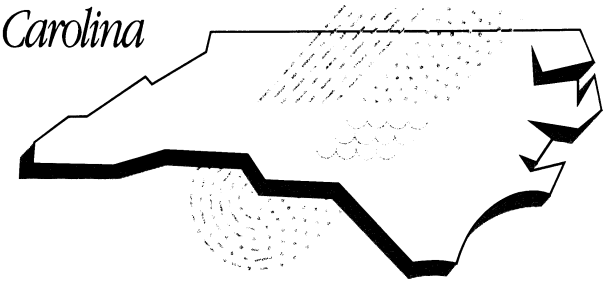
Water Resources Research Institute News
of The University of North Carolina



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Sedimentation called greatest threat to mountain streams

Unprecedented growth and development are projected for North Carolina's mountain region. According to the N.C. Division of Water Quality's (DWQ) basinwide water quality plans for western North Carolina river basins, this growth and development will increasingly threaten the quality of the region's streams and rivers. According to DWQ, the biggest threat to mountain streams is sedimentation—the erosion and deposition of soil.

Steep slopes and shallow soils—highly vulnerable to erosion once disturbed—are the norm in the N.C. mountains. According to DWQ's basinwide plans, because of the terrain and soils, only 18 percent of lands in the mountains are suitable for development purposes. DWQ says that for home building or other development, lots should have slopes of less than 12 percent and, in the absence of public sewer, soil depth of three feet or more over bedrock for onsite septic systems. These requirements are met largely only in river valleys of the N.C. mountains.

Because it is most desirable, land nearest mountain streams is developed most intensely. But, because demand for mountain land is strong, development—and agricultural activities—are increasingly taking place on steep slopes. Many miles of poorly designed, constructed, and maintained private driveways have been built on 18-19% slopes. Many acres of Christmas trees, grown on steep mountain slopes, have a high sedimentation potential if not established and maintained using appropriate best management practices.

Development activity near streams highly vulnerable to the effects of sedimentation, along with development, timber harvesting, and agricultural activity on steep slopes and fragile soils, plus the frequent rainfall for which the N.C. mountains are known make a basic recipe for serious water quality problems.

With these conditions present, increased development pressure could threaten North Carolina's clear mountain streams with turbidity, sedimentation, and habitat degradation. And, in its basinwide plans, DWQ has documented that increased development is coming.

The Cherokee Reservation gambling casino, opened in Swain County in 1997, is the only legalized gambling casino in the Southeast. It is predicted to become one of the primary gambling centers east of the Mississippi and to attract an additional two million visitors per year to the Reservation. Outlying

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Director's Forum

Kenneth H. Reckhow, Director, Water Resources Research Institute

Uses and limitations of trend analyses in water quality studies

Is water quality degradation associated with growth and development? Can we determine if water quality is improving after we implement new management actions? We need answers to these questions to make management decisions, yet clear unambiguous answers can be difficult to obtain.

First, it is important to recognize that even if a management action is affecting water quality, trends may not be apparent in water quality data for several years. Many factors, such as other sources of contaminants, seasonal cycles, precipitation, and natural variability affect measured water quality. As a consequence, it often takes many years of regular water quality data collection to statistically detect a trend—that is, small, gradual changes.

Trend detection involves finding a signal (the trend) in the midst of background "noise." The larger the noise is, or the smaller the trend is, the more data we must have to confidently assess the presence of a trend. More frequent sampling generally helps up to a point; however, data collected much more frequently than monthly lose independence, which adversely affects the statistical tests for trend. On the other hand, proper data analysis to characterize the other patterns in the data can improve the sensitivity of the test.

Once the water quality data have been collected, we could simply look at a graph of the water quality data versus time and determine the presence of a trend by visual inspection. However, the standard approach is to use a statistical technique like the seasonal Kendall test to evaluate data for the presence of a trend, as statistical tests add analytic rigor and a level of objectivity to the conclusion.

The seasonal Kendall (SK) test has become the "industry standard" in water quality trend detection. SK programs are widely available, and the test statistic is relatively easy to compute and interpret. The SK test simply indicates the likely presence (or absence) of a trend at a specified level of significance; other statistics can then be computed to estimate the magnitude of any trend present. Among the shortcomings of the SK test are its restriction to monotonic (unidirectional) trends and the limited insight it provides in comparison to other methods that might be preferred by an experienced statistician.

Once the application of the SK test indicates the likely presence of a water quality trend, several issues must be addressed to make the analysis useful for management. First, unlike a predictive water quality model, the test results provide no information about the likely causes and corrective measures for the trend. Fortunately, a good sampling design may help isolate the cause(s) of a trend. For example, if the impact on

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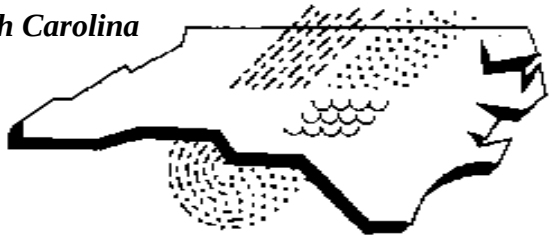

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river water quality associated with nitrogen removal from a major wastewater treatment plant is of interest, then a reasonable design option is to take samples for nitrogen concentration in the river just below the discharge.

While that particular sampling program may isolate the source, it may be less informative about the meaningful water quality impacts. For example, the treatment plant of concern may be located upstream in the Neuse River, while the water quality impact of interest may be downstream in the Neuse Estuary. Processes can occur in the river such that the trend in nitrogen concentration in the Neuse River due to the treatment plant is quite different from that in the Neuse Estuary. The estuarine trend is also likely to be less detectable, since many other factors affect nitrogen concentration in the Neuse Estuary.

To further complicate matters in this example, the public is probably more interested in algal blooms and fishkills in the estuary than nitrogen concentration. Unfortunately, measuring trends in algal blooms and fishkills in the Neuse Estuary and linking those trends to changes at a specific upstream wastewater treatment plant may be technically and economically infeasible. In that situation, scientists should describe for policy makers the implications and limitations of assessing trends in a surrogate water quality variable. In the causal chain from a nitrogen source, to nitrogen input, to riverine nitrogen concentration, to estuarine nitrogen concentration, to algal blooms, trends assessed closer to the source can more easily be related to the underlying cause, but they have less meaning to the public concerning water quality impacts.

Water quality trend assessment serves primarily as a warning system for change. This can be extremely useful for policy evaluation, but it must be emphasized that definitive conclusions on water quality trends may require years of sampling. Ultimately, if a trend is identified, additional scientific assessment is often essential to understand the implications of the trends and to identify effective corrective actions.

Sedimentation threat to mountain streams

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areas are likely to see increased commercial activity and establishment of new businesses, and the strong economic activity may spur second home building. Highways in the area are slated for widening, and a new thoroughfare from Andrews to Almond is planned.

South of Swain County, there has been a recent wave of development from Atlanta to the North Carolina state line. Throughout the Hiwassee River basin, property has sold rapidly, with Clay County seeing a doubling of land parcels over the last ten years as land has been subdivided. Out-of-state developers waiting for the right time to develop now hold about 61 percent of the land parcels in Clay County.

North and east of Swain County, the opening of Interstate 26 from Asheville to the Tennessee State line through Madison County will open more of the northern mountains to increased tourism and development.

But second home, retirement home, and commercial development is not the only land-disturbing activity projected to increase in the N.C. mountains. According to DWQ, maturing forests on private lands in areas of the mountains could see new logging activity, which, without strong enforcement of forestry best management practices could contribute significantly to an increase in sedimentation problems.

What could increased development and unaddressed sedimentation mean to mountain water resources? DWQ's documentation of current sediment-related water quality problems in the mountains may be an indication of what lies in the future:

In Lake Lure and Lake Junaluska, owners have had to spend huge sums to dredge accumulated sediment caused by unwise development and agricultural practices. After battling sedimentation in Lake Lure for many years, town officials and FEMA in 1997 following Hurricane Fran spent $1.4 million to dredge the lake. A Clean Water Management Trust Fund grant is now allowing local groups to implement a cooperative plan to restore and stabilize the watershed to eliminate sedimentation problems. At Lake Junaluska, the Southeast United Methodist Assembly, after years of annual minor dredging, in 1993 paid more than $500,000 to remove sediment brought in primarily by a stream suffering the effects of urbanization.

The Cullasaja River above Mirror Lake at Highlands is rated by DWQ "impaired" due to nonpoint source pollution, including sedimentation from home and driveway building on steep slopes and thin soils.

Laurel Creek, as the result of sedimentation from a golf course development in the New River basin, was completely degraded as aquatic habitat, even after restoration attempts.

DWQ says repeatedly in its basinwide plans that the single greatest threat to water quality in North Carolina's mountains is sedimentation. Under the N.C. Sedimentation Pollution Control Act, all those who conduct land-disturbing activity anywhere in the state are required to control erosion and sedimentation. But, as Phillip Gibson relates in his article on page 4, the N.C. Division of Land Resources cannot send sediment control officers to construction sites frequently enough to adequately enforce state regulations.

The Year of the Mountains Commission in 1996 identified sedimentation control as a priority for action. Western North Carolina Tomorrow (WNCT), which is implementing the recommendations of the Year of the Mountains, is taking the lead in the search for ways to prevent what could be a disastrous increase in sedimentation as accelerated development reaches the mountains. For information, contact Phillip Gibson, Natural Resource Program Manager, WNCT, at (800) 621-0008 or visit website http://www.wcu.edu/mrc/wnct/wnct1.html.

The Year of the Mountains: An update

by Phillip Gibson, Western North Carolina Tomorrow (WNCT)

Governor James B. Hunt, Jr. appointed the Year of the Mountains Commission (YOMC) in 1995 to "develop and market public policy goals which can address the issues of quality growth and development, natural resource protection, and preservation of the cultural identity of the [western North Carolina] region." Representatives from the 29 westernmost counties and the Eastern Band of the Cherokees presented the final report and recommendations of the YOMC in June 1996.

While the YOMC was active, regional education on land planning was conducted, educational exhibits on air quality and cultural heritage were created, thirty-six cultural treasures were identified with roadside signage, and forty-two natural heritage sites were highlighted on regional maps and brochures. However, the question is "Have the recommendations of the YOM Commission survived and been acted upon?"

Although the YOMC addressed issues beyond those in natural resources, this update examines only recommendations related to water quality: sedimentation, straight-piping of wastewater to streams, animal waste management, forest resources and water quality, and progress toward community planning.

■ **Sedimentation.** Sediment continues to be the number one pollutant of North Carolina's mountain streams. While the N.C. Sedimentation Control Commission (SCC) has provided funding and technical assistance to the mountain region for education about on-the-ground implementation of sedimentation control measures, support to address the issue of sediment is still significantly inadequate. Although the N.C. Sedimentation Pollution Control Act requires anyone anywhere who conducts land disturbing activity to control erosion and sedimentation, the N.C. Division of Land Quality has only five staff persons to review erosion and sedimentation control plans and perform site inspections in the Asheville region. As a result, Land Quality is able to visit a permitted site only once every six months. In 1998, the N.C. SCC requested funding for 113 additional positions for statewide erosion control. For the first year of three years, the Governor requested funding for 30 positions. Thirty additional positions would have allowed a site to be inspected on the average of once every 2.7 months. The result from the General Assembly's 1998 budget session was 4 positions, none of which was assigned strictly to western North Carolina.

■ **Straight-piping of wastewater to streams**. In 1997, the N.C. General Assembly provided funding for a program to help eliminate straight-piping and approved an amnesty program for violators. Presently, the Wastewater Discharge Elimination (WaDE) Program has two positions that address straight-piping statewide, and a 1-800-9-SEWAGE "amnesty" line has been set up to encourage home owners to seek assistance in upgrading their systems. (Although the amnestry program expired December 31, 1997, WaDE has recommended to the N.C. General Assembly that the amnesty provisions be made permanent.) Early efforts were aimed at educating the western counties' health departments about the program and identifying additional funding or assistance sources for qualifying residents. As of June 1997, the amnesty line had received an average of 50 calls per month with participation from 22 counties. Over 150 illegal discharging systems were identified, and more than 50 repair permits have been issued. The Department of Environment and Natural Resources considers this to be one of the most successful programs in addressing the YOMC natural resources recommendations. WaDE is presently working with WNCT to develop a television public service announcement and brochure on straight piping that may be used statewide.

■ **Animal waste management.** The N.C. General Assembly addressed this issue when it passed Senate Bill 1217 to help dairy farmers comply with the ".0200" animal waste management regulations. The Western North Carolina Development Association (WNCDA) and federal/state agencies recognized that blanket regulations were not equitable to dairy farmers facing topographical challenges in the mountain region. Meetings conducted by WNCDA with regional representatives and N.C. legislators resulted in additional N.C. Agriculture Cost Share funding to assist dairy farmers and additional time to comply with these regulations. WNCDA indicates that all dairy farms are presently in compliance as a direct result of the attention given by the General Assembly. WNCDA asserts that this regulation is a good example of how we need to examine future policies and their applicability throughout the state.

■ **Forest resources and water quality.** North Carolina made aviation history again when it became the first state to purchase the CL-215—the only aircraft designed for fire suppression. Due to long maintenance periods for this aircraft, the N.C. Division of Forest Resources is seeking support to purchase two additional aircraft. The General Assembly has provided funding for three of the four additional foresters recommended by the YOMC to help mitigate negative water quality

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impacts associated with forestry operations in western North Carolina.

■ **Community planning:** The YOMC recommended "the establishment and/or expansion of sound planning capabilities throughout the 29 counties," to "encourage local governments to implement capital improvement planning…" and "promote strong downtowns within the WNC region." This is probably the most successful Year of the Mountains program to be implemented. Ten counties now, for the first time, have a county planner due to the support of the N.C. General Assembly. In 1997, $3 million was requested to address this need. Approximately $300,000 was allocated in both 1997 and 1998 to provide those counties with planners. Several entities, such as the N.C. Division of Community Assistance, Councils of Government, Local Government Training Program of the Mountain Resource Center, and many non-profits in western North Carolina continue to work together to develop regional education and training for those planners. Western North Carolina Tomorrow is working to bring these and other groups together to construct a comprehensive education program to build regional awareness on the need for planning. Nine television commercials are presently being developed as a component of this regional program. Follow up tools such as brochures and workshops will be utilized.

The inspiration provided by the Governor and the Year of the Mountains Commission kindled enthusiasm that has helped strengthen existing bonds and develop new ones in western North Carolina communities. The General Assembly provided the financial fuel to maintain the fire. The challenge is to maintain the enthusiasm so that we may fulfill the recommendations of the Year of the Mountains.

The Year of the Mountains Commission's June 1996 Final Report can be found on the Western North Carolina Tomorrow webpage at http://www.wcu.edu/mrc/wnct/natres/natres.html. For more information on Western North Carolina Tomorrow or regional efforts to address the YOMC recommendations, contact Phillip Gibson at (828) 227-7492.

Year of Mountains Update *continued*

Program seeks permanent amnesty and resources to correct problems

Study indicates "straight piping" more prevalent than thought

According to the 1990 census of housing, 1.5% of the occupied housing units in North Carolina—about 37,500—lack complete plumbing facilities. That is, pipes that run from toilets, tubs, and washers go straight into streams or to makeshift or failing subsurface systems that provide no treatment of wastewater. Such practices pose obvious threats to human health and the environment, and the threats may be greater than the official census estimates indicate.

A pilot survey currently underway in Western North Carolina's Madison County—where the census says 4.8% of households lack complete plumbing—has revealed that more than 22% of households surveyed have wastewater discharge problems that lead to surface water pollution. If this finding holds true elsewhere, as many as 150,000-200,000 household discharges may be contaminating North Carolina surface waters with bacteria, viruses and other pathogens; nutrients; and oxygen-demanding wastes. While the perception is that straight piping takes place only in poor mountain counties, census surveys show that it occurs in poor rural communities throughout the state.

The Madison County wastewater discharge survey is a program initiated by Madison County and Land-of-Sky Regional Council. According to Heather Bullock with Land-of-Sky, the program is a sterling example of what a community can do with motivation, some grant funding, and a little help from the N.C. Department of Environment and Natural Resources' (DENR) Wastewater Discharge Elimination Program (WaDE).

WaDE was created by DENR at the direction of the N.C. General Assembly in the 1996 "budget bill." In response to recommendations by Governor James B. Hunt, Jr's Year of the Mountains Commission and lobbying by advocates for rural communities, the General Assembly directed DENR to establish a program to identify and eliminate discharges of domestic wastewater from straight pipes and failing septic systems in water supply watersheds throughout the state. The legislature provided a one-time appropriation of $12,500 and an annual appropriation of $117,500 to DENR to carry out the program. It also established an amnesty program under which violators of domestic wastewater discharge rules and laws could report and address their problems without incurring legal consequences if they did so before December 31, 1997.

Operating under the Division of Environmental Health (DEH), the WaDE program has three staff persons. Terrell Jones is WaDE Program Manager, and Peter Whitaker is Environmental Health Specialist working out of the Asheville Regional Office of DENR. Rachel Groff, working at the Raleigh On-Site Wastewater Section of DEH, answers the hot line established to take amnesty calls and maintains the database of household discharges being developed under the program. The program operates by involving county health departments in education and survey efforts and by hunting for partners to implement surveys and loan programs for plumbing upgrades in those western counties where straight piping in water supply watersheds is thought to be substantial. With assistance from WaDE environmental health

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Straight-piping program *continued*

specialists and grants from the Clean Water Management Trust Fund (CWMTF), a few counties have begun surveying watersheds to identify the extent of discharges and addressing discharge problems already identified.

The Madison County Straight-Pipe Elimination Survey Project provides a model for the WaDE program's efforts in other counties. Established in October 1997, it is a partnership effort of Madison County, county residents, the Madison County Health Department, and the Land-of-Sky Regional Council. WaDE is assisting in survey efforts, and the program is being funded by grants from the Appalachian Regional Commission, an Infrastructure Planning Demonstration Community Development Block Grant, the Western N.C. Housing Partnership, the Pigeon River Fund, the Community Foundation of Western North Carolina, matching funds from the partners, and Clean Water Management Trust Fund grants.

The goal of the project is to eliminate straight piping throughout the county. A community planning committee was established to help direct the survey, develop educational materials for homeowners, and formulate policy regarding homeowners found to be in violation of discharge rules. Meetings have been held throughout the county to let county residents know about the survey, its purpose, and the health and environmental hazards of straight-piping and failed septic systems.

The door-to-door survey is being conducted on a fire-district basis, and educational materials are distributed as surveys are done. In addition to asking residents about their septic needs, surveyors also collect information about location of discharges, financial status of residents, and housing conditions. Information is entered into a database, which is used to refer people for housing and wastewater disposal assistance and for follow up.

EPA broaches issue of effluent limits for aquaculture

In the May 28, 1998, *Federal Register* (63 FR 102), the U.S. EPA served notice that it may in the near future propose NPDES effluent limitations for fish farms. The issue is before the agency because environmental groups are raising concerns about water quality, ecological, and human health effects of what is now the fastest growing segment of U.S. agriculture. Of particular note is a report issued by the Environmental Defense Fund (EDF), *Murky Waters: Environmental Effects of Aquaculture in the US*, which explicitly calls on EPA to promulgate effluent guidelines for fish farms.

According to Tom Ellis with the N.C. Department of Agriculture and Consumer Services (NCDACS), the EPA proposal is significant in North Carolina because North Carolina is one of the nation's major producers of farm-raised fish and shellfish. In 1997, N.C. producers sold more than $19 million worth of aquaculture products.

Nationwide, finfish and shellfish are raised in both freshwater and saltwater using a variety of production systems. Catfish, shrimp, and striped bass are usually raised in ponds. Crawfish are raised in shallow ponds that simulate a wetland environment. Trout are raised in raceways, a series of concrete or earthen tanks through which water flows continuously. Salmon are raised in netpens, enclosures used to raise fish directly in lakes, ponds, and coastal bays. Shellfish are primarily grown on estuarine bottom leased from

continued next page

Straight-piping program *continued*

With two fire district surveys complete and a third nearing completion, surveyors have found a more dismal picture than they expected. According to Rick Crawford of the Madison County Health Department, of 1,630 structures surveyed, 144 had "black water" straight pipes (pipes from toilets to streams), 344 had "gray water" straight pipes (pipes from showers, washing machines, etc.) to streams, 53 had failing septic systems, and 20 had outhouses. Crawford also said that survey information shows the vast majority of those with straight pipes and failing septic systems are low- and very-low-income families. It is not realistic to expect these families to correct their wastewater problems without financial help, said Crawford.

Preliminary results from the Madison County survey were presented to the General Assembly's Environmental Review Commission in December. Reporting for the WaDE program, Terrell Jones recommended to legislators that—in light of what has been learned in Madison County—the amnesty program for domestic discharge violators should be made permanent and the WaDE program should be expanded to create a team to expedite straight pipe and failing septic system surveys across the state.

Jones also reported that WaDE and the Department of Commerce's Community Assistance Division have submitted a grant proposal to the Clean Water Management Trust Fund seeking $5 million to help capitalize a statewide revolving loan fund for low-income families that need to upgrade or replace household wastewater disposal systems. The CWMTF grant would be matched with $2 million in Community Development Block Grant funds and additional grants from other sources. Jones also said that he is exploring with the U.S. EPA the possibility of funding for a demonstration program to develop standardized methods of collecting and reporting straight-piping and failing septic system survey data.

the state. Some finfish are also grown in tanks that recirculate water. All systems require large inputs of clean water, all must deal with wastes composed primarily of uneaten food and fish feces, and some use antibiotics and other chemicals to suppress diseases that threaten animals grown in dense concentrations.

According to the EDF report, all aquaculture production systems have the potential to be significant sources of chemical and biological pollutants and nutrient wastes, with netpen systems having the greatest potential to cause environmental degradation from totally untreated waste discharges. In some places where aquaculture is a major enterprise, water quality problems have led to regulation. Norway, Ireland, and Chile have imposed moratoria on the expansion of sites for salmon netpens. In Idaho, the number one trout producer in the United States (N.C. is number two), pollution of the Snake River prompted the EPA to require trout farmers to reduce phosphorous levels in their effluent. In Texas, environmental problems associated with shrimp farms have spurred lawsuits by grassroots organizations.

Because there are no federal guidelines for aquaculture effluents, each state regulates fish farming on its own, and regulations vary widely. Water quality aspects of fish farming are currently regulated in North Carolina under an NPDES General Permit which sets limits on solids, dissolved oxygen, and pH in discharges. Aquaculture operations can be covered by the General Permit if they agree to meet the general limits and perform minimal monitoring, such as sampling their effluent once a year. If the N.C. Division of Water Quality determines that an operation may pose a threat to downstream water quality, it may require an individual permit with additional limitations

According to Ellis, who is Director of the N.C. Division of Aquaculture and Natural Resources and President of the National Association of State Aquaculture Coordinators, the worst water quality problems cited in the EDF report are associated with salmon and shrimp, which are not grown in North Carolina. Ellis said that N.C.'s General Permit system works well to protect water quality and that the State should retain responsibility for setting water quality criteria for aquaculture. However, Ellis also said that new methods to reduce the potential for pollution from aquacultural operations need to be developed and that EPA should cooperate with the U.S. Department of Agriculture and the aquaculture industry to develop best management practices (BMPs).

N.C.'s aquaculture industry

N.C.'s 250 pond, tank, and raceway aquaculture operations are sited about evenly in the Coastal Plain and mountains, with only a few in the Piedmont. Pond farms located primarily in Beaufort, Pitt, Martin, Washington, Bertie, Craven and Pamlico counties raise hybrid striped bass, catfish, and crawfish. Most of these operations rely on high-quality groundwater, and aquaculture operations draw upwards of 3.5 million gallons per day from the Castle Hayne Aquifer. No water quality problems associated with aquaculture have been reported in the Coastal Plain.

However, in basinwide water quality plans, the N.C. Division of Water Quality has cited trout farms as sources of excess nutrients in mountain streams in the Little Tennessee River Basin and the French Broad River Basin. N.C. Agriculture Cost Share funds have been used to assist some trout farmers in installing settling ponds to comply with solids limitations, and the Natural Resources Conservation Service is developing a Trout Waste Management Standard to guide construction of settling facilities and establish performance goals.

While fish does not rank among the top twenty of N.C. commodities, fish farming is seen by some as one possible replacement for tobacco, particularly for small farmers, and expansion of certain segments of the industry is expected. Both the U.S. Department of Agriculture and NCDACS promote aquaculture through research, information transfer, technical assistance, and financial assistance. The N.C. Sea Grant Program has helped establish and promote hybrid striped bass farming, and Western Carolina University, the University of N.C. at Wilmington, and N.C. State University all have aquaculture research programs.

Ellis said that while there is some room for expansion of N.C.'s trout industry, low flows in N.C. mountain streams limit not only the size of the industry but also the size of individual operations. Most N.C. trout farms are small, with the median size farm producing about 50,000 pounds of fish per year. The most obvious opportunity for expansion of N.C. aquaculture lies in the Coastal Plain. In fact, hybrid striped bass is the fastest growing segment of the aquaculture industry and North Carolina is tied with California as the number one producer.

However, at N.C. State University, researcher Dr. Tom Losordo believes that he may have developed a way to allow Piedmont farmers to participate in the aquaculture boom. In the Piedmont, where both water and land are limited resources, intensive fish farming using indoor tanks and water reuse technology could soon be shown to be commercially viable. Losordo has demonstrated that the system can rapidly grow out African Talapia using water and land efficiently and posing virtually no water quality concerns. Recirculating systems like Losordo's have relatively high investment and operating costs, but soon the first commerical Talapia farm based on the NCSU design will go on line in the Piedmont, and the economics of the system will be field tested. According to the EDF report, recirculating systems are regarded as the best approach to preventing environmental damage from aquaculture because they use less water

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Local governments in Upper Neuse Basin will test concept of local/state water quality management

In what's being called a "pioneering and historic" endeavor, local governments in the Upper Neuse River Basin will cooperate with State regulators to develop a plan that could replace parts of State-developed plans for managing water quality above Falls Reservoir. Local governments in the Upper Neuse are subject to the Neuse River Nutrient Sensitive Waters Management Strategy, including requirements for reducing nitrogen loading from wastewater treatment plants and runoff. The locally developed plan will have to conform to all state water quality regulations but can tailor the strategies for achieving water quality standards to suit specific conditions in the Upper Neuse.

The N.C. General Assembly cleared the way for local governments to become full partners with the State in managing water quality when it passed Senate Bill 114 (SL 1997-493) in 1997. That law provided that the N.C. Environmental Management Commission may approve a plan proposed by a coalition of local governments in a watershed as an alternative to the state's plan for attaining water quality standards in a river basin or subbasin. The law established requirements for organization of local governments into a coalition and for contents of water quality management plans. It provided that such plans may include pollutant trading between point source dischargers and nonpoint pollution sources.

County and municipal governments and Soil and Water Conservation Districts in the Neuse Basin above Falls Reservoir formed the Upper Neuse River Basin Association (UNRBA) as a nonprofit watershed planning organization in 1996. Each local government has committed itself to financial support for the organization, and the Triangle J Council of Governments and several municipalities have provided staff support. A grant from the U.S. Environmental Protection Agency allowed the association to hire the consulting group Tetra Tech Inc. to prepare an outline for developing a management plan, and in 1998, the Association hired Lisa Martin, formerly of the N.C. Division of Water Quality, as its executive director.

In its recent "short session" the General Assembly appropriated $300,000 to the UNRBA through the N.C. Department of Environment and Natural Resources to help with development of a local/state water quality management plan for the Upper Neuse. The framework for the Upper Neuse plan is to serve as a model for other local government coalitions who want to become partners with the State in water quality management.

At its December meeting the UNRBA accepted a proposed approach presented by Tetra Tech's Kimberly Brewer for developing the Upper Neuse Watershed Management Plan. The approach lays out roles and responsibilities, steps to be taken to develop a plan that complies with requirements of SB 114, and a schedule. According to Brewer, the UNRBA will be a comprehensive plan for managing water quality and water quantity throughout the Upper Neuse watershed and meeting the goals of the Neuse River Nutrient Management Strategy, not just a nitrogen management plan focused on problems of the Lower Neuse.

According to Lisa Martin, local governments participating in the UNRBA will be asked in February to approve a Resolution of Intent committing them to develop and implement an Upper Neuse Watershed Management Plan as proposed in the approach document.

The plan will be developed in coordination with the N.C. Division of Water Quality and N.C. Environmental Management Commission, the N.C. Department of Transportation, the Triangle J Council of Governments, the Kerr Tar Council of Governments, and the N.C. Cooperative Extension Service. Business and industry groups, citizens and environmental groups, and other interested people will be involved in plan development as well. If all goes as expected the plan will be presented to the N.C. Environmental Management Commission for approval sometime in 2000.

According to Trevor Clements of Tetra Tech, the kind of water quality planning envisioned in Senate Bill 114 provides local governments who want

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Aquaculture *continued*

and provide a source reduction method for nutrient, chemical and biological pollutants.

According to Eric Strassler with EPA's Engineering and Analysis Division, the agency has not yet decided whether to develop effluent guidelines for aquaculture. Strassler said that during the comment period on its *Federal Register* announcement, the agency received comments both in support of and opposing development of effluent guidelines. But, he said, no state water quality agencies submitted comments. As a result, he said, EPA has a very incomplete picture of how states are currently regulating aquaculture and what compliance problems are. He said the agency may conduct a preliminary study that would review information already received and gather new information,

For more information on aquaculture in North Carolina, contact Tom Ellis at (919) 733-7125 or tom_ellis @ncdamail.agr.state.nc.us or check his website at http://www.agr.state.nc.us/aquacult/. For information on the NCSU recirculating system contact Dr. Thomas Losordo at (919) 515-7587 or tlosordo @unity.ncsu.edu. The EDF report "Murky Waters" can be downloaded in PDF format at http://www.edf.org/pubs/reports/aquaculture/f%5Fdownload.html.

the responsibility much more meaningful roles than they have had in the past and allows for a much higher degree of resource coordination and leveraging. Moreover, Clements said, because state regulators and local governments will be planning partners for the first time, the process should eliminate some of the uncertainty local planners face when they develop water or wastewater plans that depend on state permitting.

For additional information about the UNRBA or the Upper Neuse Watershed Management initiative contact Lisa Martin at (919) 557-2702.

Neuse stakeholders want unbiased, reliable information

According to a study by the N.C. Cooperative Extension Service (CES), stakeholders in the Neuse River Basin need unbiased, reliable science-based information about river water quality and its effects before they will change their behavior.

With new funding from the General Assembly and six new staff positions, CES has created the Neuse Education Team whose purpose is to provide educational programs to help support implementation of the Neuse River Nutrient Sensitive Waters Management Strategy. To establish a baseline of the public's knowledge and perception of water quality issues in the Neuse River Basin, the team administered a water quality survey to 20 focus groups in the Neuse Basin. These focus groups represented seven different sectors.

Almost all groups told the interviewers that there are too many unanswered questions about water quality conditions in the Neuse and that no reliable sources of information exist. Across the board, respondents voiced the need for information about what is known and the limits of knowledge about water quality in the Neuse, as well as description and explanation of the iterative nature of watershed or river basin projects. They also said that people need a clearer understanding of how pollutant loads are calculated, particularly for nonpoint sources, and more information on the effectiveness of BMPs, the use of water quality and land use models, and appropriate fertilization practices. A paper describing the study in detail (Water Quality Views and Opinions of Stakeholders in the Neuse River Basin) is available at web site http://ces.soil.ncsu.edu/net/focus.html.

NCSU developing National Training Center for Land-Based Technology & Watershed Protection

In 1990, the nation's first "hands-on" onsite wastewater training center with working, aboveground demonstrations was established in Chatham County, North Carolina. Its successor—the National Training Center for Land-Based Technology and Watershed Protection—opened this past March at N.C. State University's Lake Wheeler Road Field Laboratory in Raleigh. The center's goal is to leverage university resources with contributions of equipment, labor, and money from government agencies, private partners, and professional organizations to become the premier facility of its kind in the United States. Its purpose is to provide for demonstration of and training in:

- advanced and conventional land-based waste treatment technologies, and
- environmental management technologies including water quality management in watersheds, small community wastewater treatment plant operation, and cropping systems for efficient waste utilization.

Dr. Mike Hoover, extension professor of soil science and the center's director, says that with 30 acres to develop and a distinguished faculty with broad expertise in waste management to draw from, the NCSU center can provide unique opportunities for training in designing, installing, and managing on-site, land application, and small community waste treatment systems.

The center will also demonstrate alternative and innovative on-site technologies and provide an area for controlled, long-term and replicated studies related to soil and septic system components. Watershed protection and water quality improvement are complementary components.

Participants in the training programs will include environmental health specialists, farmers, extension agents, professional engineers, soil scientists, system operators, installers, and public officials. Because the training center is located close to the NCSU campus, undergraduate and graduate students will attend hands-on field sessions as part of their regular coursework. Students may also join in the building effort—an excellent on-the-job-training experience for students with an interest in wastewater management and water quality.

There are six main training areas: On-Site System Demonstration, Land Application Training and Demonstration, Small Community Wastewater and Water Treatment, Watershed and Water Quality Management, Agronomic Training, and Septic System Research.

Some of the unique features planned are:

- spray irrigation and land application systems allowing hands-on calibrations and equipment troubleshooting
- two inspection-ready septic systems with built-in faults to train new inspectors
- a full scale, small community wastewater treatment plant filled with water (rather than sewage) for hands-on training
- an environmentally friendly parking lot displaying several paving systems
- a constructed wetland and stream restoration project
- permanent crop plots demonstrating nutrient deficiency and metal toxicity

continued next page

The N.C. Coastal Plain: An area in need of ground-water management

Point of View

by Ralph C. Heath, Consulting Hydrogeologist, and Richard K. Spruill, Associate Professor of Geology, East Carolina University

The ground-water system in large areas of the North Carolina Coastal Plain is rapidly approaching a crisis situation.

A review in 1969 of data from observation wells showed that water levels in the Cretaceous aquifers (principally the Black Creek and Upper Cape Fear Aquifers) in the Coastal Plain had been declining in an area extending from Pitt and Lenoir counties through Craven to Onslow County since observation records began in 1963. Water levels in the Cretaceous aquifers had also been declining in the area north of Albemarle Sound since records began in 1964. Although the decline in water levels in both areas probably started soon after World War II, there were no water-level records prior to 1963 to confirm this. Significant cones of depression have also been developing since about 1993 along the southern boundary of North Carolina, in Bladen and Robeson counties.

The water-level declines in the central Coastal Plain were assumed to be due to groundwater withdrawals at Kinston, Grifton, and Jacksonville. The declines north of Albemarle Sound were assumed to be due to large withdrawals at a paper mill at Franklin, Virginia. These declines and their potential water-management implications were called to the attention of State officials during a lecture by Heath on the central Coastal Plain region at a short course sponsored by the North Carolina Water Resources Research Institute in Raleigh in May 1970.

In an effort to evaluate the magnitude of this problem, the State Groundwater Division, under the direction of Harry Peek, began to expand its groundwater-level, observation-well program. However, before the planned expansion could be completed, leaking underground storage tanks and other groundwater contamination problems intervened. These problems, plus innumerable reorganizations of the State's ground-water staff since then, have unfortunately diverted attention from both the observation-well program and the decline of the water level in the Cretaceous aquifers.

What is the situation with the Cretaceous aquifers now? Pumping water levels in production wells at Kinston and Snow Hill, both of which are located near the western edge of the Cretaceous aquifers, are approaching the bottoms of the wells. In Onslow County, pumping levels have exposed the uppermost well screens. The cone of depression that was centered on Kinston and Grifton in 1969 has coalesced with the Jacksonville and Onslow County cone.

In the meantime, the cones of depression in Bladen and Robeson Counties are expanding around pumping centers at Elizabethtown, Tar Heel, and

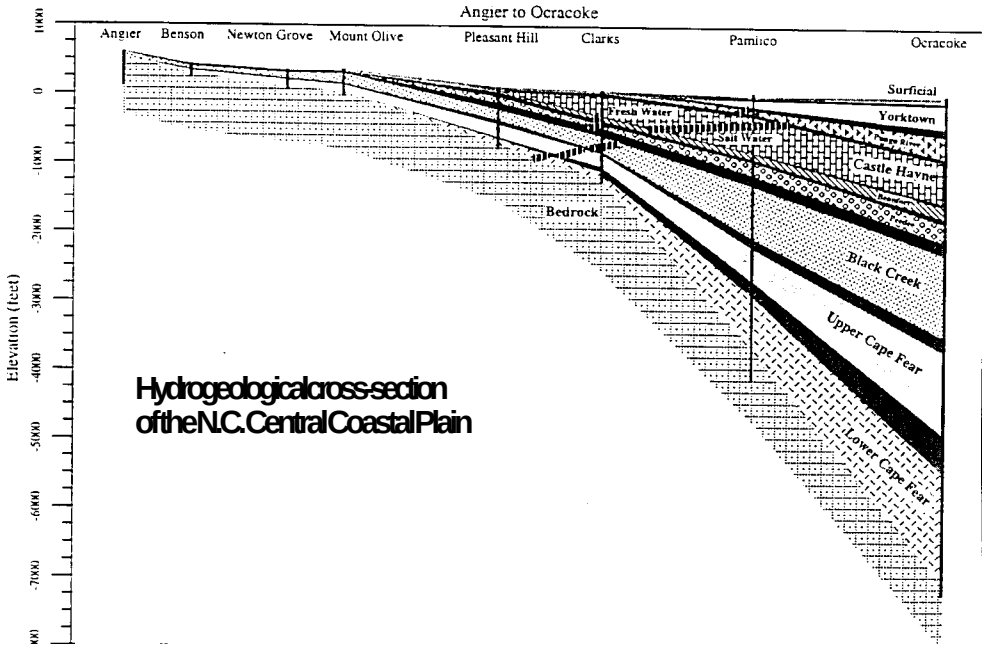
continued next page

National Training Center *continued*

- a dedicated area for long-term wastewater research
- a state-of-the-art classroom for at least 140 students

The NCSU College of Agriculture and Life Sciences dedicated acreage at its Lake Wheeler Field Lab and more than $100,000 to develop basic infrastructure for the center. Donations of more than $200,000 so far have allowed a number of technology demonstrations to be installed. NCSU is now seeking partners to help acquire and install equipment for additional demonstrations, develop displays, construct a classroom, and fund year-round operations.

For additional information on the National Training Center for Land-Based Technology and Watershed Protection or to find out about becoming a partner in the center, contact Center Director Mike Hoover at (919) 515-7305 (mike_hoover @ncsu.edu) or the Center's Training Coordinator Joni Tanner at (919) 513-1678 (joni_tanner@ncsu.edu).



Hydrogeological cross-section of the N.C. Central Coastal Plain

Lumberton. Are these counties, together with Columbus, now at the same stage as those in the central Coastal Plain at the end of World War II? Will increases in withdrawals resulting from agricultural, industrial, and population growth result, in a few decades, in a large coalesced cone of depression?

Simply stated, water levels in the Cretaceous aquifers are declining from the Virginia line to Robeson County. The rate of decline, as a result of increased withdrawals by municipalities, industries, and agriculture now ranges from about 1 foot per year in Hertford County to 6 ft/yr in Pitt County to 10 ft/yr in parts of Robeson County. The failure of the water levels in the Cretaceous aquifers to stabilize shows that the withdrawals exceed the recharge and have for at least the last few decades.

In other words, ground water is being mined from the Cretaceous aquifers and this situation has been exacerbated by two public policies whose effects on the ground-water system have been ignored. The first is the extensive land-drainage networks that have been installed in the Coastal Plain and which have lowered the water table and thereby reduced the rate of recharge to the deeper aquifers. The second is the recent program in which rural areas that were previously supplied by privately owned shallow wells drawing from the surficial aquifer are now being connected to government sponsored rural water systems supplied by deep wells drawing from the already over-stressed Cretaceous aquifers.

The capacity use area provisions of the N.C. Water Use Act of 1967 were passed to protect the State's ground-water resources. However, they cannot accomplish this purpose unless they are used, and their only use so far is in Capacity Use Area No. 1 where, in hindsight, they appear not to be needed.

The State's central Coastal Plain Cretaceous aquifer system must be regulated and the regulation is needed now. Failure to act immediately and effectively will result in irreparable harm to the ground-water system.

1998-99 Water Resources Research Seminar Series

Tuesday, January 19, 1999, 3 pm. Groundfloor Hearing Room, Archdale Building, downtown Raleigh. "Two Approaches to Modeling the Neuse River Estuary: Mechanistic and Network Analysis Models." *Assistant Professor James Bowen, Department of Engineering Technology, University of North Carolina at Charlotte, and Professor Robert Christian, Department of Biology, East Carolina University.*

Tuesday, February 23, 1999, 3 pm. 1132 Jordan Hall, NCSU Campus. "Microbial Impact from Animal Waste." *Professor Mark Sobsey, Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill.*

Monday, March 22, 1999, 3 pm. Groundfloor Hearing Room, Archdale Building, downtown Raleigh. "Water Quality Trends in the Neuse and Pamlico Basins." *Professor Donald Stanley, Institute of Marine and Coastal Resources, East Carolina University.*

Tuesday, April 20, 1999, 3 pm. 1132 Jordan Hall, NCSU Campus. "Effect of Management Practices on Land Application of Swine Waste." *Assistant Professor Steve Whalen, Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill.*

Monday, May 24, 1999, 3 pm. Groundfloor Hearing Room, Archdale Building, downtown Raleigh. "Optimizing Buffers to Reduce Pollutants in Runoff." *Associate Professor Richard McLaughlin, Department of Soil Science, North Carolina State University.*

People

Henry Lancaster has left his position as Deputy Director of the Department of Environment and Natural Resources to become Intergovernmental Affairs Director for the N.C. League of Municipalities. **Sherry Evans Stanton**, formerly DENR Assistant Director for Natural Resources, has succeeded Lancaster as Deputy Director.

David Williams, formerly with the Division of Pollution Prevention and Environmental Assistance, is the new Assistant Director for Nonpoint Source Programs with the N.C. Division of Soil and Water Conservation.

Solicitation for Water Quality Information

The N.C. Division of Water Quality (DWQ) invites all interested parties to submit water quality information relevant to the following river basins for use in developing basinwide water quality plans and reports to the U.S. EPA under Section 303 (d) of the Federal Clean Water Act:

- White Oak River Basin (New River and Bogue and Core Sounds)
- Savannah River Basin
- Hiwassee River Basin
- Watauga River Basin
- Little Tennessee River Basin

To be considered, information must be postmarked by February 5, 1999. For information on submission criteria, contact Michelle Woolfolk with DWQ at (919) 733-5083 Ext 505. For questions about upcoming basinwide planning workshops and the basinwide planning schedule, contact Suzanne Hoover with DWQ at (919) 733-5083 Ext 573.

November, December action of the N.C. Environmental Management Commission

Called meeting on Randleman Lake

On November 12, 1998, the N.C. Environmental Management Commission (EMC) held a special meeting at which they took one more step in the long and difficult journey toward providing a regional water supply for the Piedmont Triad area of North Carolina. With only one commissioner dissenting, the EMC classified for water supply a portion of the Deep River and tributaries that drain to the planned Randleman Lake and designated these waters as Critical Water Supply Watershed.

The planned reservoir, to be impounded at Randleman in Randolph County, will have a 3,045-acre pool. The project will occupy approximately 6,000 acres, and its protected watershed will encompass 80,624 acres in northern Randolph and southern Guilford counties. It will be built by the Piedmont Triad Regional Water Authority to serve Randolph County and the municipalities of Randleman, High Point, Jamestown, Archdale, and Greensboro. A single-purpose reservoir, Randleman Lake is projected to supply a safe yield of 48 million gallons per day and to come online around the year 2002.

As permitted by the Critical Water Supply designation, the EMC also adopted rules to implement a special nutrient management strategy to control eutrophication and algae growth in the reservoir. Because models predict that current nutrient levels and future hydrologic conditions in the reservoir will lead to excessive algae growth, rules adopted by the EMC require reductions of phosphorus from point sources in the reservoir (principally the City of High Point's wastewater discharge) and controls on nonpoint sources of nutrients in the watershed.

In addition to Guilford and Randolph counties, six municipalities (Archdale, Greensboro, High Point, Jamestown, Randleman, and Kernersville) have jurisdiction in the Randleman Dam watershed, and several existing water supply watersheds are contained within the planned reservoir watershed. The two counties and six municipalities will have to either develop new water supply watershed ordinances or amend existing ordinances to comply with special requirements of the Randleman Lake Nutrient Management Strategy regarding riparian area protection, development density restrictions, and stormwater management.

Requirements for point source nutrient control in Randleman Lake will fall most heavily on the City of High Point. High Point must move the discharge point for its Eastside Wastewater Treatment Plan and reduce phosphorus concentration in its discharge. In addition, the city must impose development restrictions on an additional 6,842 acres within its borders. High Point already has 12,845 acres under density restrictions for the Jamestown, High Point Lake, and West Fork Deep River watersheds. The adopted rules allow High Point and other local governments in the lower watershed 270 days to develop water supply watershed ordinances for the lower watershed that will allow denser development where certain additional conditions are met. The rules also require comprehensive stormwater plans for all governments within the watershed and special land use analyses in the Oak Hollow Lake, High Point Lake, and Deep River 1 subwatersheds.

Randleman Lake rules can be downloaded in pdf format from the N.C. Division of Water Quality website at http://h2o.enr.state.nc.us/RandlemanWP.pdf. Unless the General Assembly acts to block or revise the rules, they become effective April 1, 1999.

Regular December meeting

At its regular meeting on December 10, 1998, the EMC took the following action:

- Approved the Division of Water Quality's (DWQ) plan for awarding nearly $23 million in loans to local governments from the 1999 State Revolving Loan Fund for constructing wastewater treatment facilities; approved an Emergency Revolving Loan for the Town of King to repair a force main; and approved Supplemental Revolving Loans for the Water and Sewer Authority of Cabarrus County, the Town of Shallotte, the City of Fayetteville, and the Piedmont Triad Water Authority on behalf of the City of High Point. High Point had already been approved for $15 million in loans for upgrading and expanding its Eastside Wastewater Treatment Plan. An additional $5 million loan was approved to help with the cost of moving the plant's discharge location as required by the Randleman Lake rules.

- After much discussion, approved a request for a variance from the Neuse River Riparian Area Protection Rule for Northclift Townhomes in Raleigh. Urban stream erosion is threatening a structure at the townhomes, and the owner wants to relocate the stream to remove the threat. The relocation will require destruction and reconstruction of riparian buffer areas. Review and discussion of the merits and potential problems with engineering plans for the project led commissioners into the domain of local planning boards and commissions. The direction of the discussion seemed to disturb some commissioners and led Commissioner Douglas Boykin to ask staff if the EMC would be seeing similar prob-

lems in other places. DWQ staffer John Dorney told commissioners that they are likely to see many similar situations in urban areas where development is causing accelerated streambank erosion and making preservation of riparian areas problematic.

■ Confirmed reappointment of Susan Rexrode to the Water Pollution Control System Operators Certification Commission and appointment of Coleen Sullins, Chief of the Water Quality Section of DWQ, as chair of the commission.

■ Approved, with amendments, a Special Order by Consent (SOC) agreement between the commission and Metal Industrial, Inc. of Marion providing the business time and temporary regulatory relief to evaluate, design, and construct facilities to eliminate its discharge to Mackey Creek in the Catawba River Basin. In spite of previous efforts, the company has been unable to bring its discharge into compliance with toxicity limits. The SOC was opposed by the Lake James Environmental Association, Inc. of Nebo, and amendments to the SOC shortened the timeframe for compliance and provided that toxicity may not be increased during the time of the SOC.

■ Approved the first five-year update of the Neuse River Basinwide Water Quality Plan.

■ Approved holding public hearings on reclassification of Wesser Creek in Swain County from Class C to Class C Trout, of Rough Creek in Haywood County as Outstanding Resource Waters, of Green River in Henderson County for primary recreation and as High Quality Waters, and of Little Grassy Creek in Avery County as Outstanding Resource Waters. Dates have tentatively been set for the public hearings in May 1999. For information, contact Liz Kovasckitz with the Division of Water Quality at (919) 733-5083, Ext 572.

■ Upheld an Administrative Law Judge's decision to dismiss a contested case brought by the Hickory Alliance against the Department of Environment and Natural Resources and Godfrey Lumber Company Inc. The company had filled 80 feet of a tributary of the Dan River in Stokes County to build a road crossing for a planned chip mill before filing for a 401 Water Quality Certification for the project. DWQ issued 401 certification after the fact, and Hickory Alliance petitioned for a contested case hearing to determine if the issuance was lawful.

Basinwide planning workshops scheduled

The N.C. Division of Water Quality is updating the basinwide water quality plan for the Catawba River Basin. The following public workshops have been scheduled to take comment and present information on the Catawba River plan:

January 19, 1999—9 am to noon
Newton
Workshop on Upper Catawba Basin organized by the Western Piedmont Council of Governments

January 20, 1999—8 am to noon
Cooperative Extension Auditorium, Hal Marshall Center, **Charlotte**
Workshop on Lower Catawba Basin

January 21, 1999—8 am to noon
Belmont Abby College Commons
Belmont
Workshop on Lower Catawba Basin

Workshops for the Lumber River Basinwide Water Quality Plan update are being scheduled for February. For information on the Catawba or Lumber workshops, contact Darlene Kucken with the Division of Water Quality at (919) 733-5083 Ext 354.

DWR will ask for rulemaking on Capacity Use Area in Central Coastal Plain

At the December 9, 1998, meeting of the N.C. Environmental Management Commission's Groundwater Committee, the Director of the N.C. Division of Water Resources (DWR) said that in February he will ask the committee to recommend initiating rulemaking to declare 15 counties in the Coastal Plain under the State's Capacity Use Area Designation. John Morris said that his staff has detected dewatering of the Black Creek and Upper Cape Fear aquifers being used for public water supply and other purposes in Beaufort, Carteret, Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pamlico, Pitt, Washington, Wayne and Wilson counties. He said he will present draft rules to the committee in February to delineate these counties as a Capacity Use Area under N.C. General Statute 150B and to regulate water use in the area through permitting of withdrawals.

DWR has prepared a ***Central Coastal Plain Capacity Use Investigation Report*** which can be obtained by calling the division at (919) 733-4064.

Soil and Water Conservation Commission approves changes to address animal waste plan deficiencies

At its November 1998 meeting, the N.C. Soil and Water Conservation Commission approved creation of two new categories of "Designated Technical Specialists" who are authorized to design components of animal waste management plans. To be authorized for the new categories, technical specialists will have to receive training on how to calculate "wettable acres." The new categories and training were proposed when it came to light during N.C. Division of Soil and Water Conservation (DSWC) operational reviews that

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WRRI report available

WRRI has recently published peer-reviewed reports on projects for which it provided funding. Single copies of WRRI reports are available free to federal/state water resource agencies, state water resources research institutes, and other water research institutions with which exchange agreements have been made. Single copies of publications are available to North Carolina residents at a cost of $4 per copy prepaid ($6 per copy if billed) and to nonresidents at a cost of $8 per copy prepaid ($10 per copy if billed). Send requests to WRRI, Box 7912, NCSU, Raleigh, NC 27695-7912 or call (919) 515-2815, or Email: water_resources@ncsu.edu.

A New Method for Characterizing Aquatic Organic Matter
Report 319 November 1998

Russell F. Christman, Jian Shi, David Wagoner, Charles Sharpless, Eric Fischer, Jason Schupbach
Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill

Some disinfection by-products (DBPs), the results of chlorination of drinking water, have been shown to be carcinogenic or mutagenic. The type of DBPs produced by the effect of chlorine on organic matter varies depending on the type of natural organic matter (NOM) it contacts, the location of the contact, and even the season of the year.

This study was designed to look at differences between water samples of different origins with respect to the organic material in them to see whether or not NOM from one terrestrial surface water source (autochthonous NOM) can be distinguished from NOM transferred into a body of water from the watershed (allochthonous NOM).

NOM was isolated from four North Carolina water supplies using a reverse osmosis technique, and subjected to a variety of physico-chemical measurements to evaluate the hypothesis that autochthonous NOM would be distinguishable from allochthonous NOM.

Measurements included chromatographic behavior using size exclusion membranes and reverse phase high performance liquid chromatography; various forms of spectroscopy; elemental

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Animal waste plan deficiencies *continued*

the total acres in some waste application fields were included in plans even though waste was not applied to the entire field. The problem occurred because calculations of waste application areas in nutrient management plans did not take into account odd-shaped fields, such things as field borders and grassed waterways, or the limitations of irrigation equipment. The new designations are "Waste Utilization Plan/Wettable Acres" and "Irrigation/Wettable Acres." According to Carroll Pierce with the DSWC some existing animal waste management plans will have to be revised to correct deficiencies in land application area. Pierce said the plans will be corrected as DSWC and the N.C. Division of Water Quality conduct operational reviews and inspections.

North Carolina Precipitation/Water Resources

	November	December
Rainfall (+/- average)		
Asheville	2.76" (-0.83")	3.04"(-0.48")
Charlotte	2.28" (-0.95")	3.28"(-0.20")
Greensboro	1.55" (-1.42")	5.22" (+1.86")
Raleigh	2.40" (+0.58")	3.44" (+0.20")
Wilmington	0.97" (-2.14")	3.96" (-0.33")

Streamflow Index Station (County, Basin)	November mean flow (CFS) (% of long-term median)	December mean flow (CFS) (% of long-term median)
Valley River at Tomotla (Cherokee, Hiwassee	72 (54%)	156 (68%)
Oconaluftee River at Birdtown (Swain, Tenn)	170 (45%)	430 (82%)
French Broad River at Asheville (Buncombe, FB)	917 (56%)	1,060(52%)
South Fork New near Jefferson (Ashe, New)	149 (42%)	236 (51%)
Elk Creek at Elkville (Wilkes, Yadkin/Pee-Dee)	24 (38%)	35 (40%)
Fisher River near Copeland (Surry, Yadkin/Pee-Dee)	75.2 (54%)	126 (77%)
South Yadkin River near Mocksville (Rowan, Yadkin/PD)	113 (48%)	182 (56%)
Rocky River near Norwood (Stanly, Yadkin/Pee-Dee)	146 (29%)	628 (56%)
Deep River near Moncure (Lee, Cape Fear)	135 (37%)	560 (51%)
Black River near Tomahawk (Sampson, Cape Fear)	94.3 (28%)	295 (41%)
Trent River near Trenton (Jones, Neuse)	23.1 (41%)	62.2 (43%)
Lumber River near Boardman (Robeson, Lumber)	382 (49%)	665 (55%)
Little Fishing Creek near White Oak (Halifax, Pamlico	) 24.1 (39%)	83.4 (56%)
Potecasi Creek near Union (Hertford, Chowan)	39.7 (106%)	82.1 (56%)

Groundwater Index well (Province)	November depth below surface (ft) (departure from average for month)	December depth below surface (ft) (departure from average for month)
Blantyre (Blue Ridge)	34.39 (-0.84)	34.77 (-1.39)
Mocksville (Piedmont)	17.73 (-0.24)	17.57 (-0.59)
Simpson (Coastal Plain)	4.19 (+0.75)	2.61 (+1.32)

Source: U.S. Geological Survey's *Water Resources Conditions in North Carolina*

analysis; amino acid content; DBP production; and molecular weight and radius by laser light scattering.

The general physical and chemical properties of isolated NOM from the four lake samples examined in this study were remarkably similar. It is an open question whether this similarity is genuine or an artifact of the isolation procedure.

However, a significant difference was observed between the allochthonous and autochthonous NOM samples with respect to DBP production. NOM from the two allochthonous sources yielded greater total trihalomethane, total haloacetic acid, and total halogenated compound production per unit of carbon than NOM from the two authochthonous sources. The same was true for total haloacetonitrile production and total hydrolyzable amino acid, except the relative production of the two autochthonous sources was reversed.

The baseline question remains open. NOM from marine sources can be distinguished from fresh water sources, just as soil, peat, or coal organic matter can be distinguished from either of these. However, distinction of samples within the fresh water source category is harder to produce. Present physical and chemical methods are relatively insensitive to differences in NOM properties within a category of source. Nevertheless, the research in this report suggests that it may be possible to distinguish autochthonous NOM from that which is imported.

RECOMMENDATIONS

The authors say that to move closer to distinguishing types of NOM in fresh water, more sensitive methodology must be developed and additional studies must be performed on seasonal influences.

Recommendations for methodological improvements include using multiple isolation techniques to concentrate smaller samples of water to obtain required carbon substrate and comparing acid hydrolyzable amino acids and enzyme hydrolyzable carbohydrates from NOM isolated from a single source on a monthly sampling basis.

1999 Annual North Carolina Water Resources Research Conference

March 25, 1999

N.C. State University McKimmon Center, Raleigh, NC

Registration: $35 ($15 for students)

This conference will highlight all water resources research that is being conducted in North Carolina and provide an opportunity for researchers to meet and discuss their work with others interested in water research. University and other researchers, representatives from local, state and federal agencies, and industrial and agricultural representatives should attend this conference to gain current information on research that is addressing water resource issues. Last year's conference attracted more than 400.

This year's plenary session will address the topic "Meeting N.C. Water Supply Needs" with two invited speakers: Dr. David H. Moreau, Chairman of the N.C. Environmental Management Commission and Professor and Chair of City and Regional Planning at UNC-Chapel Hill; and Mr. John Kime, Director of the Piedmont Triad Regional Water Authority. Potential topics include: ■ Water Supply Issues ■ Environmental Risk Assessment ■ Nutrient Management ■ Environmental Effects of Structural Controls ■ Aquatic Habitat Restoration ■ Novel Measurement Techniques and ■ Flood Plain Issues. Space is available for 20 posters (6-foot tables will be provided)

A brochure will be mailed in February to those on the WRRI News mailing list. Registration information and an agenda will also be posted on the WRRI website at http://www2.ncsu.edu/ncsu/CIL/WRRI. You may also call WRRI at (919) 515-2815 and request a brochure.

Mountain Water Resources: Understanding and Management Conference

April 27, 1999

Asheville Radisson, Asheville, NC

Registration: $30 ($10 for students)

This conference will highlight water resources research being conducted in the mountain region of North Carolina and provide an opportunity for mountain researchers to meet and discuss their work with others interested in water research. University researchers, government agencies, and industrial and agricultural representatives in the mountain region of North Carolina should attend this conference to gain current information on research that is addressing mountain water resource issues. This conference will be different from the March 25, 1999, WRRI Annual Conference and only address mountain issues and research. The Plenary session will specifically focus on water resource issues in the mountain region of North Carolina. Plenary speakers are Forrest Westall of the N.C. Division of Water Quality, Tom Massie of the N.C. Clean Water Management Trust Fund, and Steve Reed of the N.C. Division of Water Resources.

Concurrent sessions will focus on ■ Flow Management and Riparian Areas ■ Wetland and Aquatic Habitat ■ Economic and Health Issues ■ Water and Wastewater ■ Groundwater ■ Economic Issues ■ Atmospheric Issues ■ Erosion and Sediment Control ■ Water Quality and Storm Water and ■ Atmospheric Impacts.

A brochure will be mailed in February but will be mailed only to individuals in the western portion of North Carolina. However, if you are interested in attending please contact WRRI at (919) 515-2815 or visit our website at http://www2.ncsu.edu/ncsu/CIL/WRRI.

Project Learning Tree offers environmental and human health risk curriculum for high school and young adults

Project Learning Tree (PLT), sponsored nationally by the American Forest Foundation with the Council for Environmental Education, has just released the latest in its series of environmental science curricula for secondary schools—*Exploring Environmental Issues: Focus on Risk*. The module provides educators activities to help students learn the rationale for and mechanics of risk assessment, risk management, and risk communication. The focus is on teaching students *how* to think about complex environmental issues, and activities are geared to developing skills in problem solving, decision making, and following the methods of inquiry and tools used by risk assessors. While the module is designed for educators of youth in grades 9-12, with some adaptation it can be used in introductory college courses. Disciplines addressed include chemistry, civics, ecology, environmental science, geography, health, language arts, math, physics and social studies.

Focus on Risk follows PLT's other secondary curricula: *Focus on Forests, Forest Ecology, and Municipal Solid Waste*.

In North Carolina PLT is sponsored by the N.C. Division of Forest Resources, the N.C. Forestry Association, and N.C. State University Forestry Extension. According to Scott Payne, with NCSU Forestry Extension, his organization will fund coordination of the curricula with the State secondary science curriculum and make the curricula available to secondary teachers probably by fall 1999. Anyone interested in the curricula can obtain a copy of any one by participating in a workshop focusing on the specific curriculum. For information on workshop scheduling, contact Scott Payne, NCSU Forestry Extension, Box 8003, NCSU, Raleigh, NC 27695-8003; Phone: (919) 515-9606; Email Scott_Payne@ncsu.edu.

North Carolina Water Resources Association

NCWRA

North Carolina Section of the American Water Resources Association

Luncheon and Forum Schedule

Feb 22, 1999	Sediment: New Approaches to Reducing Impacts
April 12, 1999	Wetlands Restoration and Related Programs
Sept 13, 1999	Stormwater: NPDES Phase II and Neuse River Rules
Dec 6, 1999	Cape Fear Basin Water Quality Issues

All luncheon/forum take place at 11:30 am at the Jane S. McKimmon Center on the N.C. State University campus. For additional information call Robert Holman at WRRI (919 515-2815).

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