report is No. 226. Institute reports are available free of charge to North Carolina residents; for out-of-state requests, there is an \$8 charge.

*Considerations for Using Herbicides for Aquatic Weed Control in Domestic Water Supplies of North Carolina* by K. A. Langeland, Department of Crop Science, and D. J. DeMont, Department of Zoology, N. C. State University.

The purpose of this project was to demonstrate the feasibility of safely using herbicides for aquatic weed control in domestic water supplies and to produce a readily available source of public information concerning the fate and environmental risk of diquat, endothall and fluridone for small-area aquatic weed control in large domestic water supply lakes. The project included a review of literature on persistence and mammalian toxicities of the three herbicides, a field study of their persistence in North Carolina ponds, and a study of flow patterns and dilution rates that could affect herbicide concentrations and movement in Lake Wheeler.

The researchers found that data available in open literature and from herbicide manufacturers show that when diquat, endothall and fluridone are used according to label regulations, concentrations that occur in bodies of water are below levels which have proven toxic to laboratory animals. Furthermore, because of dilution and dissipation after application, concentrations which reach drinking water are negligible.

Field studies of eight North Carolina ponds confirm literature findings that the herbicides are non-persistent in water. These studies, in which diquat, endothall or fluridone were applied as whole pond treatments, provided data for approximating dissipation rates of the herbicides in a dilution-free environment. Diquat dissipated steadily from all treated ponds, with regression equations predicting zero concentration at no more than 36 hours. Endothall also dissipated steadily but less quickly, with zero concentration predicted after 26 days. Fluridone was more persistent, with fluctuating concentrations observed and zero concentration predicted at up to 69 days. Environmental factors that affect photolysis of the compound, such as shading, are felt to explain fluridone's persistence.

The study of water movement patterns in Lake Wheeler was undertaken to establish principles which might be used to plan weed treatment at times when movement in a body of water is minimal and in the desired direction. During a five-month period from February through June 1984, investigators monitored limnological and meteorological conditions and observed water movement patterns. Data from all observations were compared to establish general relationships, and meteorological conditions monitored were compared with historical data to develop predictive capability. When all data specific to Lake Wheeler were taken into account, it was possible to predict the best month for application of herbicide to areas of that lake, and by using local weather forecasts it will be possible to predict the best day for application, based on wind direction and velocity.

The report is No. 227. Institute reports are available free of charge to North Carolina residents; for out-of-state requests, there is an \$8 charge.

*Nutrient Cycling and Productivity of a North Carolina Piedmont Reservoir* by Dr. Edward J. Kuenzler, Alan J. Belenz, and Joseph Rudek of the Department of Environmental Sciences and Engineering, UNC-Chapel Hill.

Although Jordan Lake should be classified as eutrophic, it has not yet shown signs of serious blue-green algal blooms, according to the authors of this report. The lake should be used for as wide a variety of purposes and to the maximum extent possible compatible with its primary function as a flood-control reservoir. However, nutrient concentrations and algal densities must be monitored in order to detect downward trends in quality,

and contingency plans should be prepared so that action can be taken if evidence of worsening conditions appears, the report states.

The report is based on a study of Jordan Lake's nutrient status and productivity, which included measurements of nitrogen and phosphorus uptake rates in relation to algal abundance and primary productivity. Results indicate that the most striking set of patterns in the lake are the seasonal patterns, suggesting that changing light and temperature may be the major controlling factors. Gross primary productivity was higher in summer than in winter; temperature showed a strong positive correlation. Correlations with nutrient concentrations were negative indicating that algal growth was controlling nutrient concentrations rather than vice versa.

The report recommends that, although reductions in inputs of nitrogen and phosphorus are desirable at any time of year, the most effective times would be early spring through summer, before and during the period of maximum algal abundance. Control of phosphorus, in particular, is important because of the presence of nitrogen-fixing species of algae, which thrive in phosphorus-rich waters.

This report is No. 228. Single copies are free to North Carolina residents; for out-of-state requests there is an \$8 charge.

**GROUNDWATER CONFERENCE  
SEPTEMBER 16** A groundwater management conference for local leaders is planned for September 16, 1986, at the N. C. State University Faculty Club in Raleigh. The conference is sponsored by the Water Resources Research Institute of The University of North Carolina and Groundwater Section, Division of Environmental Management, N. C. Department of Natural Resources and Community Development, in cooperation with U. S. Geological Survey, N. C. League of Women Voters, Conservation Council of North Carolina, N. C. League of Municipalities, and County Commissioners Association. Its purpose is to acquaint more leaders in North Carolina with the importance, use, movement, and quality of groundwater.

See green insert for program and registration form for the Leaders Conference on Management of Groundwater.

**DUKE OFFERS WATER  
QUALITY MODELING COURSE** The Duke University School of Forestry and Environmental Studies is offering a one-week course emphasizing the practical application of mathematical models to a wide variety of techniques that have utility in predicting the response of lakes and other water bodies to pollutants. The course, "Mathematical Modeling of Lake and Reservoir Water Quality," will be presented by Dr. Kenneth H. Reckhow and Dr. Steven C. Chapra and will be based on their book, *Engineering Approaches for Lake Management*. Course participants will receive a microcomputer software package, LAKECOMP, containing six programs. The course, designed for graduate students and professionals in resource management and policy, will be taught November 17-21, 1986. For more information, call the school's intensive course coordinator at (919) 684-2421.

**WATER RESOURCES CONDITIONS  
IN NORTH CAROLINA FOR JUNE** Streamflow for June was below normal for the sixth consecutive month. Record low, monthly (mean) and daily (mean) flows occurred at South Yadkin River at Mocksville (records begin 1930) and at Contentnea Creek near Hookerton (records begin 1928). Across the state, streamflow at month-end ranged from 10 to 50 percent of long-term average for June. Streams in the central and southern Piedmont are at levels expected to occur on the average, about once in 10 years.



Monthly streamflow has been above average only three times since September 1984, and has been in the lowest 25 percent of record since January 1986.

Groundwater levels in unconfined aquifers range from approximately one to three feet below average at month-end. In general, groundwater levels were above average until April or May 1986 and are now beginning to show the effects of the prolonged period of deficient rainfall.

Agricultural and forestry interests are most seriously affected by the drought. Irrigation of crops has been required, and water in some dug irrigation ponds is very

low. Pastures in the central Piedmont have been seriously affected, and crop damage estimates range as high as 75 percent.

There is the potential for a major drought depending on the rainfall in July and August, normally high rainfall months. If rainfall during these months is deficient, serious water shortages are likely.

. . . U. S. Geological Survey

#### NEW PUBLICATIONS RECEIVED BY THE INSTITUTE

(Residents of North Carolina may borrow these from the Institute for a two-week period. Where individual copies are desired, readers are encouraged to request copies from the organization issuing the publication. The addresses are provided by the NEWS for this purpose.)

##### Water Resources Planning

"Regional Aquifer-System Analysis Program of the U. S. Geological Survey, Summary of Projects, 1978-84," (USGS Circ. 1002) 1986, ed. by R. J. Sun, avail. from Dist. Branch, Text Products Section, USGS, 604 S. Pickett St., Alexandria, VA 22304-4658. (USGS)

"Basinwide Instream Flow Assessment Model to Evaluate Instream Flow Needs," (#197) 11/85, by K. P. Singh, et al., avail. from Univ. of IL, Water Resources Center, Urbana, IL 61801. (02E Instream Flow)

##### Water Quality Management

"Stream Transport and Agricultural Runoff of Pesticides for Exposure Assessment: A Methodology: Part A - Test and Appendices A through F," (EPA/600/3-86/011a) 3/86, by A. S. Donigian, Jr., et al., avail. from Env. Research Lab., Office of R&D, USEPA, Athens, GA 30613. (05B Pesticides).

"Techniques for Industrial Pollution Prevention," 1986, by M. R. Overcash, avail. from Lewis Publishers, Inc., 121 S. Main St., PO Drawer 519, Chelsea, MI 48118. Price: \$34.95. (05 PPP)

"State Program Briefs Pesticides in Ground Water," (EPA) 5/86, avail. from EPA, Office of Ground-Water Protection (WH-550G), Washington, DC 20460. (04B)

"Use of Vegetative Filter Strips to Minimize Sediment and Phosphorus Losses from Feedlots: Phase I. Experimental Plot Studies," (B. #151), 4/86, by T. A. Dillah, et al., WRRRC, VPI & SU, 617 N. Main St., Blacksburg, VA 24060-3397. (05B Ag. Wastes)

"Water Quality: Agriculture and Community Concerns in the South," (Proceedings, Atlanta, GA, Nov. 7-8, 1985), 5/86, Pub. by Southern Rural Dev. Ctr., Box 5446, Mississippi State, MS 39762. Price \$5. (05B)

"North Carolina Water Quality Standards Documentation: Toxicity of Fluoride to Freshwater Biota," (#86-01) 5/86, by DEM, NRCO, PO Box 27687, Raleigh, NC 27611-7687. (05C)

##### Water Quantity Management

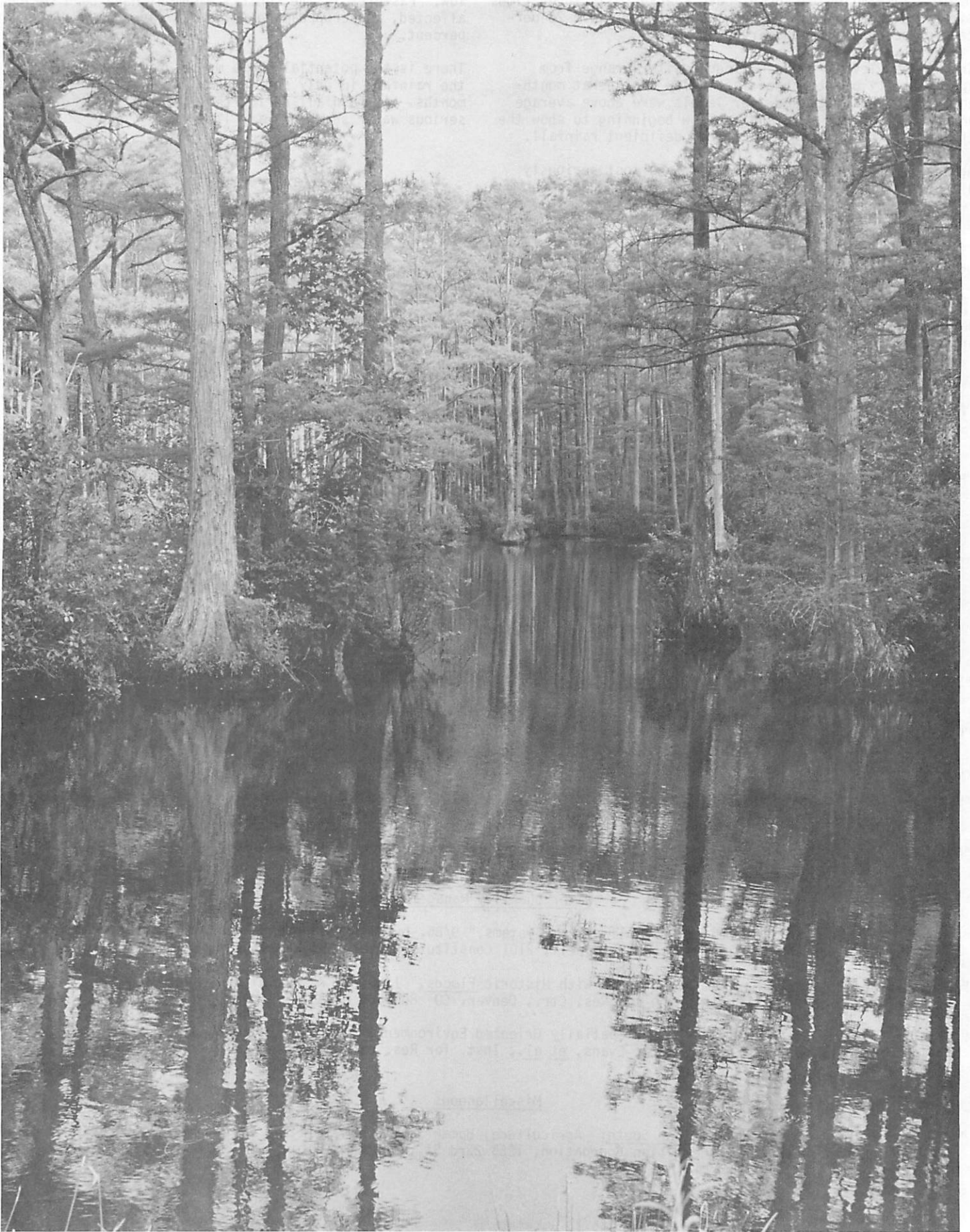
"Drought Management and Its Impact on Public Water Systems," 9/86, by Water Science & Technology Board, Water Science & Technology Board, National Research Council, 2101 Constitution Ave., NW, Washington, DC 20418. (03D)

"Comparison of Estimated Maximum Flood Peaks with Historic Floods," 1/86, by K. L. Bullard, Hydrology Br., Div. of Plan. Tech. Services, Engineering and Res. Ctr., Denver, CO 80225. (04A)

"Computer Analysis of Multiple Layers of Spatially Oriented Environmental Data for Evaluating Potential Groundwater Impacts," (LW 8602), 2/86, by B. M. Evans, et al., Inst. for Res. on Land and Water Resources, The Penn St. Univ., Univ. Park, PA 16802. (04B)

##### Miscellaneous

"Competition for Land in the American South: Agriculture, Human Settlement, and the Environment," 1985, by R. G. Healy, avail. from The Conservation Foundation, 1255 23rd St., NW, Washington, DC 20037. Price \$19.50, (includes S & H). (06B)



*Robertson's Pond in eastern Wake County Supports an unusual, beautiful stand of bald cypress--making it one of the western-most locations of bald cypress and blackwater habitat and the only such site in the Piedmont Region. Photo by David H. Howells, 1986.*

# Leaders Conference on Management of Groundwater in North Carolina

Raleigh, N.C.

North Carolina State University Faculty Club

September 16, 1986

9:00 a.m. - 4:00 p.m.

8:00 **Registration**

9:00 **Introduction** — Trends in Approaches to Groundwater Management - David H. Moreau, Director, Water Resources Research Institute of The University of North Carolina

9:15 **Groundwater Basics** — Charles C. Daniel, III, Hydrologist, U.S. Geological Survey

9:35 **Groundwater Use in Overall Water Resource Development** — John N. Morris, Director, N.C. Division of Water Resources, NRCD

9:55 **New Groundwater Protection Initiatives** Federal - E. Stallings Howell, Chief, Office of Groundwater, Region IV, USEPA State - Perry F. Nelson, Chief, Groundwater Section, N.C. Division of Environmental Management, NRCD

10:40 **Break**

11:00 **Local Government Concerns** — David E. Reynolds, Director, Intergovernmental Programs, N.C. League of Municipalities, and Edmund P. Regan, Fiscal Analyst, N.C. Association of County Commissioners

11:15 **Industrial Concerns** — Stephen W. Earp, Attorney, Smith, Helms, Mulliss, and Moore

11:30 **Groundwater Quality - Pristine or Polluted?** — Lark Hayes, Conservation Council of N.C., and Margaret Holton, N.C. League of Women Voters

12:00 **Lunch**

1:00 **Issues Which Impact Groundwater Quality** — Perry F. Nelson and M. Carl Bailey, Groundwater Section, N.C. Division of Environmental Management, NRCD (Overview statement with a panel to respond to questions)

● **Hazardous Waste Sites** — Linda Little, Executive Director, Governor's Waste Management Board

● **Solid and Hazardous Waste** — William L. Meyer, Head, Solid and Hazardous Waste Management Branch, Division of Health Services, DHR

● **Underground Storage Tanks** — Lee V. Laymon, Head, Operations Branch, Groundwater Section, N.C. Division of Environmental Management, NRCD

● **Septic Systems** — Steven J. Steinbeck, Supervisor, On-site Sewage Program, Sanitation Branch, Division of Health Services, DHR

● **Municipal and Industrial Wastes** — Robert B. Cheek, Supervisor, Permits and Compliance Unit, Groundwater Section, N.C. Division of Environmental Management, NRCD

● **Agricultural Water Use** — Ronald Sneed, Extension Irrigation Specialist, Bio. & Agr. Engineering, NCSU

2:15 **Legal Issues** — Daniel C. Oakley, Special Deputy Attorney General, N.C. Department of Justice

2:30 **Public Education - The Virginia Approach** — Kathryn P. Sevebeck, Education Director, Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University

2:50 **Break**

3:15 **Legislative Issues** — Frank J. Sizemore, III, Representative, N.C. House of Representatives

3:30 **Wrapup and Discussion**

4:00 **Adjourn**

(Detach here and return)

## REGISTRATION FORM

### Leaders Conference on Management of Groundwater in North Carolina

Cost: \$15.00 per person

I Plan to attend the September 16 Leaders Conference on Management of Groundwater in North Carolina. Enclosed is my check for \$15.00 to cover both the luncheon and the conference.

Name \_\_\_\_\_ Affiliation \_\_\_\_\_

Address \_\_\_\_\_

Telephone No. \_\_\_\_\_

Make checks payable to the Water Resources Research Institute of The University of North Carolina and mail to Water Resources Research Institute, Campus Box 7912, N.C. State University, Raleigh, NC 27695-7912. For further information, contact **Eva Tew** or **Linda Lambert** (919) 737-2815.

Deadline for receipt of registration and fee is September 9, 1986.

News



The current drought has reduced the outflow from Lake Orange, a reservoir for Orange County, to a trickle. Lake Orange is supplied by a tributary of the Eno River, and the reduced flow of the tributary is a factor contributing to the dewatering of the Eno River below Corporation Lake and Ben Johnson Lake, two other Orange County reservoirs. See related story, page 3.



*Photo by Jim Page, N.C. Dept. of Natural Resources and Community Development*

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