NEWS

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CONTENTS

N.C. WATER SUPPLY PROTECTION PROGRAM PROVIDES PROTECTION MECHANISM, TECHNICAL ASSISTANCE

From the mountains to the piedmont, North Carolina communities are taking action to protect the streams and reservoirs they rely on for drinking water by requesting reclassification of their water supplies under the North Carolina Water Supply Protection Program. According to Bob Holman, coordinator of the state's Water Supply Protection Program, 156 N.C. communities serving about half the state's population draw their drinking water from 212 extraction points on streams and reservoirs. Most communities that use surface water are west of Raleigh.

Concern among larger urban areas about the quality of their water supplies prompted the state in 1986 to create a method whereby communities may protect their surface water sources. The protection program was created by adoption of a new water supply classification system.

The state's previous water supply classification system had two categories: A-I, essentially pristine waters in undisturbed watersheds, and A-II, all other waters.

Water Supply Classification Determines Discharges Allowed

The new system has three water supply classes defined by the amount and types of permitted wastewater discharges and requirements for nonpoint source controls in the watershed.

WS-I water supplies are in natural and uninhabited or predominantly undeveloped watersheds. In watersheds classified WS-I, the Division of Environmental Management (DEM) will not permit point source discharges of any kind, and local governments must develop programs to control nonpoint source pollution. According to Holman, 33 communities with supplies previously classified A-I already have a WS-I classification, and there appear to be 59 additional communities with the potential to qualify for a WS-I water supply classification.

The **WS-II** classification designates water supplies that are in low to moderately developed watersheds. In WS-II watersheds, DEM will permit only domestic wastewater or industrial nonprocess cooling water discharges, and local programs to control nonpoint source pollution are required. About 36 communities could potentially receive a WS-II classification, Holman said.

WS-III water supplies are in watersheds with no categorical restrictions on development or discharges. It appears that 84 communities rely on water supplies that will remain in this classification.

When the new classification system went into effect, all waters previously classified A-II became WS-III.

Under the North Carolina Water Supply Protection plan, if a community with the WS-III water supply classification qualifies for reclassification to WS-II or WS-I and develops a state approved nonpoint source control program, the N.C. Division of Environmental Management will prohibit or limit point source discharges according to the watershed classification.

Six Steps Are Involved in Reclassifying Water Supplies

Holman said that the process of reclassifying water supplies involves six basic steps:

(1) The community makes inquiry and receives the state guidelines.

Guidelines for Obtaining a Protective Surface Water Classification, a two-document set consisting of a summary and detailed technical guidelines, is available from

Bob Holman, Coordinator
Water Supply Protection Program
NRCD-DEM, P.O. Box 27687
Raleigh, NC 27611
(919/733-5083)

(2) The community develops its plan and asks formally for reclassification.

(3) Water Supply Protection Program personnel evaluate current conditions in the watershed to determine if reclassification seems appropriate.

According to Holman, a watershed's already having one or two unallowed dischargers may not necessarily make it impossible for a community to receive a higher reclassification. Durham County, for instance, is working with two domestic dischargers to help the them eliminate their discharge so the county can qualify for a WS-II reclassification, and Wilkes County is attempting to help a school eliminate its discharge into Reddies Creek in order to qualify for WS-I reclassification.

(4) The community develops and **enacts** nonpoint source regulations.

(5) DEM holds a public hearing on the proposed reclassification.

(6) The hearing record is presented to the Environmental Management Commission for action.

While no community has gone through the complete *reclassification* procedure yet, Holman said it is expected that the procedure will typically take about two years. The length of time it takes an individual community to receive a reclassification will depend to a large extent on how long it takes the community to get its nonpoint source control program in place, he said.

OWASA Request Is First to Go to Public Hearing

The first water supply reclassification public hearing was held December 16 to take comments on the Orange Water and Sewer Authority's request to reclassify Cane Creek and University Lake to WS-I.

A hearing for the Town of Zebulon's request to reclassify the Little River in Wake and Franklin Counties to WS-I and Wake Forest's request for a WS-I reclassification was held January 13.

According to Holman, 44 communities or counties have requested information about reclassifying their water supplies. Of these, 32 have passed resolutions to request reclassification. Ten counties and 11 towns or cities have already adopted or will soon adopt specific watershed protection regulations.

In further support of water supply protection opportunities presented by the reclassification plan, the North Carolina General Assembly in 1987 approved funding for three new positions in the Water Supply Protection Program. According to Holman, one person will monitor discharge application permits, one will guide reclassification activities, and one will work with local governments on mechanisms to control nonpoint source pollution programs and will develop a nonpoint control manual for communities.

Holman said that to his knowledge, North Carolina's Water Supply Protection Program is the only statewide program of its kind in the nation.

Cooperation on Watershed Basis Will Be Needed for Some Communities

While the program provides a mechanism for protecting water supplies, it must be initiated at the local level and its nonpoint source control requirements must be satisfied by regulations developed, enacted, and enforced at the local level. Because water does not observe political boundaries and watersheds do not coincide with county lines or city limits, cooperation of neighboring political entities will be necessary to protect water supplies for some communities. However, the interests of neighboring political entities do not always coincide.

Last spring the Wake County delegation to the General Assembly, at the urging of Raleigh's mayor, introduced a bill requiring cities and counties in watersheds of nutrient-sensitive waters to develop and enforce watershed protection plans. The bill was aimed at providing a legal basis for requiring nonpoint source controls and hazardous materials controls within Falls Lake Watershed, the primary source of drinking water for Raleigh and much of Wake County. Part of the Falls Lake Watershed lies in Durham County.

The Watershed Protection Bill would have required controls on urban and agricultural runoff as well as restrictions on storage and production of hazardous materials in nutrient-sensitive watersheds. The bill was not broadly supported, and a substitute was introduced and passed.

The substitute bill established a commission to study the need for and implementation of a statewide watershed protection program. At the first meeting of the Watershed Study Commission in December, Durham County political leaders raised the issue of local control, and development interests charged Raleigh with trying to stymie Durham's growth.

This situation brings into sharp focus a serious obstacle any community will face in trying to protect its water supply: resistance to land-use controls and development restrictions. The conflicts are surfacing first in urban areas where development pressures are strongest, but communities in Western North Carolina are also seeing development threaten water quality, and western counties are less likely to have regulations in place to deal with development pressures.

State Offers Assistance, Private Consultants Can Also Help

Only half of North Carolina's counties currently have zoning and subdivision regulations, which are important tools for land use control and, therefore, for watershed protection. Many communities may face the need to adopt zoning and subdivision regulations and others may face the need to modify these regulations as part of their water supply protection programs. Some communities facing complex situations are turning to private consultants in an effort to construct and implement watershed management programs that will be both politically and legally defensible.

In its efforts to protect University Lake, the Orange Water and Sewer Authority (OWASA) recently engaged the consulting firm Camp Dresser & McKee to provide technical assistance for developing and implementing a watershed management plan for University Lake. The firm will also provide assistance to Durham County in developing watershed management plans for Lake Michie and the Little River Reservoir.

Communities developing watershed protection programs may turn to various departments of State government for technical assistance and various kinds of land use and economic information. For information on assistance available and contact personnel, contact Bob Holman, coordinator of the Water Supply Protection Program at the address given previously.

Local governments may also find helpful information in the book **Drinking Water Supplies: Protection through Watershed Management** available from:

UNC Water Resources Research Institute
Box 7912
North Carolina State University
Raleigh, NC 27695-7912
(919/737-2815)

Written by UNC professors Raymond J. Burby, Edward J. Kaiser, and David H. Moreau and Todd L. Miller, planning consultant with Marine Chemugics, the book provides (1) an overview of the importance of watershed management, (2) an appreciation of the scientific basis for watershed planning, (3) technical guidance for undertaking a water supply protection program, (4) a practical planning process for maintaining the quality of drinking water supplies, and (5) perspectives on how to judge the success of water supply management efforts.

APPLICATIONS BEING ACCEPTED FOR LOANS AND GRANTS FROM N.C. CLEAN WATER LOAN AND GRANT FUND

The Construction Grants Section of the Division of Environmental Management (Department of Natural Resources and Community Development) and the Division of Health Services (Department of Human Resources) are currently accepting applications from local governments for the first grants and loans from the North Carolina Clean Water Loan and Grant Fund. The fund was created by the General Assembly in 1987 to provide low-interest loans and some grants to local governments for construction of wastewater and water supply projects.

Federal Water Pollution Control Construction Grants Being Phased Out

The state legislation was passed partly in response to the federal Water Quality Act of 1987, which provides that by 1990 federal Water Pollution Control Construction Grants for wastewater treatment and collection systems will be phased out.

The federal construction grants will be replaced by annual grants to capitalize state revolving loan funds until 1994, when all federal funding for construction of wastewater projects will end. The Water Quality Act of 1987 requires that states provide a 20 percent match for all federal funds used to capitalize state loan funds and that the federal funds and state match be used first to help bring all municipal wastewater works into compliance with federal pollution control regulations.

State Revolving Loan Program Provides Transition Mechanism and Loan Flexibility

The N.C. Clean Water Revolving Loan and Grant Act of 1987 establishes a State Revolving Loan and Grant Program and within that program a Water Pollution Control Revolving Fund. The Water Pollution Control Revolving Fund will be made up of federal grants along with the state 20 percent match. Under requirements of the Water Quality Act, until all municipal wastewater systems in the state are in compliance with the act's pollution control regulations, the Water Pollution Control Revolving Fund can be used only for wastewater projects and must be distributed under federal guidelines.

In order to make some loans and grants immediately available from the state fund for a broader range of activities, the General Assembly directed that any state money appropriated for the North Carolina Clean Water Revolving Loan and Grant Fund that does not go to match federal funds will be available for other specific uses. The legislation that established the loan and grant program designates specific percentages of the available funds for (1) general loans for wastewater and water supply projects, (2) emergency wastewater and water supply loans, and (3) grants for high-unit cost wastewater and water supply projects. At this time, $5.7 million in state funds originally intended as matching funds is available under this provision because the state did not use any federal funds to capitalize its loan fund in fiscal year (FY) 1988.

States Can Divide Federal Money between Grants and Loan Funds until 1991

According to Walter Taft, chief of the Construction Grants Section, the Water Quality Act of 1987 gave states the option of putting 75 percent of their federal Water Pollution Control Construction Grants money into their revolving grant and loan funds in FY 1988. However, North Carolina chose to make all its 1988 federal funds available for traditional construction grants to local governments so no state matching funds were required for the Water Pollution Control Revolving Fund within the state loan and grant fund. That means all the money available in the N.C. Clean Water Loans and Grants Fund for 1988 can be distributed under state rules.

In FY 1989, the state must use 50 percent and may use up to 100 percent of its Federal Water Pollution Control Construction Grants, which could be as much as $44 million, for its revolving loans and grants fund. Taft said he expected that by the end of February the administration would decide how to use the 1989 federal funds. The General Assembly approved $15.8 million for the state revolving loan and grant fund for the 1988-89 biennium. If the administration decides to put all federal construction grant money into the state revolving fund, as much as $8 million of the total appropriation could be needed to match the FY 1989 federal funds, leaving about $7.8 million total for the general revolving loan and grant fund (or about $2.1 million more than is presently designated for the general account).

States will have the option of dividing federal grant money between traditional construction grants and loan fund capitalization until 1991, when federal construction grants end and all federal funds must go into state revolving loan funds.

State Fund Provides for High-Unit Cost Grants and Emergency Loans

The North Carolina Clean Water Loan and Grant Act makes the following provisions for operation of the state's revolving loan and grant fund:

* **Wastewater and Water Supply Applications go to different agencies.** Applications for loans or grants for wastewater treatment or collections systems are to be received by the Division of Environmental Management. Applications for grants or loans for water supply systems are to be received by the Division of Health Services. Applications are to be assigned priority ratings and acted upon semiannually.

* **Wastewater applicants must first ask for pollution control funding.** Applications for revolving loans or grants for wastewater treatment works and wastewater collection systems (except for emergency wastewater loans) must first be submitted for a loan or grant from the Water Pollution Control Revolving Fund. If the application is denied, the application will then be considered for a revolving loan or a grant from the General Wastewater Revolving Loan and Grant account. (Loans to construct wastewater facilities for economic development purposes as opposed to pollution control purposes are more likely to be eligible under state rules.)

* **Emergency loans are intended to address environmental or health hazards.** When failure of a wastewater treatment or collection facility creates or will create conditions jeopardizing the classified uses of the receiving water or results in a serious public health hazard as certified by the Environmental Management Commission, a repair or replacement project will be eligible for loans from the emergency wastewater revolving loan account in the general account.

* **The maximum maturity** on any loan from the fund may not exceed 20 years.

* **The interest rate** on loans from the fund will not exceed the lesser of four percent (4%) or one-half (1/2) the prevailing national market rate for tax exempt general obligation debt of similar maturities. The interest rate may be fixed at a lower rate if authorized by the Federal Water Pollution Control Act regulations.

* **The maximum amount** of a revolving loan or a grant may be one hundred percent (100%) of the nonfederal share of the construction costs of any eligible project, with a maximum amount to any one local government in any one year of $3 million.

* **Grants** will be made from the Clean Water Revolving Loan and Grant Fund only for high-unit cost wastewater and water supply projects. Eligibility for such a grant will be determined by comparing estimated average household user fees for water and sewer service to one and one-half percent (1.5%) of the median household income in the county in which the project is located. Projects that would require fees greater than one and one-half percent of the median household income will be considered eligible. The maximum grant to any one local government during any one year is $500,000. Three percent of the funds available in a review period will be available for water supply grants, with total grants awarded in a review period (six months) limited to 10 percent of the funds available.

* **Priority ratings** will be assigned to applications that are considered eligible for loans based on the following factors:

    1) public necessity and potential for providing the greatest benefit to the greatest number of people

    2) eligibility for federal funding, compatibility with the state's general program of water supply and water pollution control, the population to be served, the fiscal responsibility of the application, and need for assistance

    3) demonstration of water conservation practices

According to Taft, temporary state rules define a categorical point system by which applications are assigned numerical priority ratings. These rules will be in effect until August 1. Taft said that he expected the rules to be made permanent after undergoing the state's standard administrative rule-making process, including public hearings.

GOVERNOR'S COASTAL INITIATIVE INCLUDES PROTECTION OF WATER QUALITY AND ECONOMIC GROWTH Governor Jim Martin has established a special Coastal Initiative Commission to gather information from citizens about ways to balance environmental protection with coastal development. The coastal initiative focuses on protection of water quality and fisheries habitats, preserving natural coastal features, and encouraging waterfront development of coastal communities.

The coastal initiative, still in the planning stages, is intended to provide a reasonable balance between the competing needs of tourism, development of fisheries, and the natural environment. Governor Martin stated that the initiative can help make the coastal area "more attractive to economic opportunities while establishing stronger environmental safeguards in our most sensitive waters."

The Governor's Commission on Coastal Initiatives is charged with the responsibility of devising a comprehensive plan to provide for the orderly growth of marine related activity and to promote environmentally sound economic development among some twenty coastal counties.

The Governor appointed former Lieutenant Governor Jimmy Green to chair the Commission, which is composed of state and local officials and coastal environmental business leaders. To assist the Commission, an administrative group composed of senior management staff from each of the participating state departments and divisions, has been established. Dr. Grace Rohrer heads the administrative group and Edythe McKinney is the project coordinator. The phone number to call for more information is (919) 733-6376.

The Commission and the administrative group have been given the responsibility of formulating proposals for achieving the following objectives:

* Increase protection of ecologically fragile and environmentally significant areas

* Promote marine waterways system

* Stimulate waterfront investment in existing towns and villages

In order to achieve these objectives, state government is prepared to offer incentives to aid these coastal counties to protect our natural environment and to spur greater economic development. State resources will include grants and loans to local governments, infrastructure investments, promotional programs, special permit assistance and technical assistance. Such assistance will be provided by the North Carolina Departments of Natural Resources and Community Development, Commerce, Administration, Transportation, Human Resources, and Cultural Resources.

Six public meetings were held in January to give more details on the Coastal Initiative Plan and to invite public comment.

NUTRIENT SENSITIVE WATERS CLASSIFICATION EXPANDS TO THE LOWER NEUSE RIVER BASIN In its January meeting the Environmental Management Commission (EMC) voted to classify the lower Neuse River Basin as nutrient sensitive waters. This decision makes the reduction of phosphorus mandatory at the municipal and industrial wastewater treatment facilities that discharge more than 500,000 gallons a day into the lower Neuse below Falls Lake Dam. Removal of phosphorus at these larger facilities is expected to remove some 95 percent of the phosphorus coming from all wastewater treatment plants. The EMC ruling would also require phosphorus reduction in discharges to two parts per million at all new wastewater treatment facilities or expansions built in the basin, regardless of size.

The lower Neuse River has experienced eutrophication problems in the freshwater section between Kinston and New Bern since the late 1970s. There is an extensive data base for the Neuse River Basin, and numerous research investigations funded by The University of North Carolina Water Resources Research Institute show high levels of nutrients in the river and document major algae blooms.

The staff of the Division of Environmental Management (DEM) has developed specific nutrient management strategies for the lower Neuse River that include both point and nonpoint source control of nutrients. Reducing phosphorus in wastewater effluent is a major way of reducing the point source of nutrients.

Some Wastewater Treatment Facilities Will Use Biological Phosphorus Removal

It is anticipated that many of the wastewater treatment facilities will use a biological treatment method to remove phosphorus. Studies at the Orange Water and Sewer Authority, Durham, Burlington, and Raleigh show that phosphorus levels can be reduced to two parts per million by biological treatment.

Biological phosphorus removal is a relatively new approach which relies on anaerobic treatment of the mixed liquor followed by aerobic treatment to select for a group of bacteria which accumulate very large amounts of cellular phosphorus. When these bacteria are removed from the system as sludge, the accumulated phosphorus is removed as well. Biological nutrient treatment also reduce the amount of nitrogen in the wastewater effluent.

The process has significant operational cost advantages over chemical phosphorus removal. These advantages may be offset by greater capital costs for retrofit than chemical phosphorus removal.

The waters in North Carolina designated as nutrient sensitive now include the Chowan River, areas above the B. Everett Jordan Reservoir, and the entire Neuse River Basin.

NITRATES NOT EXPECTED TO BE A MAJOR GROUNDWATER PROBLEM IN NORTH CAROLINA

Dr. Wendell Gilliam speaking before the annual meeting of the Soil Science Society cited specific reasons why nitrates in groundwater do not appear in high concentrations below normal agricultural operations in North Carolina.

Gilliam, a professor in the Department of Soil Science at North Carolina State University, has analyzed thousands of samples of North Carolina surface and groundwater and has found that nitrate concentrations in North Carolina waters are typically lower than concentrations in waters of midwestern states such as Iowa and Illinois.

Groundwater samples taken from both Coastal Plain and Piedmont regions show low and safe levels of nitrates below the two-meter depth. Gilliam believes that the lower levels in this state are the result of several factors:

* Less than half or about 35 percent of the farmland in the Coastal Plain is in cultivation. If all of the nitrogen used in N.C. were put uniformly into N.C. drainage water, it would not cause a problem for groundwater. In the midwest the percent of land in row crops is higher so fertilizer use is much higher.

* Higher rainfall rates of about 50 inches in North Carolina tend to dilute the nitrates present.

* Confining beds or clay lenses help to restrict the downward movement of nitrates and encourage the lateral flow of water to streams.

* High water table and warmer temperatures enhance denitrification. In this process nitrates are changed to volatile nitrogen compounds or gaseous forms which ultimately enter the atmosphere.

Gilliam says that in those instances where elevated levels of nitrates have been observed with a few animal and industrial operations, much higher than recommended nitrogen levels have been applied.

PROJECT WILL EVALUATE PROTOCOL FOR IDENTIFYING SOURCES OF TOXICS IN MUNICIPAL EFFLUENTS

With funding from the Urban Water Consortium and the U.S. Environmental Protection Agency and with in-kind services from the City of High Point, Dr. Francis A. DiGiano of the UNC-CH Department of Environmental Sciences and Engineering is evaluating EPA's proposed protocol for identifying the sources of toxics in municipal effluents by testing it in the City of High Point.

The project builds on previous work done by DiGiano and UNC-CH colleagues aimed ultimately at helping municipalities establish regulatory programs for controlling the flow of toxics into wastewater collection systems.

In a two-year study conducted in 1985 and 1986 and funded by the Water Resources Research Institute, the N.C. Board of Science and Technology, and the N.C. Pollution Prevention Pays Program, DiGiano, Dr. Russell F. Christman, and Dr. David H. Moreau collaborated on a project conducted at the High Point wastewater treatment plant.

Testing done by the N.C. Division of Environmental Management had revealed that, from time to time, wastewater effluent had toxic effects on biological organisms. The research project involved testing effluent samples for toxic effects on living organisms and analyzing identical samples to determine what kinds of compounds were present. The aim was to find a relationship between toxicity and the appearance of specific chemicals so that the sources of those chemicals could be identified and eliminated. A significant part of the project involved evaluating analytical techniques for identifying chemical compounds in effluent.

According to DiGiano, even the most sophisticated analytical techniques cannot identify every chemical present in effluent, but some techniques may identify more compounds than others.

The focus of his current work is to determine if the technique recommended by the proposed EPA protocol is the most effective one available. The research will help to establish a standard procedure which can be confidently used for wastewater discharge monitoring and control.

SCIENTISTS EVALUATE SLUDGE APPLICATION PROGRAM AT RALEIGH WASTEWATER TREATMENT PLANT

The City of Raleigh has applied aerobically digested liquid sewage sludge to city-owned agricultural land for several years as a disposal/utilization method. North Carolina State University's Soil Science Department conducted research from 1980 to 1983 on the effect of sludge application on crop yield and composition and on soil properties.

Raleigh is interested now in having a study conducted to determine the impact of their sludge application program on the environment and on soil productivity. The following NCSU scientists will assist with a detailed evaluation:

* **Department of Soil Science:** Dr. Larry King (project coordinator), Dr. Mike Hoover, Dr. Wendell Gilliam, Dr. Ray Daniels, Dr. Robert Miller

* **Department of Marine, Earth and Atmospheric Sciences:** Dr. Charles W. Welby

* **Department of Civil Engineering:** Professor Ralph Heath, Dr. Robert Borden

* **Department of Biological and Agricultural Engineering:** Dr. L.M. Safley

Present sludge storage and application practices will also be evaluated.

The study is being undertaken through the Urban Water Consortium, a cooperative program of The UNC Water Resources Research Institute and several of the state's larger cities and water and sewer authorities, and is expected to be completed in December 1988.

RESEARCHERS STUDY MUTAGENIC BYPRODUCTS FROM CHLORINATION

Chlorine used for disinfection of drinking water is effective and inexpensive but forms a variety of presently unidentified mutagenic byproducts in its reactions with organic materials (humics) in raw water. Researchers in the UNC-Chapel Hill Department of Environmental Sciences and Engineering are working toward methods of identifying mutagens produced by chlorination with the aim of finding safer ways of disinfecting drinking water.

Using state-of-the-art equipment and methodology, Drs. Russell F. Christman and J. Donald Johnson are fractionating, or separating, chlorinated organic materials into various categories (such as total organic halogen, TOX, and total organic carbon, TOC) and testing the fractions for mutagenic effects on certain modified bacteria. At the same time, they are trying to identify the specific compounds present in the fractions by using a gas chromatograph/mass spectrometer (GC/MS). By comparing the results of bioassays and GC/MS analysis, they hope to pinpoint the compounds responsible for mutation.

According to the researchers, until recently it has been impossible to identify any highly mutagenic chlorination byproducts, and it has been assumed that mutagenic effects observed in concentrated residues from some chlorinated drinking waters resulted from the presence of a variety of only slightly mutagenic materials. Recent discoveries, however, have called that assumption into question. The researchers say that the identification in 1981 of the strongly mutagenic chlorinated hydroxyfuranone in the effluent of a kraft paper mill and the subsequent discovery of the same compound in chlorinated drinking water suggests the possibility that the unaccounted for mutagenicity of whole drinking water residues may be due to trace concentrations of a few intensely mutagenic compounds. If this is the case, they say, it may be possible to identify drinking water sources unsafe for chlorination by testing for the presence of mutagenic byproduct source substances. They also say that since various parameters of chlorination treatment (such as chlorine-to-carbon ratio and contact time) seem to affect byproduct formation, their research could also produce knowledge needed to devise more effective water treatment strategies.

Their research is jointly supported by the American Water Works Association Research Foundation and the UNC Water Resources Research Institute.

COMPUTER-BASED SYSTEM IS AIMED AT HELPING REGULATORS MAKE WASTE DISPOSAL SITING DECISIONS

In a project sponsored by the Water Resources Research Institute and the N.C. Division of Environmental Management, researchers at Duke University have constructed a system of interactive computer-based procedures which can aid regulatory officials in assessing risk to groundwater supplies from waste disposal sites. The researchers describe the system as an important first step toward developing an expert system for groundwater quality management.

Dr. Miguel A. Medina, Jr. and Jonathan B. Butcher of the Department of Civil and Environmental Engineering and Carlos M. Marin of the School of Forestry and Environmental Studies describe the system in their recently completed project report, "An Advisory System for North Carolina Groundwater Quality Modeling and Management Needs."

An expert system is a group of related computer programs which incorporates human expertise to probe and analyze situations and make predictions or recommendations in specific fields. Some of the first expert systems were constructed to aid physicians in making medical diagnoses.

The advisory system developed by the Duke researchers is intended to help officials in the N.C. Division of Environmental Management make decisions about granting permits for waste disposal sites. It incorporates screening procedures, models and knowledge bases that can be drawn upon to predict how susceptible a specific site is to groundwater contamination, what kinds of contaminants might escape from a proposed disposal facility, in what direction and how quickly a contaminant plume might move, and how likely it is that a violation of groundwater quality standards will occur.

The system incorporates the expertise of its developers in modeling groundwater flow and mass transport into a component called CHOICE. CHOICE serves as an expert questioner, asking the user for specific data which it then uses to select among various procedures and models to build a simulation of the site. The researchers describe CHOICE as a friendly and intelligent interface which aids non-expert users in selecting and preparing input data and interpreting the mathematical model output.

Also incorporated into the system is a regional data base which the system can draw upon for general site information.

A user's manual for the advisory system and for each of the component models along with example applications are available for review at the UNC Water Resources Research Institute, 219 Oberlin Road, Raleigh (WRRI Report Number 236).

VIRGINIA REPORT ASSESSES LOCAL MANAGEMENT OF NONPOINT SOURCE POLLUTION

A study conducted by William Cox and Lorraine Herson of the Virginia Tech Department of Civil Engineering with support from the Virginia Water Resources Research Center has reviewed the nonpoint source (NPS) pollution control efforts in Virginia. NPS pollution has caused water quality problems in the Chesapeake Bay, the Occoquan Reservoir in northern Virginia, and the Chowan River Basin.

The Cox and Herson study begins with a description and analysis of current laws and programs for NPS control. A subsequent evaluation of land use controls includes case studies of localities and an analysis of alternatives to approaches used in Virginia. The final section of the study evaluates the effectiveness of Virginia NPS pollution controls and recommends possible improvements.

Because state government plays no part in zoning and subdivision regulations in Virginia, major responsibility for land use controls lies with local governments. One conclusion of the study is that increasing state oversight and financial assistance is necessary for implementation of an effective statewide NPS pollution control program. The researchers also urge that information about the importance of NPS controls be given to local program planners and that program personnel and contractors undergo mandatory training.

Control of Nonpoint Source Pollution in Virginia: An Assessment of the Local Role (Bulletin 158) is available free of charge to Virginia residents. For those out of state, the charge is $6 a copy if payment accompanies the order and $8 if billing follows. Write to

Publications Services
Virginia Water Resources Research Center
617 N. Main St.
Blacksburg, VA 24060-3397

A loan copy is available from The UNC Water Resources Research Institute (919) 737-2815.

REPORTS ON SOUTH CAROLINA WATER USE AND OUTLOOK, LAW, FINANCING, AND POLICY

The Water Resources Research Institute has received a number of publications on key water issues in South Carolina. Among the publications is a report on the situation and outlook for water resource use through the end of the century. The report is part of a multi-year study to assess water resource needs and options prepared for the South Carolina Water Resources Commission by the Strom Thurmond Institute at Clemson University. The other water publications produced by the Thurmond Institute on important water topics in South Carolina include:

* The Evolution of South Carolina Water Law, 1783-1985
* Water Law and Water Rights: Recent Developments and Implications for South Carolina
* Water Supply Estimates for Major Drainage Basins in South Carolina
* Comparative State Water Policy
* Financing Water Resource Infrastructure
* Financing Water System Capital: Implications for Water Pricing in South Carolina

The publications were received from the Strom Thurmond Institute of Government and Public Affairs, 201 Martin Street, Clemson University, Clemson, South Carolina 29634-5130 (Telephone 803/656-4700).

URBAN STORMWATER MANAGEMENT CONFERENCE SET FOR APRIL 29 IN ASHEVILLE

A regional conference on urban stormwater management will be held on Friday, April 29, 1988, on the campus of the University of North Carolina at Asheville. The conference is designed to inform stormwater managers and elected officials of water quantity and quality problems associated with stormwater runoff and of management strategies to address these problems. The conference will also be of interest to educators, consultants, developers, and individuals with interest in water resource management issues.

According to conference coordinator Bill Eaker of the Land-of-Sky Regional Council, federal and state stormwater quality regulations will be highlighted during the conference.

"There is a great deal of uncertainty concerning future EPA stormwater discharge permits and their impact on city and county stormwater management programs," said Eaker.

Funding of these programs is another central issue, according to Eaker. "Many stormwater managers believe in operating these programs as 'utilities' where property owners are assessed user fees to cover capital and O&M costs," he said.

The director of the Storm and Surface Water Utility of the City of Bellevue, Washington, will speak during the conference on his experiences with the creation and operation of Bellevue's stormwater utility. Also featured at the conference will be the City of Asheville's urban stormwater program including a four-year cooperative hydrology-water quality study being conducted for the City by the U.S. Geological Survey.

The conference is cosponsored by the City of Asheville, Land-of-Sky Regional Council, UNC Asheville, The UNC Water Resources Research Institute, N.C. Department of Natural Resources and Community Development, and the U.S. Geological Survey. For registration information write the Land-of-Sky Regional Council, 25 Heritage Drive, Asheville, NC 28806 or call Bill Eaker (704/254-8131).

DUKE UNIVERSITY OFFERS ENVIRONMENTAL MANAGEMENT SHORT COURSES

The School of Forestry and Environmental Studies at Duke University is offering a series of week-long continuing education courses for professionals in natural resource management.

Among the courses offered are "Environmental Law," to be taught April 11-15 by Milton S. Heath, Jr. (professor of public law and water resources at UNC-CH and adjunct professor at Duke) and "Basic Groundwater Hydrology" to be taught April 18-22 by Ralph C. Heath (adjunct professor of civil engineering at NCSU and lecturer at Duke).

"Environmental Law" will examine contemporary environmental law and its common law antecedents in the context of the American legal system. The course includes briefing of cases, a moot court argument, a short on-campus law library research project, and lectures.

"Basic Groundwater Hydrology" will cover the basic principles, concepts, and methods of groundwater hydrology including the water storage and transmission characteristics of rocks, the physical characteristics and features of the groundwater regions of the U.S., the collection and analysis of data used in determining the hydraulic properties of groundwater systems, and problems related to the development and protection of the groundwater resource.

For additional information about these and other courses in the series write or call:

WASTE REDUCTION-POLLUTION PREVENTION: PROGRESS AND PROSPECTS WITHIN NORTH CAROLINA

A Major Statewide Conference
March 30 and 31, 1988
North Raleigh Hilton, Raleigh, NC

PURPOSE: The Pollution Prevention Pays concept is that industrial, commercial, and governmental operations can save money by reducing the amount of waste they generate instead of treating and disposing of the waste. The concept becomes more valid every day, as the state and the nation begin to run out of waste disposal sites and as the liability attached to waste disposal methods that do not protect human health and the environment rises.

North Carolina has been a leader in promoting the Pollution Prevention Pays concept. In May 1982, the first Pollution Prevention Pays symposium in the United States was held in Winston-Salem and shortly thereafter a statewide program of multimedia waste reduction assistance—the North Carolina Pollution Prevention Program—was established in the Division of Environmental Management of the Department of Natural Resources and Community Development. Since then the nonregulatory Pollution Prevention Program has documented many successes in waste reduction and has been recognized as the most effective in the country.

This second statewide Waste Reduction-Pollution Prevention Conference is another important step in North Carolina's continuing efforts to educate industrialists, government leaders, public officials, and citizens about the concepts, approaches, and current technology whereby wastes, pollution, and their associated costs can be curbed. The conference features concurrent sessions with 50 technical presentations addressing a complete range of waste reduction concerns from regulatory and financial incentives to state-of-the-art technology for specific industries.

WHO SHOULD ATTEND: The conference is designed to be of practical benefit to both management and front-line personnel in industrial, commercial, and governmental operations where any kind of waste is generated.

It also can be of great informational value to educators, media representatives, and citizens interested in environmental issues.

FOR ADDITIONAL PROGRAM INFORMATION: A list of speakers and an outline of each technical session are available. For this information or any other details about the conference program, please contact Dr. James M. Stewart, UNC Water Resources Research Institute (919/737-2815) or Mr. Gary Hunt, N.C. Pollution Prevention Program (919/733-7015).

SPONSORS: The principal sponsors of the conference are the North Carolina Pollution Prevention Program of the Division of Environmental Management (N.C. Department of Natural Resources and Community Development) and The University of North Carolina Water Resources Research Institute, in cooperation with the Solid Waste Management Section of the N.C. Department of Human Resources.

Cosponsors are: Governor's Waste Management Board ▼ N.C. League of Municipalities ▼ N.C. County Commissioners Association ▼ Consulting Engineers Council of N.C. ▼ N.C. Textile Manufacturers Association ▼ American Furniture Manufacturers Association ▼ Blue Ridge Branch of the Electroplaters Association ▼ Professional Engineers of N.C. ▼ Citizens for Business and Industry ▼ NCSU Industrial Extension Service ▼ National Association of Hosiery Manufacturers ▼ League of Women Voters of North Carolina ▼ Conservation Council ▼ Clean Water Fund ▼ Sierra Club ▼ N.C. Water Pollution Control Association ▼ Southeast Waste Exchange

PROGRAM

Wednesday, March 30

8:00 - 9:00 am Registration and refreshments

9:00 - 9:30 Welcome, **Roger Schecter**
Director, Pollution Prevention Program, N.C. Department of Natural Resources and Community Development

9:30 - 10:00 National Waste Reduction Strategies
James Lounsbury
Special Assistant for Waste Minimization, U.S. EPA

10:00 - 10:30 Coffee

10:30 - 11:30 Bringing It Home: N.C. Perspectives

Bruce Ethridge
N.C. House of Representatives

Bill Holman
Environmental Lobbyist

B.F. Bentley
General Electric Company

11:30 - 12:00 Waste Reducing, Clean Technologies in Europe—Fact or Fantasy
Don Huisingh
North Carolina State University

12:00 - 1:30 pm Lunch

1:30 - 3:00 Concurrent Session I (See next page for topics)

3:00 - 3:30 Coffee

3:30 - 5:00 Concurrent Session II (See next page for topics)

Thursday, March 31

8:30 - 10:00 am Concurrent Session III (See next page for topics)

10:00 - 10:30 Coffee

10:30 - 12:00 Concurrent Session IV (See next page for topics)

12:00 - 12:30 Lunch

12:30 - 1:30 Recognition of recipients of the Governor's Awards for Excellence in Waste Management for 1987
Earl R. MacCormac
Governor's Science Advisor

1:30 - 4:00 Concluding Plenary Session:

Challenges for Future Waste Reduction-Pollution Prevention Initiatives

Joel Hirschhorn, Office of Technolgy Assessment, U.S. Congress

Panel: Moderator—**Roger Schecter**

Joe Harwood, Chairman, Environmental Concerns Committee, N.C. Citizens for Business and Industry
Linda Little, Executive Director Governor's Waste Management Board
Marion Nichol, Conservation Council of North Carolina

CONCURRENT SESSIONS

Session I—1:30 - 3:00 pm

Topic A: Waste Reduction-Pollution Prevention
in **The Electroplating Industry**
Leader: **George McRae**, Stanadyne Inc.

Topic B: Waste Reduction-Pollution Prevention
in **The Textile Industry**
Leader: **Sam Moore**,
Burlington Research Inc.

Topic C: Reducing Hazardous Waste Production
in **Degreasing Operations**
Leader: **Jerry Kohl**, NCSU Industrial Extension Service

Topic D: Waste Reduction-Pollution Prevention
in **Low-level Rad-waste Management**
Leader: **Edgar Miller**, Afton Associates

Session II—3:30 - 5:00 pm

Topic E: Waste Reduction-Pollution Prevention
in **The Furniture Industry**
Leader: **Vincent Ross**, Ross Associates

Topic F: Waste Reduction-Pollution Prevention
in **Commercial, Clinical, and Educational Laboratories**
Leader: **Wayne Thomann**,
Duke University Medical Center

Topic G: **Developing and Implementing Waste Reduction Programs**
Leader: **Gary Hunt**,
Pollution Prevention Program,
N.C. Department of Natural Resources and Community Development

Topic H: **Viable Options for Household Hazardous Waste Management**
Leader: **Mary Beth Edleman**,
UNC Environmental Resources Project

Session III—8:30 - 10:00 am

Topic I: Waste Reduction-Pollution Prevention
in **The Food Processing Industry**
Leader: **Roy Carawan**,
NCSU Department of Food Science

Topic J: Waste Reduction-Pollution Prevention
in **The Microelectronics Industry**
Leader: **Stan Taylor**, Data General

Topic K: **New Concepts in Municipal Solid Waste Reduction**
Leader: **Betsy Dorn**,
Mecklenburg County Engineering Department

Topic L: **Regulatory Incentives and Issues in Waste Reduction**
Leader: **William Paige**, Supervisor
Technical Assistance Unit,
Hazardous Waste Management Branch

Session IV—10:30 - 12:00 pm

Topic M: Waste Reduction-Pollution Prevention
in **The Chemical Processing Industry**
Leader: **Michael Smith**, Sandoz Co.

Topic N: Waste Reduction-Pollution Prevention
in **The Printing Industry**
Leader: **Donald M. Preiss**,
NCSU Industrial Extension Service

Topic O: Waste Reduction-Pollution Prevention
with **Fiberglass Moldings**
Leader: **Darryl Davis**, Head
ECU Department of Manufacturing

Topic P: **Financial Incentives to Waste Reduction**
Leader: **Michael Overcash**,
NCSU Department of Chemical Engineering

CONFERENCE FEE AND REGISTRATION

The conference fee of $60 includes materials, coffee breaks, and two lunches. One-day registration is available for $35.

To register by mail please return the registration form provided to The UNC Water Resources Research Institute. Payment should accompany registration. Checks should be made payable to The UNC Water Resources Research Institute. If you must cancel your registration, a refund can be made if you notify us at least 10 days prior to the conference. We will gladly accept last-minute substitutions. **Registration deadline is March 23, 1988.**

FOR ADDITIONAL REGISTRATION INFORMATION

Please call Eva Tew or Linda Lambert at the Water Resources Research Institute (919/737-2815).

LOCATION AND ACCOMMODATIONS

The conference will be held at the North Raleigh Hilton located at 3415 Wake Forest Road in Raleigh. Rooms for conference participants will be available at the special rate of $49 for either single or double occupancy. To obtain this special rate, contact the reservation desk at the North Raleigh Hilton (919/872-2323) and mention that you are attending the Waste Reduction-Pollution Prevention Conference.

For those who do not wish accommodations at the Hilton, the Econo Lodge (919/872-9300), Cricket Inn (919/878-9310), and Residence Inn (919/878-6100) are nearby.

CLIP AND RETURN THIS FORM TO:

UNC WATER RESOURCES RESEARCH INSTITUTE,
BOX 7912, NORTH CAROLINA STATE UNIVERSITY, RALEIGH, NC 27695-7912

WASTE REDUCTION-POLLUTION PREVENTION:
PROGRESS AND PROSPECTS
WITHIN NORTH CAROLINA

REGISTRATION FORM

Name ______________________________

Affiliation ______________________________

Phone ______________________________

Address ______________________________

____

If registration is for one day only, please indicate date: ______________________________

Please circle the letters of the concurrent sessions you will attend:

March 30:

Session I: A B C D

Session II: E F G H

March 31:

Session III: I J K L

Session IV: M N O P

Disinfection By-Products: Formation and Control

March 10, 1988 — Chapel Hill, North Carolina

Background

The 1986 Amendments to the Safe Drinking Water Act are likely to result in major changes in drinking water treatment practices in the United States over the next decade. The recently promulgated surface water treatment rule (November 1987) contains specific criteria for assuring that adequate disinfection of drinking water from surface supplies is achieved. Additionally, in 1989, the EPA will be promulgating regulations mandating disinfection of all public water supplies. Included in the regulatory agenda for 1989 is the establishment of maximum contaminant levels (MCLs) for disinfection by-products. This includes revision of the current MCLs governing trihalomethanes (THMs) as well as MCLs for a number of other potentially harmful disinfection by-products which have been identified in treated drinking water. Best available technologies (BATs) will be designated for achieving compliance with the established MCLs.

Objectives

The objectives of this workshop will be to review:

* chemical principles governing the formation of by-products resulting from chlorine and other disinfectants used in drinking water treatment
* health effects associated with disinfection by-products identified in drinking water
* microbiological principles governing the effectiveness of disinfection and other treatment processes for control of bacteria, viruses, and protozoa
* technological and management approaches for control of disinfection by-products, e.g., alternate oxidants adsorption, air stripping

Audience

The workshop is designed for water utility managers, plant superintendents and chemists, consulting engineers, and regulatory agency personnel.

Speakers

Mr. Wallace Venrick is head of the Public Water Supply Branch, Environmental Health Section in the North Carolina Division of Health Services. The other speakers are all faculty members in the Department of Environmental Sciences and Engineering in the School of Public Health, University of North Carolina at Chapel Hill. All are nationally and internationally recognized experts in the field of drinking water quality management.

Program

8:00 a.m.	Registration
9:00	**Regulatory Outlook: Present and Future** Wallace E. Venrick
9:45	**Disinfection By-Products: Formation and Health Effects** J. Donald Johnson Russell F. Christman
10:30	Break
11:00	**Disinfection By-Products in North Carolina Drinking Water** Philip C. Singer
11:45	**Disinfection: Principles and Applications Relative to the New Regulations** Mark D. Sobsey
12:30	Lunch (on your own)
2:00 p.m.	**Disinfection By-Product Control: Alternative Oxidants and Disinfectants** Philip C. Singer
2:45	Break
3:00	**Disinfection By-Product Control: Air Stripping and Carbon Adsorption** Francis A. DiGiano
3:45	**Disinfection By-Product Control: Source Selection and Watershed Management** Daniel A. Okun
4:30	**Panel Discussion**
5:00	Adjourn

Program Director

Philip C. Singer, PhD, Professor
Department of Environmental Sciences and Engineering
School of Public Health
University of North Carolina at Chapel Hill

Program Fee

The program registration fee is $40. The fee includes program materials, breaks, and CEUs. Make checks payable to **Division of Community Health Service.** If your agency plans to pay your registration fee, we encourage you to send either a purchase order or a personal check (and ask your agency to reimburse you). **To guarantee you a place at the program, we must receive a check or purchase order for your total registration fee no later than March 3.**

Full-time students may register at a reduced fee of $10.

Registration

To register, please complete the registration form and return it with a check or purchase order to: Registrar (CE 125), Office of Continuing Education, UNC-CH School of Public Health, CB# 8165 - Miller Hall, Chapel Hill, NC 27599-8165. Make checks or purchase orders payable to **Division of Community Health Service.**

Student Registrations: Full-time students must sign up in advance by completing the attached registration form.

REGISTER IMMEDIATELY BY PHONE by calling **919/966-4032.** A check or purchase order must be sent to confirm your registration.

You will receive written confirmation of your registration. If you have not received a letter two weeks prior to the program date, please call 919/966-4032 to check on the status of your registration.

Cancellation and Refund Policies

Participants who cancel before March 3 will receive a refund for the amount they have paid **less $10** which must be kept to defray administrative costs. Participants who cancel after March 3 will receive no refund. **Substitutions within the same agency are welcome at any time.**

Continuing Education Credit

Continuing Education Units (CEUs) have been applied for through the UNC-CH School of Public Health.

For Further Information

Sharon Wills, Program Assistant
Office of Continuing Education
UNC-CH School of Public Health
CB# 8165 - Miller Hall
Chapel Hill, NC 27599-8165

Telephone: 919/966-4032

Admission to School of Public Health programs is without regard to race, sex, national origin, color, religion, handicap, age or veterans status.

REGISTRATION FORM (CE125)

Disinfection By-Products

[ ] This is to confirm my telephone registration

Name ____________________ Soc. Sec. No. ____________

Full-time Student [ ] Yes [ ] No

Position ____________________

Agency ____________________

Address ____________________

____
City State Zip

Business Phone ____________ Home Phone ____________

[ ] I am handicapped and have special needs for overnight accommodations, learning aids, and/or facility accessibility information. Please contact me at my business/home phone (circle one).

REGISTRATION FEE:

Regular fee	$40.00
Student fee	$10.00
Enclosed please find a check or purchase order for	$ ________.

Please return this form along with your check or purchase order (payable to Division of Community Health Service) to:

Registrar (CE125)
Office of Continuing Education
UNC-CH School of Public Health
CB # 8165 - Miller Hall
Chapel Hill, NC 27599-8165

Intensive Course Coordinator
School of Forestry and Environmental Studies
206-B Biological Sciences
Duke University
Durham, NC 27706 (919/684-2135).

SEMINAR ON ALBEMARLE-PAMLICO ESTUARINE PROGRAM SET FOR FEBRUARY 23 AT NCSU Dr. Douglas Rader, Project Coordinator for the Albemarle-Pamlico Estuarine Study, will participate in a water resources seminar sponsored by the Water Resources Research Institute. The seminar is scheduled for February 23 from 12:00 to 1:00 pm in Senate Hall at the North Carolina State University Student Center.

Dr. Rader will review the major problems, goals, and research needs associated with the Albemarle-Pamlico estuarine system.

GILLIAM RECEIVES TWO AWARDS Dr. Wendell Gilliam, Professor of Soil Science at North Carolina State University, has recently received the Fellow Award from both the Soil Science Society of America and the American Society of Agronomy. Dr. Gilliam is best known for his research on determination of factors controlling nutrient losses from soils, water management to reduce water pollution, and the effects of soil erosion on soil productivity. He has been a research investigator for numerous Water Resources Research Institute projects and is author of five research reports published by the Institute on the movement of fertilizer nutrients in soil and drainage water in North Carolina.

POSITIONS AVAILABLE **The Utah Water Research Laboratory and the Utah State University Department of Civil and Environmental Engineering invite applications for faculty positions** to be chosen from the four areas listed below. Rank is open and will be determined by qualifications.

The positions offer a nine-month base (with opportunities for three months of summer salary) to support research at the Utah Water Research Laboratory and opportunities for teaching at graduate and undergraduate levels. Teaching will be with joint appointments through the Department of Civil and Environmental Engineering or possibly other academic departments. Applicants must hold a PhD degree in water resources engineering or related fields. Desired specialty areas are:

* Surface water hydrology

* Groundwater hydrology and hydraulics

* Systems analysis as applied to water resources planning and management

* Natural environmental aquatic systems analysis and computer modeling

Persons interested in applying should submit resumes that indicate educational background, teaching and research experience, publications, and professional activities. They should provide the names and addresses of three persons who can be contacted to provide references. Applications should be sent to L. Douglas James, Director, Utah Water Research Laboratory, Utah State University, Logan, Utah 84322-8200.

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

"The Situation and Outlook for Water Resource Use in South Carolina 1985-2000 - First and Second Year Ex. Summary, and Second Year Report," for SC Water Resources Comm., by The Strom Thurmond Inst. of Gov't. & Public Affairs, 201 Martin St., Clemson Univ., Clemson, SC 29634-5130. (06B)

The following working papers are available from The Strom Thurmond Institute of Government and Public Affairs, 201 Martin St., Clemson Univ., Clemson, SC 29634-5130. (06B)

"Financing Water Resource Infrastructure," (WP090187), by J. B. London, et al.

"Financing Water System Capital: Implications for Water Pricing in South Carolina," (WP072787), by H. H. Ulbrich, et al.

"Comparative State Water Policy," (WP093087), by J. B. London, et al.

"Water Supply Estimates for Major Drainage Basins in South Carolina," (WP090787), by A. B. Badr, et al.

"Water Law and Water Rights: Recent Developments and Implications for South Carolina," (WP081877), by H. H. Ulbrich.

"The Evolution of South Carolina Water Law, 1783-1985," (WP082187), by W. F. Steirer.

Water Quality Management

"Empirical and Process Models for Acidification and Alkalinity Regulation in Lakes of the Upper Great Lakes Region," (#124), 11/87, by P. L. Brezonik, et al., WRRC, Univ. of MN, St. Paul, MN 55108. (05B)

"Effects of Tillage System, Crop Residue Level, and Fertilizer Application Technique on Losses of Phosphorus and Pesticides from Agricultural Lands," (#157), 1987, by S. Mostaghimi, et al., WRRC, VPI&SU, 617 N. Main St., Blacksburg, VA 24060-3397. (05B)

"Control of Nonpoint Source Pollution in Virginia: An Assessment of the Local Role," (158), 11/87, by W. E. Cox, et al., WRRI, VPI&SU, 617 N. Main St., Blacksburg, VA 24060-3397.

"Tailoring Flocculant Molecular Structure to Improve the Condition and Dewatering of Wastewater Sludges," (TR#179), 9/87, by J. A. Caskey, et al., WRRC, Purdue Univ., W. Lafayette, IN 47907. (05D)

Water Quantity Management

"Executive Summary Report, Eno River Area Capacity Use Investigation," 9/87, by Div. of Water Resources, NRCD, P.O. Box 27687, Raleigh, NC 27611-7687. (06B)

"Operation of Hydrologic Data Collection Stations by the U.S. Geological Survey in 1987," (87-563), 1987, by A.C. de la Torre, for add. info. contact Chief, Br. of Operational Support, USGS, 504 Nat'l. Center, 12201 Sunrise Valley Dr., Reston, VA 22092. (USGS)

Miscellaneous

"Proceedings - Fourth Annual Gatlinburg Acid Rain Conference," 10/87, ed. by H. Olem, TVA, Evans Bldg., Knoxville, TN 37902. (06B)

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