NEWS
WATER RESOURCES RESEARCH INSTITUTE
OF THE UNIVERSITY OF NORTH CAROLINA

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CONTENTS

CONFERENCE LOOKS AT PROBLEMS, NEEDS OF ALBEMARLE SOUND

A conference on Albemarle Sound--Trends and Management Needs was held March 3 at the College of the Albemarle in Elizabeth City.

Over 100 invited local leaders, government officals, and scientists met to review what is known about Albemarle Sound and its tributaries and to consider management alternatives for dealing with the pollution of these waters. The Albemarle region has seen a 74% decline in commercial fish catches over the past 10 years, conference speakers noted, and nuisance algal blooms have lowered property values, discouraged tourism, and caused fish kills.

In response to these problems the N. C. General Assembly in 1981 appropriated funds for study of the problems and needs of the Albemarle system. The legislation, H. B. 747, called for the creation of an eight-member commission to conduct the study and report findings to the 1983 General Assembly.

The N. C. Department of Natural Resources and Community Development, which is conducting restoration efforts in the Chowan River, is responsible for developing an Action Plan for the Albemarle basin by January 1983. The Plan is to identify any immediate actions necessary as well as what is needed in the way of long-term studies or management plans.

The purpose of the Albemarle Conference was to assist with these activities by bringing into sharper focus the information currently available on the Albemarle system and providing a forum for the parties involved to communicate and begin determining what future restoration efforts are necessary.

The conference was sponsored by the Water Resources Research Institute and the UNC Sea Grant Program. Co-sponsors were the Divisions of Environmental Management and Marine Fisheries, NRCD; the Coastal Resources Commission; the Albemarle Basin Task Force; and the Agricultural Extension Service.

A conference proceedings containing text of presentations and discussion is being prepared by the sponsors and, when available, will be announced in this newsletter.

EMC VOTES TO BEGIN NEW STUDIES OF CF INDUSTRIES IMPACT ON CHOWAN

The N. C. Environmental Management Commission at its March meeting voted to dismiss, without prejudice, proceedings in the matter of CF Industries and Farmers Chemical Association and to require further studies on the industry's impact on the Chowan River.

The vote followed a report by an EMC hearing panel that recommended the dismissal on grounds that substantial evidence was lacking from the N. C. Division of Environmental Management to show that CFI was polluting the Chowan with nitrogen. The Chowan River is overenriched with nitrogen and phosphorous, as evidenced by periodic nuisance algal blooms and other water quality problems. The river is classified as nutrient-sensitive, and the State has established nutrient discharge limits.

CFI, which leases its land and facility from FCA, operates an ammonia-nitrogen fertilizer plant on the Chowan near Tunis in Hertford County. Studies from DEM indicate that nitrogen from the plant reaches the river through groundwater and surface water (via a swamp separating the plant from the river) and airborne particles. In September, 1980, DEM requested that the EMC issue a Special Order requiring CFI and FCA to perform certain monitoring and cleanup tasks. This action was contested and subsequently put before a hearing panel.

The hearing officers, in recommending dismissal of the proceedings, cited differences in data presented and sampling methodologies used by the two parties to quantify the amount of nitrogen discharged to the river by the plant. They also noted that the complex nature of the river (occasional reverse flow due to tidal influence) makes upstream-downstream comparisons difficult in the absence of accurate flow data.

The EMC set up a schedule for further study of the situation. By no later than March 1984, a final report is due from DEM, to include findings and recommendations for corrective action. A progress report is due in one year.

REPORT PROVIDES CASE HISTORIES OF LOCAL WATERSHED MANAGEMENT EFFORTS TO PROTECT DRINKING WATER SUPPLIES

A recently completed study by researchers at the Center for Urban and Regional Studies at UNC-Chapel Hill evaluated the watershed protection programs of eight major communities in the nation. Programs in these communities illustrate some of the most effective and innovative measures currently being used to protect water supplies. Results could help other localities attempting to manage water supply watersheds.

Growing public health concerns associated with synthetic organic chemicals and other carcinogenic substances is causing increased concern by public health professionals for improved drinking water quality. More water quality problems are anticipated as watersheds of many communities are wholly unprotected from a wide range of potential sources.

This case study of eight communities shows a concern for six possible threats to their drinking water including: (1) discharges of municipal and industrial wastewater; (2) malfunctioning septic tanks; (3) urban stormwater; (4) rural runoff; (5) accidental chemical spills; and (6) natural pollution. The study indicated that documentation of water quality problems was important in motivating communities to act to protect their drinking water supplies.

According to the study "Two basic approaches to watershed management were tried in the communities studied. First, most of the communities were involved in controlling the location of land uses within water supply watersheds. Second, site-level design requirements to control erosion and stormwater runoff were also a common component of watershed management programs. Within these two broad approaches, communities were employing a wide variety of specific management measures, ranging from zoning and subdivision regulations to individually negotiated agreements with private landowners."

Experiences with watershed management in the eight communities studied provide insights for other localities about to engage in water supply protection activities. Some of the lessons learned from the case studies include:

1. Evaluate possible reservoir sites for natural background loads of pollution, pollution caused by existing land uses and the potential for pollution caused by expected land uses.

2. Total public acquisition of water supply watersheds is frequently not practical.

3. Watershed management efforts should begin before the watershed becomes heavily developed.

4. Steps must be taken to improve cooperation among local governments and between local governments and state agencies and legislatures.

5. State involvement in watershed management is an effective method of obtaining intergovernmental cooperation.

6. Regional agencies are helpful in the development and refinement of watershed management programs.

7. Local governments are key actors in successful watershed management programs.

8. Zoning and other controls on the location of new development are effective methods of protecting water quality.

9. On-site point and nonpoint pollution controls are essential for cleaning up existing development and controlling pollution from new development in watersheds.

10. Court challenges to watershed management programs provide substantive guidance for how to formulate legally defensible programs.

11. Political obstacles remain the most difficult barrier for watershed management programs to overcome.

12. Watershed management is a continuous process.

This extensive study is documented in a 376-page report titled "Protecting Drinking Water Supplies Through Watershed Management: A Casebook for Devising Local Programs" by Todd L. Miller, Raymond J. Burby with Edward J. Kaiser and David H. Moreau at the University of North Carolina at Chapel Hill.

Funding for the study was provided by the Office of Water Research and Technology, U. S. Department of the Interior. A guidebook for local programs is under development. Copies of casebook publications are available for $12 from the Center for Urban and Regional Studies, The University of North Carolina at Chapel Hill, Chapel Hill, NC 27514.

INTERIOR'S ROLE WITH WATER PROJECTS CHANGING

The Reagan administration has proposed new guidelines to govern the way the Corps of Engineers, the Bureau of Reclamation, the Soil Conservation Service and the Tennessee Valley Authority justify their plans for new water projects.

The new guidelines are more flexible than the existing mandatory regulations put in place by the Carter administration for implementation by the Cabinet-level Water Resources Council (WRC). The existing WRC principles, standards and procedures are rules the agencies must follow while considering whether to favor or reject a proposed project.

The new guidelines would give the agencies--and particularly the Council on Natural Resources and the Environment, headed by Interior Secretary James G. Watt--more discretion in evaluating project proposals. They would also limit the mandatory access that the present rules give to environmental groups.

The National Wildlife Federation, threatens to take the administration to court on the grounds that it violated rules that apply to the adoption of guidelines. The federation also opposes the substance of the guidelines because, among other things, they give priority to "national economic development" while placing a lesser value on environmental concerns.

Congress is actively considering the establishment of a new national water policy board to replace WRC, which has been zero-budgeted by the Reagan administration as part of the shift of water policy-making to the Secretary of Interior. A bill sponsored by Sen. James Abdnor (R-S.D.) is ready for the Senate floor, and legislators from three House committees are trying to agree on a similar bill for consideration there.

NEW INTERIOR DEPARTMENT BUDGET ZERO'S OUT OWRT

Under the new Interior Department budget request, all programs in the Office of Water Research and Technology (OWRT) would be terminated. Congress appropriated $10.6 million for the office in fiscal 1982. The Water Resources Research Institute receives its federal funding from OWRT. Increases in funds for the Interior Department include constructing water projects in the west, upgrading deteriorating national park facilities and increasing access to energy and mineral resources on federal lands.

Hearings have been conducted by the Senate Environment and Public Works Water Resources Subcommittee on new legislation that would authorize a new university water resources research program. Senator James Abnor (R-S.D.) is chairman of the committee.

PROCESS BEGINS TO ALLOCATE JORDAN LAKE WATER SUPPLY

Officials from the N. C. Department of Natural Resources and Community Development are now working with local governments to allocate the 100 million gallons a day of water supply capacity in the B. Everett Jordan Lake. The Jordan is a U.S. Army Corps of Engineers multi-purpose lake in Chatham County. Several local governments over the 20-year history of the lake project have expressed an interest in using the lake for water supply. The State of North Carolina intends to contract with local governments to provide for the allocation to users and repayment of the water supply costs. The cost of the water supply storage is about $5 million which must be repaid to the federal government with interest over a 50-year period.

To facilitate the initial assignment of Jordan Lake water, the Department of Natural Resources and Community Development has requested that local governments wishing to reserve a portion of the available storage make a written request by June 30, 1982 to: Director, Office of Water Resources, NRCD, P. O. Box 7687, Raleigh, N. C. 27611.

POULTRY PRODUCER ASSESSED $5,000 PENALTY FOR IMPACTS ON LAKE

A 50,000 laying hen complex classified as a "concentrated animal feeding operation" in Davie County has been assessed a $5,000 civil penalty by the Environmental Management Commission. The penalty, assessed to Wildwood Farms, was for discharging wastes into the waters of the State in violation of water quality standards without having obtained a permit from the Environmental Management Commission.

The poultry operation, located on about four acres with a liquid manure handling system, generated about 7,000 pounds of waste per day. The staff of the Division of Environmental Management found discharges of liquid wastes into tributaries that feed and drain the lake at Seven Springs Girl Scout Camp. Part of the poultry complex was about 300 feet from the lake.

PUBLICATION REPORTS EFFECTS OF UPLAND DRAINAGE ON ESTUARINE NURSERY AREAS OF PAMLICO SOUND

A recently published report by the UNC Sea Grant provides information on the effects of upland drainage on primary nursery areas for brown shrimp. The studies were conducted in 1977 and 1978 in primary nursery areas of northern Pamlico Sound by Preston P. Page, Jr., N. C. Office of Coastal Management and Robert Jones, N. C. Division of Marine Fisheries. Support for the study came from UNC Sea Grant, the Coastal Energy Impact Program, and the N. C. Division of Marine Fisheries.

In the study, four sampling stations were established and sampled three days per week. The four stations received either heavy, moderate or no drainage through man-made water courses. All stations functioned as primary nursery areas during periods of low rainfall and high salinity (1977). Brown shrimp production at all sites was depressed during periods of extremely high rainfall and low salinities (1978). Salinities at the unaltered sites were more stable during periods of high runoff than those recorded at two sites receiving drainage through ditches. Recovery times at the altered sites were approximately ten days. The most significant reduction in production of juvenile brown shrimp occurred at the extensively ditched site during periods of moderate to heavy rainfall. Five additional species of fish and shellfish appeared to prefer the unaltered nursery areas. Productivity of these species was significantly higher at the unaltered sites each year. Rapid pulses of freshwater appeared to be a dominant stress on juvenile organisms.

Copies of the report may be obtained from UNC Sea Grant College Program, 105 1911 Building, N. C. State University, Raleigh, NC 27650, UNC-SG-WP-81-10, Price: $1.00.

MAP DEPICTS N. C. POCOSINS STATUS

A recently finished pocosins map, assembled by Curtis J. Richardson, Rhonda K. Evans, and David Carr at Duke University, depicts their development status as of 1980. Copies of the map may be purchased for $10.00 each from the Integrated Case Studies Program in Natural Resource Analysis, School of Forestry and Environmental Studies, Duke University, Durham, NC 27706.

Reduced rates may be obtained for bulk orders. Data for individual county by county maps are available at Duke for researchers interested in specific pocosin developments.

SCS EXPANDS CONSERVATION TILLAGE EFFORTS

Foy Hendrix, Conservation Agronomist with SCS, reports that a special no-till campaign for 1982 is moving well. SCS distributed educational materials on no-till to all of its field offices and set a goal to hold at least 24 meetings across the state on the topic. SCS representatives indicate special emphasis is being placed on conservation tillage in all areas.

Additional use of the no-till practice by farmers is expected to significantly help in reducing erosion problems in North Carolina.

RIVERS TO BE THEME OF 1984 WORLD'S FAIR

"The World of Rivers--Fresh Water as the Source of Life" will be the theme of the 1984 World's Fair. To be held in New Orleans, the exhibition will feature aspects of life affected by the world's waterways: food, industrial development, cultural enhancement and transportation.

More than 15 million people are expected to attend.

NAMES IN THE NEWS

Anne Taylor Named Deputy Assistant Secretary for Natural Resources. Anne Taylor, formerly Director of the Office of Regulatory Relations, has been named Deputy Assistant Secretary for Natural Resources. The Office of Regulatory Relations' staff and functions continue to be directed by Anne Taylor under a name more appropriate to the work of this office: Natural Resources Planning and Assessment. Roger Schecter has been named Assistant Director. Anne Taylor joined state government in 1977 as a Policy Advisor for Natural Resources in the Department of Administration, and in 1979 served as a Special Assistant for Natural Resources in the Department of Natural Resources and Community Development. Her new appointment and office name change became effective in February, '82.

Raplh Heath Retires from USGS. Ralph C. Heath, District Chief of the U. S. Geological Survey's Water Resources Division in North Carolina from April 1967 until December 1980, retired on March 6, 1982. Heath began his career with the Survey in Tallahassee, Florida in 1948 and served the Division in the Florida District until 1956, when he transferred to Albany, New York. Among the other distinctive positions he occupied during his career were Acting District Geologist of Florida and District Geologist and District Chief of New York.

Heath, a native of Kinston, N. C. is widely respected among the scientific community for his broad understanding of ground-water hydrology, particularly the occurrence and movement of water, perspectives of water and it's impact on society. In addition, he devoted much time and effort to sharing his knowledge with others as a frequent lecturer at universities, and short courses for various technical groups and professional society meetings.

From December 1980 until retirement Heath served on the staff of Chief Hydrologist, Reston, Va.

James Turner New USGS District Chief. James F. Turner was recently appointed by the U. S. Geological Survey's Water Resources Division as District Chief, North Carolina. Turner's appointment was effective March 15, 1982. Turner is a native of North Carolina and a 1961 graduate of North Carolina State University. He is a veteran of more than 20 years with the Survey with a previous assignment in North Carolina and most recently in Florida. Turner has a broad background in surface-water hydrology, particularly digital modeling of stream and estuary systems. He succeeds former District Chief, Ralph C. Heath, who retired on March 6, 1982.

HYDRILLA CONFERENCE SET FOR MAY 4

A workshop is scheduled for May 4 at the N. C. State University Faculty Club to assess what is known about hydrilla and the latest control measures. The workshop will feature the top hydrilla experts in the country and representatives of several state hydrilla management programs. Hydrilla, a submerged aquatic plant found in 13 sites in North Carolina in 1981, poses a potential threat to water resources of the State. In those states where hydrilla has become established and spread, annual control costs run into the millions. Several groups have an interest in seeing that the hydrilla problem is managed to prevent its spread into other lakes in the State. The workshop is designed to increase the level of understanding of participants about hydrilla and its control. The workshop is expected to set the stage for a more effective control and education program and to assess future needs for hydrilla research in North Carolina. Sponsors are the Department of Natural Resources and Community Development and the Water Resources Research Institute. Individuals interested in attending should contact Eva McClung at the Water Resources Research Institute, 737-2815.

OTHER WORKSHOPS, CONFERENCES AND COURSES

Managing Our Limited Water Resources Conference is to be held in Lincoln, Nebraska May 19-21, 1982 and will focus on the High Plains regional water management studies, will be developed through a half-day Plenary Session and two days of concurrent Program Sessions on the following five water management aspects: (A) High Plains and Regional Management Studies, (B) Groundwater Management, (C) Recreational, Instream Flow, and User-Oriented Management Aspects, (D) Water Management by Use Efficiencies and Other Innovations, and (E) Law, Rights, and Water Management.

Any questions or requests for additional information concerning the conference should be addressed to: Dr. Curt Brandhorst, Department of Conferences and Institutes, 205 Nebraska Center, University of Nebraska-Lincoln, Lincoln, Nebraska 68583-0900, Telephone (402) 472-2844.

On-Site Sewage Conference planned for April 20-22, 1982, in the McKimmon Center on the campus of N. C. State University in Raleigh, North Carolina. The conference will be devoted principally to the presentation of state-of-the-art papers dealing with recently completed and current research and demonstration related to on-site or small wasteflow treatment and disposal systems. A wide variety of subject matters dealing with the old problems of sewage disposal along with new developments to make it easier to handle domestic wastes will be presented at the conference. Some of the topics include Site Evaluation and System Selection, Treatment Capability of Soils, Septage Management, and Management of Small Wasteflow Systems.

Complete program information and registration will be sent in the near future but if you are not on the mailing list, please contact Steve J. Steinbeck, Conference Coordinator, at P. O. Box 2091, Raleigh, North Carolina.

Avoiding Legal Problems in Floodplains and Wetlands Law. A training institute for lawyers sponsored by the American Bar Association's Special Committee on Housing and Urban Development Law is to be held May 13 - 14, 1982, at the Colony Square Hotel, Atlanta, Georgia.

This program will describe in detail the problems floodplains and wetlands present, the resulting legal issues, procedural techniques, the key components of private non-statutory liability that can result in substantial damage assessments and relevant constitutional issues.

For further information call or write: Shirley A. Gravely, American Bar Association, 1800 M Street, NW, 2nd Floor, South Lobby, Washington, DC 20036, telephone (202) 331-2277.

Skills-Oriented Micro-Hydro Workshop on May 21-23 is offered by Appalachian State University. Emphasis will be given to hands on field experience in: (1) measuring the head of the site, (2) determining stream flows by flow meter and weir, (3) determining the power potential of a stream, (4) design or choice of intake, penstock, turbine and generator, and (5) operation of a 17 KW demonstration high head project. The course will give 1 semester hour credit through ASU. For further information contact: Dr. Ayers, Earth Studies, Dept., ASU, Boone, NC 28608.

Management of Hazardous Chemical and Low Level Radioactive Waste is a new course offered by the departments of Chemical and Nuclear Engineering at NCSU. The course is open to practicing engineers, safety officers, and other individuals responsible for hazardous chemical and/or low level radioactive waste. The course will utilize lectures, field trips, and student projects to provide: (1) Information on current practices and regulations for management of hazardous chemical and low level radioactive wastes, (2) Experience with actual waste management problems and solutions. Emphasis is on recycling, land treatment, incineration, waste exchanges and other techniques to minimize the need for waste burial, (3) Information on tests, literature, "experts", short courses, and equipment suppliers to assist individuals in solving the specific waste management problem(s) of their company or institution, (4) Information on problems associated with siting, ownership, insurance, and ultimate disposal.

Instructors are Professors J. Ferrell and M. Overcash of Chemical Engineering and J. Kohl of Nuclear Engineering.

The 3-unit graduate credit course, NE 591 E/ChE 598E, will meet at North Carolina State University, Raleigh, NC on Monday (3:00-4:00) and Wednesday (3:00-4:30) afternoons.

For more information, a course outline and a "special student" enrollment form, contact J. Kohl, 737-2303.

Hazardous Waste Management Under RCRA New Workshops are being offered by Industrial Extension Service at North Carolina State University-Raleigh at the McKimmon Center, June 1 & 2, 1982; Wilmington-Hilton Inn, May 19-20, 1982; Hickory-Ramada Inn, May 24-25, 1982; Charlotte-Holiday Inn North, May 26-27, 1982.

This workshop has been developed with help from the N. C. Division of Solid Waste Management to assist Hazardous Waste Generators and others concerned with Hazardous Wastes to meet the personnel training and emergency and contingency planning requirements of RCRA. Information will also be supplied on handling, storing, treating, incinerating, and shipping hazardous wastes. Each participant will receive a comprehensive manual. The first two presentations were sellouts to enthusiastic groups of participants.

For more information and a registration form, contact: Linda Watkins, NCSU, IES, PO Box 5506, Raleigh, NC 27650, (919) 737-2356.

Stream Habitat Analysis as Applied to Water Management is a short course offered June 7-11, 1982, in Denver, Colorado by the Instream Flow and Aquatic Systems Group of the U. S. Fish and Wildlife Service and the Department of Conferences and Institutes, Colorado State University.

The course offers "hands on" experience in applying technical information about aquatic habitat to important water resources decisions. Emphasis is placed on understanding the various uses of habitat related technical data in management, preparing data for negotiation. Both lecture and extensive participation in problem solving are used in the course. This course is designed for the Fish and Wildlife Service (FWS) Field Supervisors and

Area Managers; consulting biologists and engineers; State fish and game supervisors; and middle management personnel from other Federal, State and private entities who assess or implement instream flow recommendations.

For registration information write to: Conferences and Institutes, Rockwell Hall, Colorado State University, Fort Collins, Colorado 80523.

Water Law Short Course sponsored by the Instream Flow and Aquatic Systems Group of the U. S. Fish and Wildlife Service and the Department of Conferences and Institutes, Colorado State University will be held June 24-25, 1982.

The Water Law Short Course covers the basic principles involved in the regulation and management of surface waters. A special emphasis is placed on the protection of instream uses of water.

This course is for federal, state, local, and private employees: fishery biologists, wildlife biologists, hydrologists, forest hydrologists, attorneys desiring an introduction or review, land use planners, university faculty, water managers, public works managers, representatives of irrigated agriculture, legislators and other elected officials, and those individuals interested in an overview of water law.

For further information write to: Conferences and Institutes, Rockwell Hall, Colorado State University, Fort Collins, Colorado 80523.

Clean Water--New Directions for the 80's scheduled for May 20-21 at Washington's Hyatt Regency Crystal City Hotel is cosponsored by *Inside EPA Weekly Report* and the Center for Energy and Environmental Management.

This conference will focus on the key issues shaping the debate--from general efforts to redirect water quality programs to specific regulatory requirements that will be subject to intense scrutiny--then relate them to their potential impact on economic growth, jobs, environmental protection, and federal/state relationships.

To obtain further information write CEEM, Box 536, Fairfax, VA 22030 or call the Conference Hot Line: 800-424-9068, (in Washington, DC 250-5900).

Hazardous Materials and Toxic Substances Control Seminar to be held June 21-25, 1982, in Atlanta, GA. This is an interdisciplinary seminar designed to provide an understanding of the hazards of chemicals, regulations controlling these materials, and control and safe handling of toxic substances. The University of Arkansas for Medical Sciences, Division of Interdisciplinary Toxicology is presenting these sessions.

This is a practical, comprehensive seminar designed to furnish an overall understanding of hazardous materials control and its application to compliance with the Clean Air and Water Act, Hazardous Materials Transportation Act, Resource Conservation and Recovery Act, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and the Toxic Substance Control Act.

To register, phone: (501) 661-5766. It is recommended that you make your reservations at least four weeks in advance, and be sure to mention you are attending this seminar. Housing and seminar location information will be sent upon receipt of registration form.

POSITION AVAILABLE Project Coordinator in Brunswick County, on the coast of North Carolina, population 35,700 has an immediate opening. The position is responsible for providing technical information and overseeing the expansion of a $25,000,000 county-wide water system, to be responsible for subsequent management of the system, serve as an important member of the management team and work directly under the supervision of the County Manager. A degree in civil engineering with three to five years experience in water or other related area or an equivalent combination of training and experience is required. Applications will be accepted through May 14, 1982. Salary is negotiable.

Applications may be submitted to: Brunswick County Personnel Department, PO Box 249, Bolivia, North Carolina 28422.

WATER RESOURCES CONDITIONS IN NORTH CAROLINA Streamflow for the month was well below normal in the Mountains and western Piedmont, normal in the eastern Piedmont, and slightly below normal in most of the Coastal Plain region. Moderate rains on March 6-8 caused rises on most streams, but no flooding was reported. Rainfall throughout the remainder of March was generally light, and total rainfall for the month was 1 to 2 inches below normal in most areas.

Flows at USGS index gaging stations ranged from only 70 percent of normal in the South Yadkin River near Mocksville (Davie County) to normal conditions in the Deep River at Moncure (Lee County). Flows in the French Broad River, which were below normal from July 1980 to December 1981, decreased again to below-normal conditions.

Ground-water levels in shallow water-table aquifers rose during the month in the Mountains and Piedmont and declined slightly in the Coastal Plain region. Compared to long-term averages, levels were normal to 1/2 foot below normal in the Mountains and 1 to 1 1/2 feet above normal elsewhere.

. . . . *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

"Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana," (#9), 12/81, by R. G. Kazmann, WRRI, Louisiana State U., Baton Rouge, LA 70803. (W & E)

"Energy Siting in Utah: A Programming Model," (UWRL/P-81/04), 6/81, by D. L. Snyder, et al, Utah Water Research Lab., College of Engr., UT State U., Logan UT 84322. (W & E)

"Design Considerations in the Use of Glauber Salt for Energy Storage," (UWRL/P-81/05), 11/81, by D. G. Chadwick, et al, Utah Water Research Lab., College of Engr., UT State U., Logan, UT 84322. (W & E)

"Water Conservation Incentives and Strategy,"10/81, by W. Whipple, Jr., et al, avail. from Center for Coastal & Env. Studies, Rutgers--The State U. of NJ, Doolittle Hall, Busch Campus, New Brunswick, NJ 08903. (03D)

"Classification and Management of Wetlands in the Western Kentucky Coal Field," (#131), 1982, by W. J. Mitsch, et al, WRRI, U. of KY, Lexington, KY 40506. (02H-1 Wetlands)

Water Quality Management

"Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina," (WP 81-10), 12/81, by P. P. Pate, Jr., et al, UNC Sea Grant College Program, 105 1911 Bldg., NCSU, Raleigh, NC 27650. (02L Estuaries).

"Protecting Drinking Water Supplies Through Watershed Management--A Casebook for Devising Local Programs," 8/81, by T. L. Miller, et al, Center for Urban & Regional Studies, UNC-CH, Chapel Hill, NC 27514. (04D Watershed Protection)

"Environmental Impact of Land Use on Water Quality--Final Report on the Black Creek Project Phase II," (EPA-905/9-81-003), 5/81, by E. J. Monke, Dept. of Ag. Engr., Purdue U., Ag. Engr. Bldg., W. Lafayette, IN 47907. (05B Non-point Runoff)

"Evaluation of a Compartmental Model for Prediction of Nitrate Leaching Losses," (#81-23), 12/81, by M. Mehran, et al, avail. from US Army Cold Regions Research & Engr. Lab., Hanover, NH 03755. (05D Land Treatment)

"A Comparison of Trout Populations, Reproductive Success, and Characteristics of a Heavily Silted and a Relatively Unsilted Stream in Western North Carolina," 1/82, by J. L. West, et al, limited copies avail. from WRRI, 124 Riddick, NCSU, Raleigh, NC 27650-5999. (05C)

"The Kinetics of Rotating Biological Contactors Treating Domestic Wastewater," (UWRL/Q-81/04), 9/81, by A. Pano, et al, Utah Water Research Lab., College of Engr., UT State U., Logan, UT 84322. (05D Wastewater Treatment Processes)

Water Quality Management

"Remote Sensing for Water Resources and Hydrology: An Assessment of the Corps of Engineers' Program," 1981, by Panel on Remote Sensing for Water Resources, avail. from Space Applications Board, National Research Council, 2101 Constitution Ave., NW, Washington, DC 20418. (07 Remote Sensing)

Miscellaneous

For further information on the following publications, contact USDA, SCS, Box 27307, Raleigh, NC 27611:

"Soil Survey of Jones County, North Carolina, 11/81. (SCS)
"Soil Survey of Washington County, North Carolina," 11/81. (SCS)

THE IMPACT OF SEPTIC TANKS ON SHELLFISH WATERS

N. C. Division of Environmental Management
Water Quality Planning Branch

INTRODUCTION

In North Carolina, with the fourth largest area of shellfish waters among all states, the contamination of shellfish waters with bacteria and viruses has become an issue of great concern. Approximately twenty percent of our coastal waters are closed because of excessive levels of bacteria. Associated with some of the closed shellfish waters has been an increase in residential development along the North Carolina coast, much of it relying on conventional on-site septic tank disposal systems. This development is occurring in counties where 75 to 90 percent of the soils have been classified by the U.S. Soil Conservation Service as having severe limitations for conventional systems.

The North Carolina Division of Environmental Management, with the support of the Shellfish Sanitation Unit of the Department of Human Resources, conducted an investigation of bacterial contamination of shellfish waters in four New Hanover County tidal creeks during the summer of 1978. This effort was part of the water quality program established by Section 208 of the Clean Water Act.

MATERIALS AND METHODS

The water quality monitoring program was limited to four tidal creeks in the New Hanover County area of southeastern North Carolina (Figure 1). Land use in the four watersheds was primarily single family residences or woodland. Futch Creek, the sparsely populated control watershed, contained a significant amount of pastureland and cropland. A description of each of the watersheds is included in Table 1.

A detailed soil survey was published for the study area in 1977. In each of the four watersheds, residences were located on an overlay based on the 1:24,000 scale USGS topographic maps. The house location map was superimposed on the soils map to provide an estimate of the percentage of homes with septic tank systems in soils with severe, moderate, or slight limitations in each watershed (Table 1).

Twenty-two sampling locations were established in the four drainage basins (Figure 1). Ten stations were in the mid-sections of the four tidal basins; four stations were in the mouths of the creeks where water exchange was at its maximum; and eight stations were in the freshwater tributaries of the basins. No industrial or high density commercial developments and no direct point source discharges were located in these four watersheds.

Following the collection of water samples in sterile glass bottles, the samples were placed on ice and delivered to the Central Laboratory of the North Carolina Division of Environmental Management. The multiple-tube fermentation technique, as specified in Standard Methods, was utilized to enumerate total and fecal coliform bacteria counts. Samples were collected twice following rainfall and three times during dry weather during the summer of 1978 to demonstrate differences in transport of bacteria to the estuarine waters. Only the fecal coliform data are reported here since the Division of Health Services now closes shellfish waters based on a fecal coliform standard (14 MPN/100 ml).

RESULTS

Due to a lack of rainfall during the study, water table and soil moisture conditions were optimal for the conventional septic tank systems to function properly. The results of this study can be summarized in 3 categories: 1) data from the middle reaches of the tidal creeks, 2) data from the mouths of tidal estuaries, 3) data from the tributary stations.

1) Middle Reaches of Tidal Creeks

Drainage water, runoff, and a complex mixture of bacteria flow from the different tributary source areas to these tidal creeks that were once uncontaminated shellfish waters. Of the four creeks studied, only Creek 1 (Futch Creek - the rural control) was open to the taking of shellfish. Creeks 2 and 4 have been closed during the last decade, and Creek 3 has been closed for several decades.

Mean values for indicator bacteria sampled in the mid reaches of the four tidal creeks are included in Table 1. Very low mean values were monitored in Futch Creek (rural control), while average coliform densities increased dramatically with greater levels of unsewered residences. Note that the four fold increase in homes from the rural creek to Creek 4 resulted in ten fold increases in mean fecal coliform densities. The increase in relation to Creek 3 was almost twenty fold.

Some of this elevated level of bacteria in Creek 3 may be associated with a 100 slip marina located on the creek. While the marina utilizes a ground absorption system to treat its wastewater, motor boats undoubtedly stir up the bacteria-laden sediments, and overboard discharges of fecal matter add additional contamination.

Figure 1 Sampling Stations in the Four Watersheds

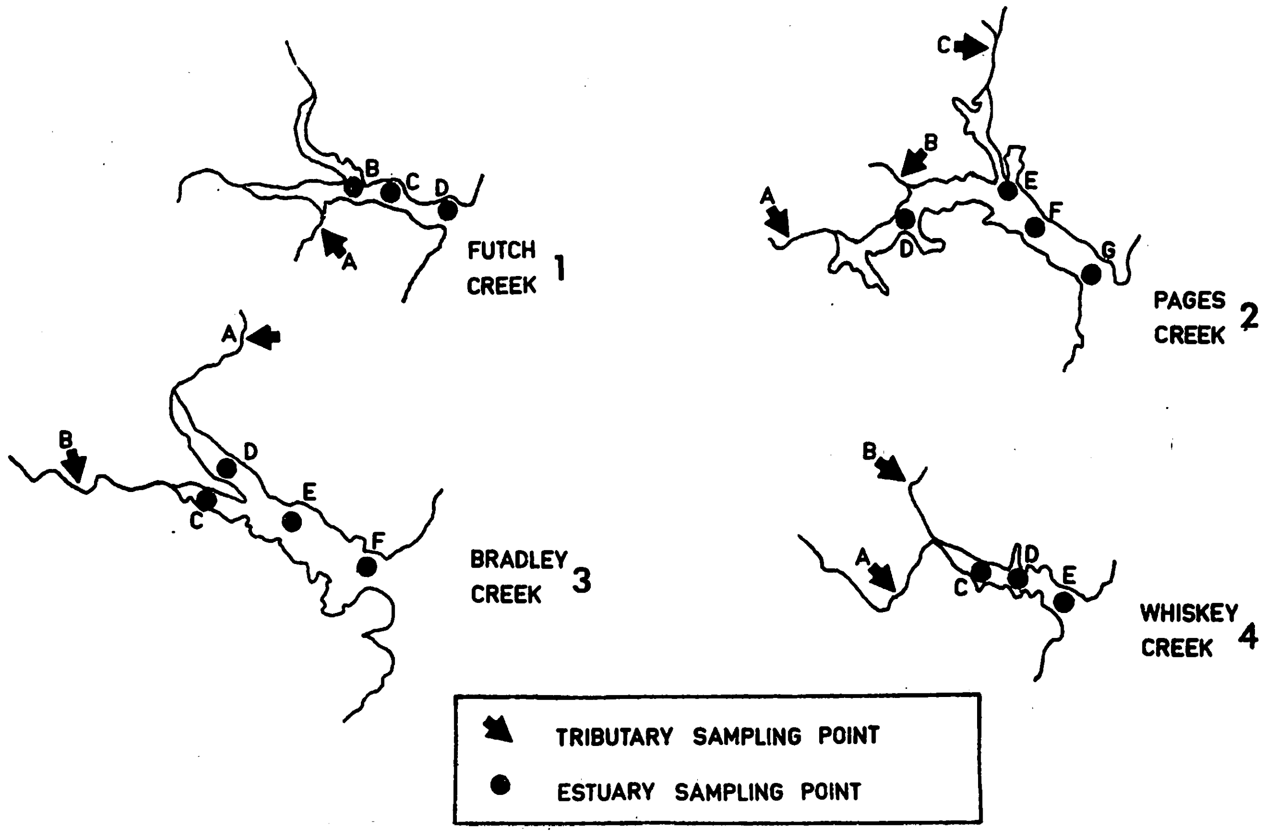


Table 1 Physical Characteristics and Coliform Data From the Middle Reaches and the Mouths of the Four Study Creeks

PARAMETER	1 Futch Creek	2 Pages Creek	3 Bradley Creek	4 Whiskey Creek
DRAINAGE AREA (ACRES)	2112	3526	3507	1472
SEPTIC TANK DRAINFIELDS	169	600	1334	764
ACRES OF WATERSHED PER SEPTIC TANK	12.5	6.0	2.5	2.0
PERCENT OF DRAINFIELDS ON SEVERE SOILS (a)	45%	63%	46%	70%
PERCENT DRAINFIELDS ON INAPPROPRIATE SOILS (a)	96%	91%	74%	96%
MEAN FECAL COLIFORM MPN/100 ML MIDDLE REACHES	8	11	157	112
MOUTH	5	3	18	77
SHELLFISH STATUS (b)	OPEN	HALF CLOSED	CLOSED	CLOSED

(a) Soils classified as severe or inappropriate based on Soil Conservation Service maps

(b) Shellfish status as determined by the Shellfish Sanitation Unit, Division of Health Services

Nonparametric statistical methods were utilized to test whether significant differences in bacterial levels existed between the different creeks. Standard parametric tests were not used because recent research indicates that the assumptions of normality and homogeneity of variances are often not applicable in water quality studies. Consequently, the nonparametric Wilcoxan Two Sample Test, as explained by Walpole, was used as the appropriate measure to test the hypothesis that mean values of coliform density were similar for each of the four creeks. The hypothesis of equal means was rejected in each case except for the comparison between Creeks 1 and 2, the two least contaminated creeks. Based on this data set, statistically significant differences were demonstrated in bacterial levels between almost every creek. It is likely from observations in each watershed that the difference is caused by the numbers of septic tank drainfields that existed in each watershed, although the boating activity in Creek 3 was a contributing factor.

Mouths of Tidal Estuaries

At the mouth of each tidal creek, water exchange with saltier, less polluted water is at its maximum. Consequently, bacterial densitites were lower than in middle reaches of the creeks due to dilution and die-off of the bacterial indicators. Such a trend can be seen in Figure 2 for rural Futch Creek (Watershed 1) and heavily residential Whiskey Creek (Watershed 4). For each estuary, the top figure represents the level of fecal/total coliform bacterial levels found during dry weather.

Note in Figure 2 that 10-30 fold increases in coliform densitities were monitored following wet weather and that higher densities were found in Whiskey Creek in each case (Whiskey Creek was estimated to have about 4 times more homes with septic tank drainfields). Also in each case, the dilution and/or die-off of bacteria was observed as the well-mixed mouth of the estuary was approached. The high level of bacteria in the middle of Whiskey creek following rainfall was consistently noted. It appeared that a high concentration of unsewered subdivisions on unsuitable (clayey) soils adjacent to the creek was responsible for these elevated counts. Surfacing of septic tank effluent was observed in wet weather, and leakage was observed during dry weather. The difference in mean values of fecal and total coliform bacteria between the four creek mouths is presented in Table 1. Low values were monitored in the two creeks still open to shellfish, while much higher densities were recorded in the two creeks with greater levels of residential development which are closed to shellfishing. The elevated values for the mouth of Creek 4 suggest the direct delivery of bacteria by a ditch system used to drain the residences constructed in clayey soils adjacent to the creek.

The Wilcoxan nonparametric test was again used to detect significant differences in bacterial densities between the different creek mouths. Only the differences between Creeks 2 and 4 were found to be significant ($P<10$). With the small number of observations that were taken at the mouths (4 or 5), the observed differences were difficult to demonstrate statistically.

Tributary Watersheds

Eight small tributary watersheds, ranging in size from 128 to 864 acres were monitored for coliform bacteria. A cursory description of each watershed is given in Table 2. The estimate of drainage area for each watershed was difficult to determine in the flat terrain. In addition, water flow in watershed 4-A was complicated by an overdesigned, straightened, drainage channel that connected to another creek outside the study area.

High levels of indicator bacteria were found in watersheds with greater numbers of unsewered residences. Mean values of fecal coliform bacteria are presented in Table 2.

A comparison of coliform densities between different watersheds can be illustrated by plotting mean coliform values versus the estimated density of unsewered homes in each watershed. Figure 3 illustrates this relationship for mean fecal coliform levels. Definite trends can be seen for higher mean values of bacteria as the number of septic tank systems is increased in the watersheds. Regression analyses were performed to determine whether significant correlations were observed in Figure 3. The resulting correlation coefficient, $r = .84$ for the dry weather relationship, was significant at the $p = .01$ level and therefore showed good statistical correlation between increased levels of bacteria from watersheds with increased numbers of unsewered residences. For the wet weather relationship, the effects of runoff produced more scatter and lowered the correlation coefficient to $r = .47$.

High values of fecal and total coliform were noted following wet weather in the rural Watershed 1-A. With two residences, this rural area drained a significant amount of cropland and some pastureland. These bacterial levels are likely attributable to runoff from the agricultural areas since extremely low levels were recorded during dry weather. Eroding drainage ditches appeared to be a problem in Watershed 2-C (28 residences). Very high total coliform values and low fecal values implicate eroded soil coliform bacteria as the likely source of contamination. The very high densities of fecal bacteria during dry weather in the watersheds with the greatest numbers of septic tank systems suggests that seepage is occurring from malfunctioning septic tank systems. Due to these high, dry-flow coliform values, effluent from drainfields rather than washoff of impervious areas is probably responsible for much of the bacterial contamination. Researchers came to similar conclusions in a tidewater Virginia study of shellfish pollution in tidal waters draining residential developments.

Figure 2 A Comparison of Coliform Levels in Two Creeks During Wet and Dry Weather

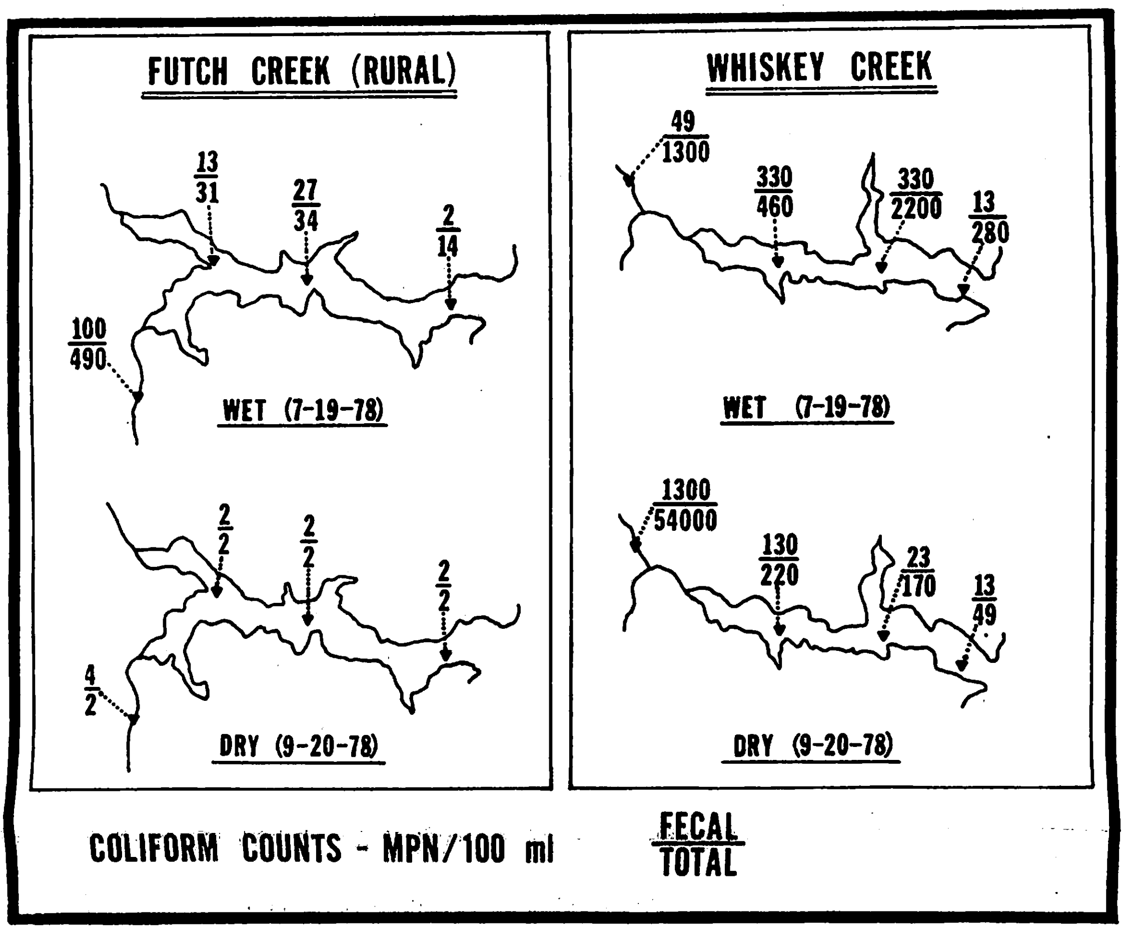
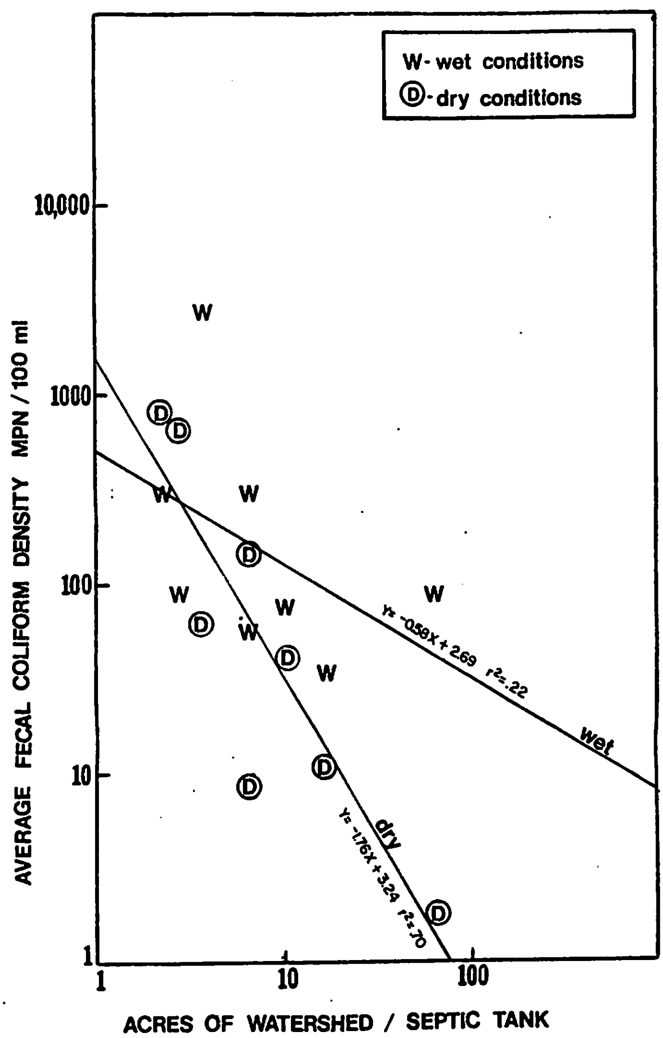


Table 2 Physical Characteristics and Coliform Data From the Tributary Stations on the Four Study Creeks

	TRIBUTARY WATERSHED STATIONS							
PARAMETER	1-A	3-A	2-C	4-A	2-B	2-A	3-B	4-B
DRAINAGE AREA (ACRES)	128	250	294	230	262	346	307	864
SEPTIC TANK DRAINFIELDS	2	15	28	35	40	96	109	357
ACRES OF WATERSHED PER SEPTIC TANK	64	17	10	7	7	3.5	3	2.5
PERCENT OF DRAINFIELDS ON SEVERE SOILS	50%	46%	57%	48%	43%	61%	69%	72%
PERCENT DRAINFIELDS ON INAPPROPRIATE SOILS	100%	46%	65%	94%	92%	84%	83%	99%
GEO. MEAN FECAL COLIFORM (MPN/100 ML)	12	15	23	12	121	205	198	389
SHELLFISH STATUS	OPEN	←			CLOSED			→

Figure 3 Regression of Fecal Coliform Values on Acres of Watershed per Septic Tank



SUMMARY AND CONCLUSIONS

In each of the four study watersheds (Table 1), more than 45 percent of all residences were estimated to utilize septic tank drainfields on soils with severe limitations. In addition, excessive levels of bacteria resulted in closed shellfish waters in both of the watersheds where more than 60 percent of the homes were on severe soils. Septic tanks on coarse soils may also contribute to the bacterial contamination. When this percentage was combined with the one for severe limitations, three of the four watersheds had at least 80 percent of the residences on inappropriate soils.

A convenient index of the potential for contamination was also provided by the total number of unsewered residences and the estimated density of septic tank systems per unit watershed area. From Table 1, a density of more than 1 septic tank for every 7 acres of watershed resulted in shellfish closures. Very high levels of bacterial contamination were noted at densities greater than 1 soil absorption system per 3 acres of watershed area. In 1970, Creek 2 was entirely open to shellfishing and was estimated to have 357 residences in its watershed (density of 1 drainfield per 10 acres). By 1978, the upper half of Creek 2 was closed as residences increased to 600 (density of 1 drainfield per 6 acres).

A summary of soil limitations and drainfield densities for the 8 tributary watersheds is included in Table 2. Once again, the majority of homes were constructed on the least desirable soils. Note that all four watersheds having fecal coliform averages greater than 100 MPN/100 ml had septic tank densities of at least 1 drainfield per 7 acres. Very high densities, and greater than 60 percent of residences on soils with severe limitations, characterized the three watersheds with the highest levels of fecal pollution. In order to provide enough uncontaminated water (from undeveloped land) to dilute septic tank effluent, it appears that septic tank densities of approximately 1 septic tank system per 10 acres of watershed would be optimum in areas adjacent to shellfish waters. In order to overcome the limitations of these unsuitable soils, extensive ditching and tile drains have been used in an attempt to lower water table elevations in these coastal areas. When drainfields are installed very close to tile drains or to these ditches, the potential for bacterial and viral contamination increases greatly.

MANAGEMENT PRACTICES TO PROTECT SHELLFISH WATERS

To reduce and prevent pollution of shellfish waters, several different state agencies, county governments, developmental interests and concerned citizens will need to work together. In most cases, it is more cost-effective to prevent pollution before it occurs than to upgrade already contaminated waters. Therefore, it is very important that future development proceed in a manner that will protect shellfish waters. The following concepts summarize different systems or "Best Management Practices" to upgrade water quality in already contaminated shellfish waters and protect water quality in existing uncontaminated shellfish waters. If the general principles outlined below are adhered to, it should be possible to have "reasonable" development and still maintain natural resource protection. It is important to note that the real power to ensure the proper balance of these two activities rests with local governments. The options developed in this section are intended to serve as a guide to decision makers as they balance the benefits and costs of alternative development strategies.

Different combinations of these management practices should be implemented depending on the speicific situation:

1) Conduct revegetation and stabilization of any bare soils, including ditch banks. This is helpful because the indicator bacteria used to test for shellfish contamination can also be found in the soil.

2) On poor soils that already have conventional systems encourage the use of water conservation devices to minimize effluent generation.

3) On poor soils, install additional drainfield lines or a multiple chamber tank. Frequent pumping of septage should also be encouraged.

4) Additional development in tidal watersheds with contaminated shellfish waters should be limited to homes with alternative systems, or those on only the most suitable of soils.

5) In the most densely developed areas, install central sanitary collection sewers. Innovative and alternative small systems can be funded for these areas, with certain restrictions, under the Clean Water Act.

6) Limit residential development in coastal areas containing shellfish waters. Maintain dilution water by spreading out development. As densities approach one drainfield per seven acres of watershed area, local governments should keep in close communication with the Shellfish Sanitation Unit of the Department of Human Resources to ensure shellfish contamination is not occurring.

7) Research in coastal and flat areas has demonstrated that stormwater and pollutant transport can be minimized by using ephemeral channels and grassed swales for drainage,and by separating impervious areas and septic systems from drainageways. Several actions can be taken to reduce the delivery of septic tank effluent and urban washoff to coastal waters. The drainage system should follow the circuitous, more clayey (and therefore stable) natural depressions rather than being dug on a rectangular grid. These systems should be designed to allow overbank deposition of pollutants during large storm events. Some potential homesites should be sacrificed to accomplish this goal. Whenever possible, the drainage network should consist of parabolic grassed waterways - rather than curb and gutters or deeply excavated ditches--to allow infiltration of stormwater. Ditches should not outfall directly into the tidal creeks.

8) An integral part of proper planning for coastal development should involve erosion control and stormwater management. Detention basins should be placed between the developments and coastal estuarine waters to prevent freshwater intrusion into the saltwater, to trap sediment eroded during construction, and to promote reduction of bacteria from septic tank leakage and storm runoff. All bare roadside areas, ditch banks, and construction sites should be stabilized quickly to prevent siltation of estuarine areas.

(Editor's Note: *For additional information contact Dr. George Everett, Division of Environmental Management, Water Quality Planning Branch, 512 N. Salisbury Street, Raleigh, NC 27611, telephone: 919-733-5251.)*

ITEMS OF INTEREST:

And more . . . .

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SPECIAL NOTICE

NORTH CAROLINA CONFERENCE ON WATER MANAGEMENT

Built around the theme "Water Management for the 1980's," this conference will define water management challenges for the decade and develop proposals for improving water management to meet North Carolina's needs. Speakers will include water resource leaders from local governments, state and federal agencies, industry, and the scientific community. The speakers and discussions will focus on problems and management opinions in three major areas:

- Water Supply - regional water systems, conjunctive use of surface water and groundwater, water conservation, and financing water systems.

- Water Quality - water quality trends, wastewater treatment, toxic pollutants, complex coastal water quality problems, trends in federal support for water quality, financing wastewater treatment.

- River Basin Management - planning for competing water uses, legal aspects of water management, recreational water use, navigation, preparing for floods and droughts, and new federal policies affecting the Corps of Engineers and the Soil Conservation Service.

Local government elected and administrative officials, State legislative officials, state and federal agency personnel, industrial and environmental representatives, and other citizens concerned with water management are strongly invited to participate in the conference and in the discussion sessions on each major topic.

The conference will be held on May 25, 1982 at the Royal Villa Hotel and Convention Center, Raleigh, North Carolina. The conference is being sponsored by Department of Natural Resources and Community Development, Water Resources Congress, the Water Resources Research Institute, the League of Municipalities, the Association of County Commissioners, the North Carolina Chapters of American Water Works Association and Water Pollution Control Association, and others.

Following the main conference at 4:30 p.m. both the Advisory Committee of the Water Resources Research Institute of The University of North Carolina and the North Carolina Water Resources Congress will be holding annual meetings.

Complete programs including registration forms will be mailed to personnel and members of the sponsoring groups during the last week in April. Conference participants are urged to preregister if at all possible.

For more information, contact John Sutherland, Office of Water Resources, Department of Natural Resources and Community Development, P. O. Box 27687, Raleigh, North Carolina 27611; telephone number (919) 733-7856.