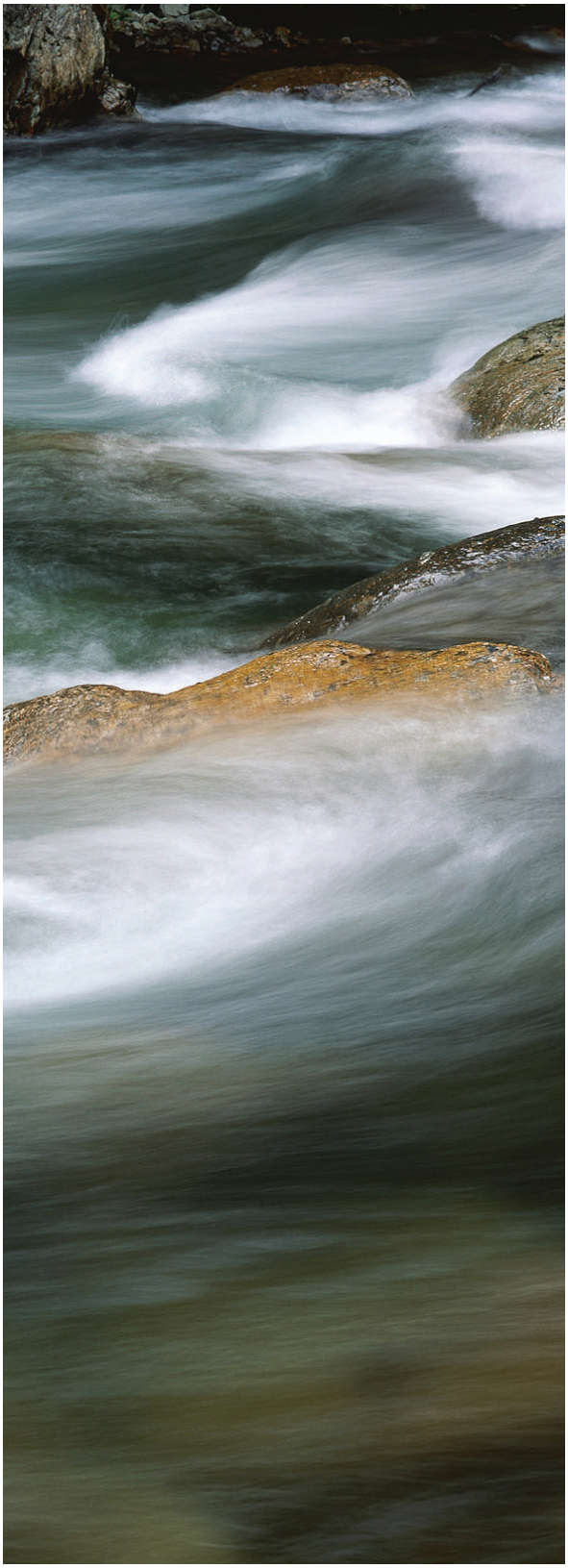

The Future of Water in North Carolina:

Strategies for Sustaining Clean and Abundant Water

Conference Report

Bill Holman
Leslie Kleczek
Eben Polk

August 2007

NICHOLAS INSTITUTE
FOR ENVIRONMENTAL POLICY SOLUTIONS
DUKE UNIVERSITY

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About the Nicholas Institute: The Nicholas Institute for Environmental Policy Solutions was founded in 2005 to engage with decision makers in government, the private sector, and the nonprofit community to develop innovative proposals that address critical environmental challenges. The Institute will address the demand for high-quality and timely data relevant to these pressing environmental problems. It seeks to act as an "honest broker" in policy debates by fostering open, ongoing dialogue between stakeholders on all sides of the issues and policy-relevant analysis based on academic research. The Institute's staff leverages the broad expertise of Duke University as well as public and private partners nationwide. The Nicholas Institute's mission is to become a leading source of effective solutions to critical environmental problems—by providing decision makers in the public and private sectors with unbiased evaluations of policy risks and rewards, and innovative, practical ideas for meeting complex challenges.

Disclaimer: This conference report reflects the views of its authors and not necessarily the views of sponsoring partners. Any errors are the responsibility of the authors.

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Executive Summary

On March 1st, 2007, in Raleigh, North Carolina, Duke University's Nicholas Institute for Environmental Policy Solutions convened the conference "The Future of Water in North Carolina: Strategies for Sustaining Abundant and Clean Water". Approximately 200 people attended representing a diverse mix of local and state government, industries, consulting firms, universities, and environmental organizations. The conference featured an opening address by Lieutenant Governor Beverly Perdue and a lunchtime keynote address by former Secretary of the Interior Bruce Babbitt. Experts from a variety of fields and regions presented strategies for managing water resources. A closing summary panel distilled the main insights from the day and provided an opportunity for audience participation.

The conference posed questions and provided many ideas pertaining to the long-term future of North Carolina's water resources. In this report, the key points of convergence drawn from the conference are presented. The findings do not represent complete consensus but reflect the general direction of the discussion. Each point of convergence is paired with a recommendation for North Carolina's water policy and summarized below.

Registration, measurement, and regular reporting of water use are essential to sustainable management of water resources. North Carolina should require all major users of surface and groundwater to register and report their use. The State, moreover, should compile this data into easily accessible formats and report regularly to the legislature and the public. (Page 6)

Land use decisions affect the quality and quantity of our water resources. North Carolina should systematically integrate state and local land use and water policies and funding. (Page 8)

Green infrastructure – our forests, farms, wetlands, floodplains, natural areas and riparian buffers – is a vital economic and ecological component of our state's long-term prosperity. In recognition of the essential services these resources provide, North Carolina should improve its prioritization and protection of green infrastructure. (Page 10)

Market-based approaches that put a dollar value on the services provided by natural resources and ecosystems (ecosystem services) have potential to improve and protect water resources. North Carolina should reevaluate and consider how to improve nutrient trading and other market-based approaches, to complement existing water quality regulations and incentive-based programs. (Page 12)

Greater efficiency in water use and reuse can sustain water resources, reduce conflicts, and reduce risks during droughts. North Carolina should commission a study of the potential for improved state-wide water use efficiency and reuse, including the role of water pricing, to improve the sustainability of water use in the state. (Page 14)

Climate change is an added challenge to sustainable water resources management. North Carolina must anticipate, plan for, and adapt to the water resource impacts of climate change. (Page 17)

Conference Summary

Featured Speakers

Lieutenant Governor Beverly Perdue opened the day by recognizing North Carolina's history of innovation in water management, including the creation of the Clean Water Management Trust Fund in 1996, the passage of the Clean Water Responsibility Act in 1997, $800 million worth of Clean Water Bonds in 1998, and potentially more clean water bonds forthcoming in 2007. Despite these achievements, however, she emphasized that there is still much to be done. With population and water use increasing, North Carolina is in need of a comprehensive strategy for protecting and distributing water over the next 50 years. The Lieutenant Governor recognized that economic development and environmental protection must go hand in hand. She welcomed the River Dunes project on the Neuse River in Pamlico County as a development that attempts to balance economic goals with good planning to protect water quality and maintain the environmental integrity of the coast.[1] In closing, Lieutenant Governor Perdue stated that in beginning a serious long-term, strategic discussion of water management the challenge will be finding ways to make critical decisions in a timely fashion.

Former Secretary of the Interior and former Governor of Arizona Bruce Babbitt offered qualified praise to North Carolina during his lunchtime address. For such efforts as reducing nutrients in the Neuse and Tar-Pamlico River basins, he said "you're a little ahead of other states, but that is not saying much." Secretary Babbitt discussed his goal as Secretary of the Interior to remove dams and restore aquatic habitats, beginning with Progress Energy's Quaker Neck Dam on the Neuse River. He also recounted his involvement in moving the Cape Hatteras Lighthouse, a project undertaken to preserve the historic landmark in the face of rising sea levels. Secretary Babbitt repeatedly stressed that state and local land use decisions affect water quality and quantity, and that planning decisions and policies should account for this. He discussed, too, the concept of conditionality, where approval or funding of a proposed project would be contingent upon meeting conditions for environmental performance. He cited this as an effective method for ensuring compliance with regulation while simultaneously promoting creative problem-solving.

Green Infrastructure Panel

In light of continuing rapid growth and development in the state, and limited financial resources, this panel highlighted that land trusts, local governments, state organizations and other organizations involved in land conservation need to work together to develop a strategic, prioritized plan that identifies lands that are most crucial to protect and restore water quality. Such a plan should help funders, land trusts, and partners identify what lands to protect first with limited resources.

- *Wink Hastings* from EPA's Chesapeake Bay Program[2] presented that program's pioneering plan for protection and restoration of valuable green infrastructure. The work done as part of this project could serve as a model for similar projects in other regions.
- *Richard Whisnant*, from UNC-Chapel Hill's School of Government, discussed the numerous land protection and conservation organizations across North Carolina, including the Million Acre

[1] For more information: http://www.riverdunes.com/index.asp
[2] http://www.chesapeakebay.net/index.cfm

Initiative[3], pointing out that there has been an increase in the rate of land conservation in North Carolina but development is occurring twice as fast.

- *Linda Pearsall*, from the North Carolina Natural Heritage Program, described the One North Carolina Naturally program[4] which is creating a coordinated system of maps for the entire State, reflecting conservation efforts, partnerships, and areas of high conservation priority.
- *Curt Richardson*, in the Nicholas School of the Environment and Earth Sciences at Duke University, presented tools for prioritizing wetlands for restoration. The tool bases prioritization on the potential water quality benefits from restoration and the land owner's willingness to participate. The Wetland Center at Duke[5] used these models to map potential wetland restoration sites in the Lower Cape Fear River Basin.

Valuing Water: From Ecosystem Services to Efficiency Panel

This panel featured speakers with expertise in different aspects of valuing water and natural resources. Presentations included an overview of the benefits of improving water use efficiency, the importance of rate structures, and the potential for nutrient trading and other ecosystem service markets.

- *Heather Cooley* from the Pacific Institute in Oakland, California, presented a study that found California could reduce urban water use 33% by implementing water use efficiency measures. She argued that there is potential for North Carolina to pursue similar water use efficiency goals.
- *Jeff Hughes* from UNC-Chapel Hill's Environmental Finance Center discussed water utility rate structures and the often under-valued services of green and grey (pipes and pumps) infrastructure required to distribute and treat water. His research shows that rates send clear messages to users regarding how they are to value water as a resource. He pointed out there is a wide variety of rates across the state. Setting rates requires significant knowledge of the customer base.
- *Len Shabman*, of Resources for the Future, discussed his work with ecosystem service markets. A true market for ecosystem services must have a cap or ceiling limiting pollutants or runoff, and be performance-based. Dischargers and landowners should be rewarded for actual improvements in ecosystem functions, such as moderating or protecting natural stream flows or reducing or avoiding nutrient loading. In North Carolina this would mean paying for performance achieved through the nutrient trading and wetland and stream mitigation programs, rather than the current system of paying for best management practices.
- *Mark Kieser*, of Kieser and Associates and the Environmental Trading Network, shared lessons learned from water quality trading programs across the country. Environmental markets that have successful trading programs generally include: a mix of regulatory drivers and market opportunities; enforceable caps; sufficient supply and demand; ability to provide multiple environmental commodities (e.g., nutrients, sediment, carbon, or habitat); and a system to ensure consistent and standardized metrics for outcomes across all programs.

Regulatory Leverage Points Panel

This panel identified a few ways in which the state of North Carolina is currently pursuing and could purse better management of resources using existing and new regulations.

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[3] http://www.onencnaturally.org/pages/home/home.html
[4] http://www.onencnaturally.org/
[5] http://www.nicholas.duke.edu/wetland/

- According to *Barbara Goldberg*, a former Arizona water attorney, North Carolina can take cues from Arizona's example. Arizona passed innovative performance-based laws to protect scarce groundwater resources in the 1990s. Leadership by then-governor Bruce Babbitt, pressure from population growth, and federal requirements forced state legislators to act.
- *Avner Vengosh*, from the Earth and Ocean Sciences division of the Nicholas School of the Environment and Earth Sciences at Duke University, discussed the need for better monitoring for naturally occurring contaminants in groundwater. In several areas of the state, the levels of natural contaminants in ground water, including radon, arsenic, and radium, exceed drinking water standards. There is no system in North Carolina for monitoring the more than two million existing private wells.
- *Chris Beacham* with the NC Department of Commerce expressed the interest of his department in achieving environmental protection in concert with economic growth. A particular challenge he highlighted is that economic and environmental planners use different maps and data sets for planning.
- *Sydney Miller* from the Triangle J Council of Governments discussed the numerous programs and regulations in North Carolina that can be implemented more effectively including Basinwide Water Quality Plans, Local Water Supply Plans, National Pollutant Discharge Elimination Systems, the Regulation of Surface Water Transfers, Monitoring and Capacity Use Areas. Assembling these numerous tools into a comprehensive state-wide plan could lead to better decisions about water allocation and resource protection.

The conference closed with a summary session. Representatives from various stakeholder groups were invited to offer reactions to the day's proceedings to determine areas of potential collaboration and areas that present barriers to better water resource management. Several points of convergence were distilled that present opportunities for further research, analysis, and policy development. The following sections summarize these points, including why they require further attention, and ideas for policy development.

Points of Convergence

Registration, measurement, and regular reporting of water use are essential to sustainable management of water resources.

Historically, water use in North Carolina has been based on common law riparian rights under which landowners adjacent to a body of water have the right to 'make reasonable use of it', according to their own interpretation of the phrase. As demand began to outstrip supplies, however, the General Assembly required some registration and reporting of some water uses. Currently, the aspects of water use and distribution that are regulated in North Carolina include:

- Non-agricultural users who withdraw 100,000 gallons per day or more of water from surface or groundwater and agricultural users who withdraw one million gallons or more in any one day of ground or surface water must register every five years with the State Division of Water Resources. (General Statute 143-214.22H)
- Local Water Supply Plans require local governments providing public water to 3,000 or more individuals to update plans every five years to reflect current and projected population, water

use, water supplies, and emergency response procedures and submit them to the NC Division of Water Resources. (General Statute 143-355(l))

In March this year the Environmental Management Commission also finalized rules implementing HB 1215 (SL-2002-167). Under the rules, entities that must register withdrawals and systems that prepare Local Water Supply Plans must also report monthly and average daily water use on an annual basis, and develop water shortage response plans. Forthcoming reporting should improve the basis for future water allocation and management decisions.

There are also a number of smaller-scale water use registration, measurement, and reporting regulations and programs in North Carolina.[6]

- **NC Capacity Use Act of 1967**, of which the Central Coastal Plain Capacity Use Area is the major example. The Central Coastal Plain Capacity Use Area encompasses 15 southeastern counties and requires a combination of regular reporting and measurement with gradual cut-backs of water use to address declining ground water levels.
- **NC Interbasin Transfer Act of 1993, as amended in 2007,** requires the Environmental Management Commission to approve any transfer of surface waters greater than two million gallons per day between the 17 major river basins and 21 sub-basins.
- **Federal Energy Regulatory Commission (FERC) Re-Licensing** for large hydroelectric dams requires habitat improvement, stream flow improvement for water quality, water supply and waste assimilation, and detailed record-keeping of water levels and flows. Power companies in the Roanoke, Yadkin-Pee Dee, Catawba, Little Tennessee and Hiwassee River basins have been re-licensed or have applied for re-licensing. The States of Virginia, South Carolina and Tennessee are also involved in FERC re-licensing.
- **Federal Tennessee Valley Act (TVA) regulates structures** in tributaries of the Tennessee River in western North Carolina, including the Hiwassee, the Little Tennessee, the French Broad, and the Wataugua. This includes any physical feature in contact with the river or adjoining lands such as intake and discharge pipes or dams. The TVA maintains records of water withdrawals and use in these tributaries.
- **US Army Corps of Engineers** builds, operates, maintains, and manages locks, dams, and lakes on the Yadkin, Cape Fear, Neuse, and Roanoke Rivers, all of which are managed by contracts and pursuant to state regulations.

These programs provide important data and information for water managers and can be adapted to different river basins and local situations. They result, however, in a piecemeal state and federal approach to management of water resources.

As the state's population grows and conflicts over water allocations grow, the critical question of how to ensure enough clean water for all is becoming increasingly important. Is it time to develop a comprehensive system for permitting and managing water withdrawals? How can existing laws and programs be made more effective? The 2007 General Assembly directed the legislature's Environmental Review Commission to study the allocation of water resources and the transfer of water from one river basin to another in the Amend Interbasin Transfer Law, HB 820.

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[6] Courtesy of Milton Heath, UNC-Chapel Hill School of Government. Forthcoming publication in Water Resources Law Bulletin.

North Carolina water policy also reflects fragmented governance of water resources. For example, the complex but crucial relationship between ground and surface water is not addressed in North Carolina statutes or policies. Consequently, they are managed as two separate sources – an approach that hinders proper management of high quality ground and surface supplies. To adequately and sustainably allocate water supplies on behalf of all users requires that our understanding of water resources be accurately reflected in policy and practice.

Recommendation
Given the gaps in our existing policies for tracking water use, and the need for more detailed assessment of our use, an evaluation of North Carolina's water use framework, including policies for tracking and allocating use, is needed. This is necessary to ensure that North Carolina can accommodate increased demand, incorporate new knowledge of how to protect water quality, quantity, and habitat, and establish criteria for sustainable management of water resources. Additionally, evaluation of water law could identify data gaps in measurement and reporting, necessary to help private and public decision makers in short- and long-term planning. This, in turn, will help prevent crises in water scarcity due to population growth, drought, and climate change.

Land use decisions affect the quality and quantity of our water resources.

Former Arizona Governor and US Secretary of the Interior Bruce Babbitt plainly told North Carolinians, "Land use decisions affect water quality." He acknowledged this is not a politically savvy thing to say and joked that he was obviously not seeking any further elected office.

Standard approaches to development generate and rely heavily upon impervious surfaces by virtue of their siting, location, and materials. They also can introduce new sources of pollution from sediment and nutrients. An average of 100,000 acres per year of farm and forestland in North Carolina are converted to development, or about 1,000,000 acres per decade – affecting both water quality and quantity. Impervious surface prevents infiltration of precipitation to groundwater, which increases peak flood levels and inhibits the gradual release of groundwater into streams. Moreover, impervious surfaces increase both the volume and velocity of polluted runoff. Erosion and sedimentation smother life in streams, fill reservoirs with sediment, and reduce water storage capacity.

Further, conventional approaches to development and agriculture frequently destroy riparian buffers, drain and fill floodplains and wetlands, and channel and bury streams in culverts. These impacts increase flooding and prevent natural filtering and buffering of runoff.

Viable alternatives to high-impact development and agriculture exist. Land can be farmed, timbered, or developed in ways that minimize impacts to water quality and quantity. Best management practices and regulations exist for low-impact farming, forestry, and development.

Land use and its effects on water quality and quantity were topics interwoven throughout the conference discussion. Conference participants agreed that land use planning and regulation along with investments in both green and grey infrastructure should be carried out at a watershed level. A major challenge is that local governments do not align with watershed boundaries.

North Carolina has a history of grappling with the land use-water resources relationship. The 1989 General Assembly recognized that land use decisions affect water quality and quantity when it enacted the Water Supply Watershed Protection Act. The Watershed Protection Act established minimum statewide standards to protect surface drinking water supplies. The NC Environmental Management Commission adopted 30 foot riparian buffers, stormwater rules, and other measures to implement the Act.

After massive fish kills in the Tar-Pamlico and Neuse Rivers in the 1990s, the Environmental Management Commission (EMC) adopted rules to protect existing forested riparian buffers 50 feet from streams, and to reduce nitrogen from wastewater treatment plants in these river basins. The EMC also adopted stormwater management rules for these river basins.

In 1998 the General Assembly encouraged local governments to adopt land use plans by tying these plans to eligibility for grants from the $800,000,000 Clean Water Bonds. The 2005 General Assembly expanded these incentives and encouraged local governments to adopt comprehensive land use plans, flood hazard ordinances, capital improvement plans, and coastal habitat protection plans in Session Law 2005-454 (HB 1095). The 2007 General Assembly debated another clean water bond and appropriated $100,000,000 in one time funds to the Rural Economic Development Center for drinking water and wastewater projects. The funds appropriated to the Rural Center continue the incentives for land use planning set out in Session Law 2005-454. These incentives are examples of the conditionality approach discussed by former Secretary Babbitt in his keynote address.

The Upper Neuse Clean Water Initiative to help protect Falls Lake and other drinking water supplies, driven by support from local governments and other stakeholders, may provide a new model for planning at the watershed level. It builds on the minimum state and local watershed protection rules, and provides incentives with local and Clean Water Management Trust Fund monies to help landowners go beyond compliance with the minimum rules. In this model, downstream water users are helping to support upstream activities to maintain the quantity and quality of their supplies.

Rules which have been under development for almost ten years to reduce levels of nitrogen and phosphorus from all sources in Jordan Lake and the Upper Cape Fear Watershed may be a warning for what happens when planning is not undertaken and consensus is not reached. The proposed Jordan Lake rules not only require stormwater controls on new development (cost effective and relatively inexpensive) but also contemplate retrofitting stormwater controls in existing developed areas (very expensive). Jordan Lake illustrates not only a cumbersome process but also the higher cost of failing to address land use and water quality from the start—costs in both dollars and in water resource impairment. The NC Division of Water Quality estimates the costs to retrofit existing development in the Upper Cape Fear/Jordan Lake Watershed could reach approximately $550 million—the most expensive component of rules proposed to protect and restore Jordan Lake.

Recommendation

State, local and private land use decisions affect water quality and quantity. Effective planning, regulations, incentives, and education are all needed at the state and local levels to systematically integrate land use and water resource decisions. For example: 1) state river basin plans for water quality and quantity should project expected changes in land use and impacts on water quality and quantity; 2) local ordinances regulating development should better address stormwater runoff and the potential for flooding; 3) state economic development planning should consider water

constraints; and 4) both state and local governments should use the conditionality approach, where approval or funding of a proposed project would be contingent upon meeting conditions for environmental performance.

Green infrastructure - our forests, farms, wetlands, floodplains, natural areas and riparian buffers - is a vital economic and ecological component of our state's long-term prosperity.

Our forests, farms, wetlands, floodplains, natural areas, and riparian buffers are the "green infrastructure" of North Carolina. The concept of green infrastructure is a way to recognize that open space and well-managed working lands including forests and farms are necessary components of healthy communities. The US Forest Service, for its part, defines green infrastructure as "an interconnected network of protected land and water that supports species, maintains natural processes, sustains air and water resources, and sustains health and quality of human life."

Green infrastructure is essential to the state's environmental and economic health and to water quality and quantity. It can be protected and restored with incentives, education, and regulation. North Carolina has undertaken a number of activities to identify and protect green infrastructure, particularly for its water quality benefits. These efforts are led by many agencies and organizations, but are not linked together in a comprehensive prioritized plan.

- River basin assessment -- the NC Environmental Management Commission and Division of Water Quality currently develop and adopt plans for each river basin every five years.
- Drinking water source assessment -- the NC Division of Environmental Health conducts source water assessments to identify potential threats to drinking water supplies.
- Watershed restoration planning -- the Ecosystem Enhancement Program identifies sites for wetland, stream and buffer restoration.
- Water quality funding -- the Clean Water Management Trust Fund (CWMTF) has funded the development of riparian corridor conservation plans by local land trusts.
- Coastal habitat protection planning -- the Division of Marine Fisheries works with the Divisions of Coastal Management and Water Quality to protect fisheries habitat.
- Water quality on working lands -- the Division of Soil & Water Conservation's Conservation Reserve and Enhancement Program (CREP) provides financial incentives to help landowners go beyond compliance with minimum state water quality regulations to protect stream buffers and wetlands in some river basins.
- Flood hazard mitigation -- the NC Division of Emergency Management has worked with some local governments to develop flood hazard mitigation plans.

The Land for Tomorrow coalition asked the 2007 General Assembly to increase funding for the state's four conservation trust funds[7] by $200 million per year for five years, and proposed a new community development initiative called Landing Jobs.[8] The General Assembly appropriated $128 million for fiscal year 2007-2008. Some local governments, such as Mecklenburg and Wake Counties, are considering local bond referenda for land and water conservation in 2007.

[7] Clean Water Management Trust Fund, Natural Heritage Trust Fund, Parks and Recreation Trust Fund, Agricultural Development and Farmland Preservation Trust Fund.
[8] www.landfortomorrow.org

The Department of Environment and Natural Resources (DENR) recognizes the need to develop a statewide conservation strategy and has adopted a green infrastructure approach. It has begun developing the Strategic Conservation Plan for North Carolina to provide a more comprehensive framework for green infrastructure planning and to address conservation of natural areas, land for recreation, conservation of working farms and forests, and protection and restoration of coastal habitats.[9]

At the conference, Linda Pearsall, then Director of the Natural Heritage Program and now Interim Assistant Secretary for Natural Resources at the NC Department of Environment and Natural Resources (DENR), said that DENR plans to complete the first draft of its strategic conservation plan in the summer of 2007. The draft will identify places important for maintaining biological diversity and water resources, pulling together data from across the state for these and other resources, including working lands and recreation. A second draft of the plan will identify opportunities for restoration of riparian buffers, wetlands, and ecosystems. The plan should serve as a unified prioritization tool for public and private conservation and restoration initiatives. (See Appendix A for more details.)

The plan will almost certainly identify more conservation needs than public and private funds can address in the short run. Review of the plan by university scientists, other state agencies, local governments, conservationists, landowners, and the public will be needed to assist DENR, conservation trust funds, local governments, and land trusts in prioritizing the state's most important conservation investments.

Recommendation
Conference participants converged on the need to improve the prioritization of joint conservation and development decisions. The cost of securing green infrastructure is increasing rapidly. Prioritization can help ensure that public and private funds are spent to the greatest benefit. It also offers an opportunity for more coordinated and cohesive results among the many actors. For example, the economic development community needs to join the conservation community in the development of this plan to make sure it takes into account information that could benefit the state's long-term economic health. DENR has taken the lead in developing the green infrastructure plan[10], which the Nicholas Institute believes is an essential undertaking.

Market-based approaches that put a dollar value on the services provided by natural resources and ecosystems (ecosystem services) have potential to improve and protect water resources.

The State of North Carolina established maximum limits for nitrogen and phosphorus in two river basins, the Neuse and the Tar-Pamlico, and is working to reduce loadings of these two nutrients. Since implementation began in the 1990s, the programs have successfully decreased nitrogen in the Neuse and nitrogen and phosphorous in the Tar-Pamlico from wastewater dischargers and nonpoint

[9] www.onencnaturally.org
[10] "Grey" infrastructure is planned for by the State Water Infrastructure Commission (SWIC), created in 2005 and appointed by the Governor and General Assembly. The SWIC annual reports plan for the state's building and maintenance of drinking water, wastewater, and stormwater systems. The Nicholas Institute will also follow and support the SWIC's work.

sources, principally agriculture.[11] The programs have not reduced pollution from stormwater runoff. The Tar-Pamlico program allows wastewater dischargers to meet nutrient requirements by paying for best management practices that reduce nitrogen and phosphorus from agricultural lands. The Neuse program allows wastewater dischargers organized with the Neuse River Compliance Association to trade nitrogen reductions.[12]

Although these systems are sometimes called nutrient trading markets, in reality they behave as a more traditional fee-based regulatory program. Neither the Tar-Pamlico nor Neuse program has completed a trade among pollution sources, though the Neuse program has trades pending. Also, the programs allow non-point polluters such as developers to pay fixed offset fees for nitrogen and phosphorus runoff, rather than purchasing actual nutrient reductions in the basin. The fees are only indirectly linked to nutrient reductions that may occur at some future point. The fees have been set by the legislature rather than by a market, and are at a level insufficient to cover the real costs of reductions.

Ultimately, reductions in the Tar-Pamlico and Neuse have largely been achieved due to a decrease in applications of nitrogen-rich fertilizer, a shift in crops, restoration of riparian buffers (funded by Conservation Reserve Enhancement Program and offset fees), installation of other best management practices, and a reduction in the number of acres farmed.[13] The 2007 General Assembly enacted HB 859, Transition Nutrient Offset Program, to direct DENR to develop and implement a plan to transition the nutrient offset program from a fee-based program to a program based on the actual cost of providing nutrient credits.

Payments, best management practices, and maximum nutrient limits are important components of any water quality improvement program. But could true market systems in some cases do a better job addressing the continuing and growing challenge of water pollution from nonpoint and point sources? Markets are an attractive possibility because, when set up correctly, they offer a cost-effective and economically efficient way to achieve real reductions in nutrient loading and polluted discharges into waterways.

The conference proposed that several elements would be required for successful environmental markets:

- The state should set a limit on pollution low enough to stimulate real reductions.
- Markets should set prices for pollutant reductions, rather than the State.
- Payments should be made for performance rather than practices; performance could include, for example, reductions in extreme stream flows, or nutrient and sediment loading.
- Trades should be carefully and transparently tracked and accounted.

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[11] 2005 Annual Progress Report on the Tar-Pamlico Agricultural Rule and 2005 Annual Progress Report on the Neuse Agricultural Rule. Submitted to the Environmental Management Commission, Water Quality Subcommittee on November 9, 2005. Meeting Agenda available at http://h2o.enr.state.nc.us/admin/emc/2005/EMCAgenda2005.htm. See also Section 319 Nonpoint Source Success Stories, "Neuse River Basin, Basin-wide Cleanup Effort Reduces Instream Nitrogen," US EPA, at http://www.epa.gov/nps/success/state/nc_neu.htm.

[12] NC Division of Water Quality. Nonpoint Source Management Program: Slide Presentation on the Tar-Pamlico Trading Program. http://h2o.enr.state.nc.us/nps/tarpam.htm

[13] NC Division of Water Quality. Nonpoint Source Management Program: Tar-Pamlico Trading Program. http://h2o.enr.state.nc.us/nps/tarpam.htm

- Pollutant reductions should be monitored and/or verified using neutral or independent parties according to established protocols and metrics.
- Ecosystem services should be quantified consistently, and a common metric for outcomes should be established.
- The market's geography or boundary should strike a balance between market size and the risk of creating pollution hotspots.
- Finally, a market should not make transaction costs so high that they are greater than the benefits of the market itself.

It is possible that eventually these and other components of successful markets could be incorporated into existing North Carolina nutrient trading programs to make them more effective, and could also be established in the other numerous nutrient-sensitive waters of the Piedmont, such as Falls Lake, Jordan Lake, Randleman Lake, High Rock Lake, and the Catawba River lakes.

North Carolina is in a good position to test market systems to improve and protect its water resources because it has an abundance of the necessary components: nutrient-sensitive waters, a growing population, increasing nonpoint source pollution, farms and forests in need of additional sources of protection, willing landowners, mitigation bankers, and numerous institutions interested in monitoring, managing, and understanding how to make markets in ecosystem services deliver pollution reductions and other environmental and economic benefits.

Recommendation
North Carolina should assess the potential for nutrient markets in specific watersheds as an additional mechanism to improve and protect water resources. Such an assessment should consider where markets could meet criteria for feasibility and success, as suggested above, and should compare the market approach to the available alternatives for holding pollution below targets. A first assessment could begin in the Neuse River Basin, as the General Assembly has initiated changes through HB 859 that will make the nutrient program function more like a real market.

Greater efficiency in water use and reuse of water resources can sustain water resources, reduce conflicts, and reduce risks during droughts.

Water scarcity is a new concern as North Carolina grows rapidly and as communities anticipate future growth. The symptoms of scarcity, including increased competition and lawsuits, on-again-off-again water restrictions, empty reservoirs, and diminished stream flows, have heretofore been perceived as a peculiarity of the western United States. Yet North Carolina is already beginning to experience these problems.[14]

Water use efficiency and reuse have the potential to play a valuable role in the state. Specifically, efficiency in use and reuse can help to mitigate drought and avoid water limitations, improve water system reliability, reduce the need for direct discharges of wastewater into streams, reduce allocation conflicts, and maintain water levels in streams that are necessary to support vital ecosystems, fisheries, recreation, and more. Water conservation also creates additional capacity to support

[14] At the time of this report, 37 percent of the 6 million NC residents serviced by reporting water systems have been notified of voluntary conservation measures, and 10 percent are part of systems that have announced mandatory conservation measures. South Carolina has announced a lawsuit against North Carolina in opposition to the interbasin transfer from the Catawba River awarded to Concord and Kannapolis. Reservoir levels are low.

economic development, reduces energy used in heating and moving water, improves air quality, and saves money.

North Carolina has in recent years taken steps to ensure better water supply management during droughts and emergencies, but has not pursued a comprehensive, on-going effort at permanently increasing water use efficiency and reuse.

In response to the severe droughts of 1998-2002, the 2002 General Assembly passed HB 1215, Conserve Water/Promote Green Energy (SL 2002-167), which required that DENR evaluate and report on water conservation measures being implemented in North Carolina,[15] that the Environmental Management Commission (EMC) adopt rules governing water conservation and reuse during drought and water emergency situations,[16] that local governments include in their local water supply plans information about current and future water conservation and reuse programs (to be summarized in the state water supply plan), and that state agencies aim to reduce water use by 10 percent. The EMC drought rules finalized on March 19, 2007 establish default water use reductions for drought-designated areas and require that entities currently required to register withdrawals also report monthly water use on an annual basis and develop water shortage response plans. HB 1215 and the subsequent EMC drought rules should improve North Carolina's response to shortages, but more can be done to reduce water shortages and the need for emergency conservation measures through additional improvements in efficiency of use.

Some communities and local governments have sought to address water use with financial and educational approaches in addition to temporary drought restrictions. Many have ongoing education and recognition programs for water conservation. The Town of Cary uses a rate model to ensure that costs for water services are accurately reflected in rates. Orange County has adopted seasonal water rates that encourage conservation by raising rates during the peak summer season. Chatham County Water is one of approximately 75 utilities that have implemented an increasing block rate structure for residential customers that provides a basic amount of water at a low cost and charges more for additional consumption.[17] Permanent mandatory conservation measures are much rarer. Triangle communities including Orange County, Cary, and recently Raleigh have enacted permanent watering restrictions.

North Carolinians use less water per capita than some neighboring states, but are not on pace to improve water use efficiency despite many options available to do so. In 2000, North Carolina's per capita daily urban water use, according to data reported to the United States Geological Survey (USGS), was 177 gallons per day. (This figure includes public water supplies for residential, commercial, and industrial water, and domestic and industrial self-supplies, but excludes mining, livestock, and irrigation). This placed the state's per capita daily urban water use generally below most arid Western states and its neighbors South Carolina, Virginia, Georgia, Kentucky, and

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[15] The report issued by the Division of Water Resources pursuant to HB 1215 is available online at http://www.ncwater.org/Water_Supply_Planning/Water_Conservation/hb1215/. The Division invites comments on the promotion of efficiency and on the administrative rule governing water conservation and reuse during droughts and water emergencies. Hearings were held on the administrative rules in January 2006.

[16] The EMC final rules are available online at http://www.ncwater.org/Water_Supply_Planning/Water_Conservation/hb1215/documents/rules.pdf

[17] NC Environmental Finance Center. April 2007. Water and Wastewater Rates and Rate Structures in North Carolina. Available online at http://www.efc.unc.edu/publications/pdfs/NCLM_EFC_AnnualW&WWRatesReport-2007.pdf.

Tennessee.[18] Unofficial estimates for 2005 provided by the North Carolina Rural Economic Development Center and the USGS indicate per capita daily urban water use of approximately 166 gallons. If North Carolina's population grows as projected to 12.2 million in 2030, and Rural Center projections for total water use are accurate, the per capita daily water use in 2030 would be 163 gallons, essentially no more efficient than today's water use.[19]

As Heather Cooley from the Pacific Institute discussed at the March 1 conference, Seattle Public Utilities presents an excellent example of improved water use efficiency. While adding 400,000 residents since 1975, the city reduced consumption by approximately 25 million gallons per day and boosted daily efficiency, reducing use on average by 50 gallons per day per person.

The challenge of becoming more efficient in water use mirrors that of energy use to an extent, because water and energy utilities in North Carolina depend on sales volume for revenues. While the current legal framework discourages energy utilities from investing in efficiency, water utilities have the option to encourage water use efficiency without harming their bottom line. For example, utilities could recover investments in efficiency retrofits, adopt higher rates for heavy use of water, or further decouple revenue from sales volume. With careful planning, utilities could help their customers become better stewards of the state's water resources. But until efficiency is perceived less as a threat to the financial stability of utilities, it will not be easy to incorporate.

Water supplies fluctuate within natural limits but supply infrastructure beyond a certain extent cannot grow with population. Climate change may well exacerbate supply limitations, making supplies less reliable. Water use efficiency and reuse are two of the most valuable tools to provide room for growth while keeping water in streams and reservoirs for their necessary purposes.

A number of potentially cost-saving options may be worth consideration at state and local levels:

- Targets for improved efficiency in domestic, commercial, and industrial water use.
- Incentives and programs for improved efficiency in agricultural water use.
- Stronger efficiency standards and enforcement in building and development codes, and for water-using appliances, including dishwashers, washing machines, and toilets.
- Requirement or encouragement of retrofitting homes for water efficiency when resold.
- Rebates and labels for efficient appliances in addition to any at the federal level.
- Metering technologies and billing practices that improve information on types of use, improve data collection, and allow separate rates for irrigation and indoor use. (For example, separate irrigation meters, internet-enabled meters and on-line tools to collect and show data.)
- Economic incentives including seasonal pricing and higher rates for increasing blocks of water use (with appropriate sensitivity to the circumstances of low-income households).
- Improved water accounting and leak detection programs.

[18] Hutson, Susan, et al. February 2005. Estimated Use of Water in the United States in 2000. United States Geological Survey. Available online at http://pubs.usgs.gov/circ/2004/circ1268/.

[19] Projections by the Rural Center suggest total demand for urban uses will reach 1,988 million gallons a day (MGD) by 2030. North Carolina Rural Economic Development Center. 2005. Water 2030: Water Supply and Demand Overview. Available online at http://www.ncruralcenter.org/water2030/index.html.

Recommendation
We recommend the North Carolina General Assembly or its Environmental Review Commission initiate a comprehensive review of the statewide potential for increased water use efficiency and reuse, through a variety of policies and incentives, including those listed above, and their potential to save water, alleviate water supply problems, and reduce costs. Such a review could provide state legislators a balanced look at the potential savings, the opportunity to set state and local goals, and the available options to increase water use efficiency and reuse.

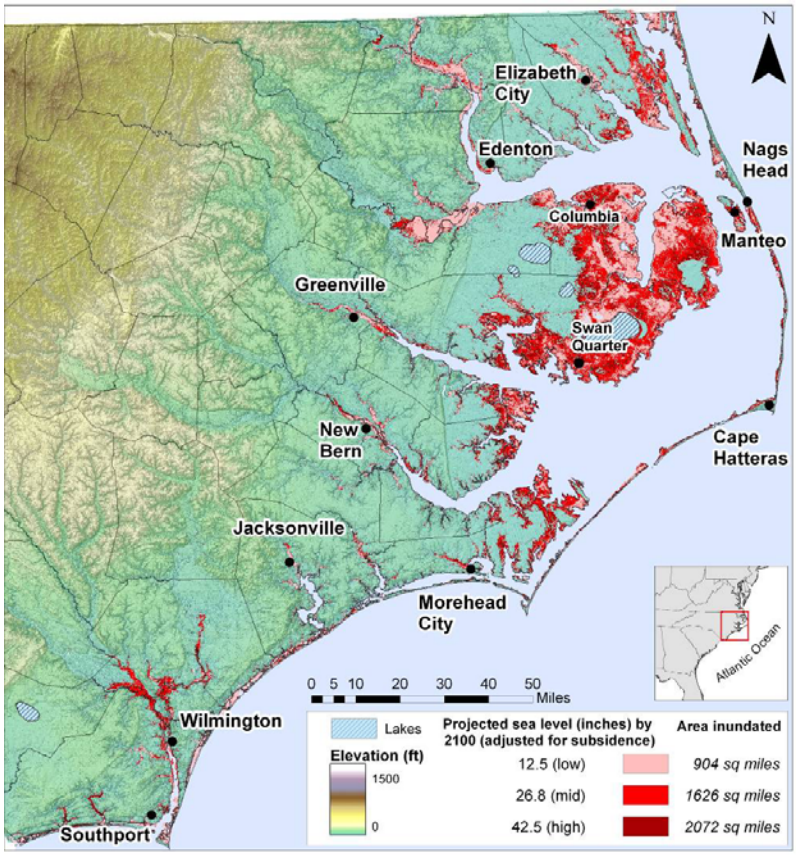
Climate change is an added challenge to sustainable water resources management.

Sea level rise and other manifestations of climate change, including increased variability in precipitation, pose a significant long-term risk to North Carolina's water resources, particularly along the coast. North Carolinians can expect drier summers (when water is needed the most), wetter winters (when water needs are lower), higher-intensity storms and associated flooding and infrastructure damage, disappearing and moving wetlands, changing fisheries, decreased drinking water (increased evaporation on reservoirs and saltwater intrusion), and increased irrigation needs.

North Carolina's coast is among the most vulnerable to sea level rise, storm surge, and hurricanes in the United States (see Figure 1 below). Over 1.2 million acres in North Carolina are below one meter in elevation. Further, North Carolina's coastal sea level rise is effectively double the global average because of land subsidence at the coast.[20] North Carolina's coast is shaped by dynamic processes, including natural barrier island migration, sea level rise, subsidence, and extreme weather events. But coastal development does not yet fully account for these dynamics, and thus is more vulnerable to them.

[20] Poulter, B., and P. N. Halpin. In Press. Raster modling of coastal flooding from sea level rise. Internationl Journal of Geographic Information Sciences.

Figure 1. Potential losses in coastal North Carolina due to sea level rise.



Note: Inundation from sea-level rise is one of a number of considerations in coastline evolution. Other factors not accounted for in this map (including severe storm erosion, subsidence, vertical accretion of marshes, and barrier island collapse) will also determine the actual shape of NC's coastline in decades to come.

Source: Poulter, B. and PN Halpin. In Press. Raster modeling of coastal flooding from sea level rise. International Journal of Geographic Information Sciences.

A recent study by researchers at East Carolina University, UNC-Wilmington, Appalachian State University, and Duke University released on March 15, 2007, estimated the impacts of sea level rise and climate change on coastal North Carolina.[21] In just four counties chosen as representative of North Carolina's coast (New Hanover, Dare, Carteret, and Bertie Counties) lost property values from sea level rise are estimated to be $6.9 billion.[22] In the same four counties, additional interruption of business from increased hurricane intensities (without change in hurricane frequency) is estimated to cost $1.44 billion through 2080. Greater hurricane intensity would also inflict losses on forests and agriculture. Sea level rise would cost $3.9 billion in reduced opportunities for beach trips at southern NC beaches and fishing trips across the coast. [23]

[21] Bin, O., C. Dumas, B. Poulter, and J. Whitehead. 2007. Measuring the impacts of climate change on North Carolina coastal resources. Final Report prepared for the National Commission on Energy Policy. Available online at http://econ.appstate.edu/climate/NC-NCEP%20final%20report.031507.pdf.

[22] Sea level rise was projected to be 81 cm by 2080. The value of sea level rise losses, including residential and non-residential property losses in four counties ($6.9 billion), business interruption in the same four counties ($1.44 billion) , and beach trips at southern NC beaches and fishing trips across the coast ($3.9 billion) is estimated as the net present value of losses projected through 2080 at a 2% discount rate.

[23] Beach and fishing data were only available for five southern NC counties, Brunswick, New Hanover, Pender, Onslow, and Carteret.

Our coast also particularly susceptible to salinisation of ground and surface water, which will impact public water supplies and freshwater fisheries and ecosystems, with subsequent impacts to North Carolina's economy and natural heritage. Salt water is already intruding into coastal aquifers. It is possible that the impacts of climate change on coastal water resources could be moderated by a mix of conservation, wetlands restoration, and more adaptive land use. For example, the network of coastal canals used to drain lands also allows saline water to penetrate further inland than it otherwise would, and may significantly increase the area affected by rising seas. Selective closure may reduce impacts of saltwater intrusion.[24]

The coastal region is not the only climate change concern. Climate change will also be particularly challenging for the more developed areas of the state where water supplies are strained during dry periods and where impermeable surfaces and construction in flood prone areas can increase flood damages. Forests around the Southeast may be more susceptible to fire; the unprecedented fires this summer in southern Georgia and northern Florida serve as a warning. So far this year North Carolina has fought almost 1,300 more wildfires than normal.[25]

Recommendation
We recommend that North Carolina assess the potential impacts from climate change and sea level rise so we can prioritize what adaptation actions will protect public health and safety, protect the environment, minimize economic costs, and ensure sustainable and clean water resources.

Next steps to sustain abundant and clean water in North Carolina

Last century, North Carolina's water policies and practices served it well enough in an era of a growing, albeit small, population and of relatively abundant water resources. In the 1970s North Carolina successfully reduced visible water and air pollution from industries and municipalities. North Carolina responded again in the 1990s after fish kills choked the Neuse and Tar-Pamlico Rivers.

North Carolina has not yet responded to the pressures and competition for scarce water resources in the 21st century. By 2030, twelve million North Carolinians will demand use of the same water resources that served four million North Carolinians in 1960. Even now, the state is still struggling to respond to eutrophication in major drinking water supplies, including Jordan Lake, Falls Lake, High Rock Lake, Randleman Lake, Lake Wylie and Lake Rhodhiss.

The Nicholas Institute sponsored "The Future of Water in North Carolina: Strategies for Sustaining Clean and Abundant Water" to spark a public discussion about how to improve the framework for managing water resources in the 21st century.

The recommendations made in this report fall within a larger water policy and institutional context. At this contextual level, we believe a strengthened policy and institutional framework for North Carolina's water resources is needed to ensure that water resources in North Carolina remain sustainable and sufficient, and to ensure that attempts to improve our management of water

[24] Pearsall S and B Poulter. 2005. Adapting coastal lowlands to rising seas. A Case Study in M.J. Groom, Meffe, G.K. and Carroll, C.R. (Editors). Principles of Conservation Biology (3rd Edition), Sinauer Press, Sunderland, Massachusetts.
[25] The News and Observer. August 22, 2007. Thomas Goldsmith. "State needs 15-plus inches of rain to ease drought."

resources are not stymied by underlying structural or institutional shortcomings. A new framework should include:

- integration of water quality and water quantity planning, policies, and laws;
- integration of ground water and surface water policies;
- transparent and accessible data about water withdrawals and uses;
- coordination of regulatory policies, state funding, incentives, and public education;
- realistic pricing of water resources;
- planning for conservation, restoration, and development at a watershed scale pursuant to a river basin plan;
- interstate management of rivers with our neighbors in Virginia, South Carolina, Georgia and Tennessee; and
- planning for and adapting to global climate change.

Recommendations

These recommendations to policymakers are based upon presentations, panels, and discussions from the March 1, 2007 conference.

- An evaluation of North Carolina's water use policies is needed to ensure that water supplies can accommodate increased demand, to incorporate new knowledge of how to protect water quality, quantity, and habitat, and to establish criteria for sustainable management of water resources. Additionally, evaluation of water law could identify data gaps in measurement and reporting, necessary to help private and public decision makers in short- and long-term planning.

- Effective planning, regulations, incentives, and education are all needed at the state and local levels to systematically integrate land use and water resource decisions. For example: 1) state river basin plans for water quality and quantity should project expected changes in land use and impacts on water quality and quantity; 2) local ordinances regulating development should better address stormwater runoff and the potential for flooding; 3) state economic development planning should consider future water constraints; and 4) both state and local governments should use the conditionality approach, where approval or funding of a proposed project would be contingent upon meeting conditions for environmental performance.

- Complementary to and sensitive to the land use policies discussed above, improved prioritization and coordination of conservation and development decisions is needed. The cost of securing green infrastructure is increasing rapidly. Prioritization can help ensure that public and private funds are invested for the greatest benefit. It also offers an opportunity for more coordinated and cohesive results among the many actors.

- North Carolina should assess the potential for nutrient markets in specific watersheds as an additional mechanism to improve and protect water resources. Such an assessment should consider where markets could meet criteria for feasibility and success, and should compare the market approach to the available alternatives for holding pollution below targets. A first assessment could begin in the Neuse River Basin, as the General Assembly has initiated changes that will make that basin's nutrient program function more like a real market.

- The North Carolina General Assembly or its Environmental Review Commission should initiate a comprehensive review of the statewide potential for increased water use efficiency and reuse, through a variety of policies and incentives and their potential to save water, alleviate water supply problems, and reduce costs. Such a review could provide state legislators a balanced look at the potential savings, the opportunity to set state and local goals, and the available options to increase water use efficiency and reuse.

- North Carolina should assess the potential impacts from climate change and sea level rise so the state and communities can prioritize which adaptation actions will best protect public health and safety, protect the environment, minimize economic costs, and ensure sustainable and clean water resources.

Next Steps for the Nicholas Institute

In the near term, the staff of the Nicholas Institute, in partnership with other universities and stakeholders, intends to focus on the following initiatives contributing to a new framework for managing water resources in North Carolina:

- Assisting the General Assembly and DENR in improving the registration, measurement, reporting and allocation of water resources;
- Following the development of DENR's NC Strategic Conservation Plan and assisting DENR and others in improving the plan and setting priorities;
- Working with interested stakeholders in the Upper Neuse River Basin to improve and integrate state and local planning, monitoring, land use regulations, incentives, and education to increase protection of Falls Lake and eight other drinking water supplies, and assessing the potential for ecosystem service markets. The Nicholas School and Nicholas Institute are are also developing a tool to identify and value ecosystem services on landscapes at the watershed scale.
- Assisting the General Assembly and DENR in exploring the potential for and barriers to efficient use of water resources;
- Assisting state, local and private decision makers in planning for and adapting to global climate change and sea level rise.

Working with other research institutions in the state, with policy makers, environmental leaders, the business community, landowners, and other stakeholders, the Institute seeks to ensure that the citizens of North Carolina continue to enjoy a high quality of life, that growth can be accommodated in environmentally sound ways, and that the natural systems on which all human activity ultimately depends remain healthy and productive for generations to come.

Appendix A—DENR's Strategic Conservation Plan for North Carolina

The NC Department of Environment and Natural Resources recognizes the need to develop a statewide conservation strategy. In response, we have adopted the green infrastructure approach and have begun developing:

The Strategic Conservation Plan for North Carolina

Why?

- Our state is experiencing intense growth pressure - our projected 50% population increase within 25 years will consume up to 8 million acres of natural land.
- Growth itself is not the problem – it is the *pattern* of growth that is the issue.
- We must act quickly to capture the critical networks of natural areas or they will be gone.
- It is cheaper to protect high quality, high functioning systems now than to restore damaged natural systems later.

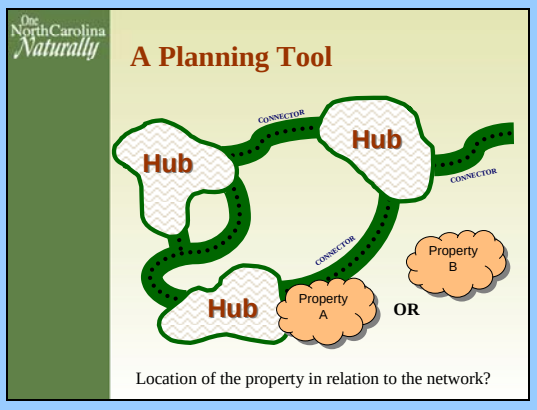
Methodology

- Develop GIS raster-based computer model with data from multiple partners.
- Focus on 4 components:
    - Ecological - biodiversity, water quality, ecosystem services
    - Recreation/Open Space – parks, trails and greenways, nature reserves
    - Working Lands – farms, forests, waterfronts
    - Coastal Habitat Protection Plan – marine & estuarine ecosystems
- Identify significant hubs and connectors on a statewide scale.
- Identify gaps in network for protection and restoration priorities.
- Inform planning at regional and local levels.
- Update every six months.

Multiple Benefits

- Our planning process will identify, evaluate and prioritize an interconnected network of essential ecosystems.
- This strategic and inclusive approach to long-term planning can inform conservation funding decisions.
- By integrating the goals of multiple programs, strategic planning produces more effective and efficient conservation outcomes.
- A coordinated, collaborative method maximizes resources and reduces duplication of efforts.

The Green Infrastructure Approach



Proposed Criteria for Biodiversity:

- *Significant Natural Heritage Areas (terrestrial and aquatic)*
- *NC Natural Heritage Element Occurrences outside SNHAs*
- *Landscape/Habitat Indicator Guilds*
- *State Wildlife Action Plan (SWAP)*
- *Important Bird Areas (IBAs)*
- *Outstanding Resource Waters & High Quality Waters (ORW &HQW)*
- *DWQ Bioclassifications*
- *Natural swamp waters*
- *NHP, WRC, & TNC priority watersheds*
- *Shellfish harvest waters & hard bottom areas*
- *Primary fish nursery areas*
- *Anadromous fish spawning waters*
- *Submerged Aquatic Vegetation (SAV)*
- *Oyster sanctuaries*
- *Stream buffers (100' – 300')*
- *Wetlands (CREWS & NWI)*

For more information contact:

NC Natural Heritage Program
Linda.Pearsall@ncmail.net or Kim.Douglass@ncmail.net

One NorthCarolina Naturally

Appendix B—Comments on the Conference

Comments were received from:[26]

- N.C. Wildlife Resources Commission
- Cynthia Van der Wiele
- Barnes Bierck, P.E., Ph.D.
- Sydney Miller

Comments from N.C. Wildlife Resources Commission

The North Carolina Wildlife Resources Commission appreciates being invited to the conference to represent fish and wildlife interests in the overall conversation of managing the State's water resources. The following comments are provided in the spirit of improving the associated post-conference paper and setting the stage for future discussions.

Strategies

The pre-conference paper does an excellent job of summarizing the issues facing the State and setting the stage for a discussion on strategies to address those issues. Unfortunately, the conference itself did not fulfill our expectations of a focus on strategies. While the questions in the pre-conference paper are pertinent, most panelists did not answer them and the moderators did not guide the panelists and audience along those paths. This was somewhat expected due to the attempt to address the many aspects of water management in the three panel discussions. Therefore, we suggest that future conferences and workshops should focus on one aspect (e.g., green infrastructure, valuing water, regulatory leverage points) at a time so that more in-depth discussions can take place.

The presentations made by some panelists did not assist in discussing strategies. Some were a restating of the issues already described in the pre-conference paper, while others were too focused on research or a particular program. Future venues should eliminate the presentations and allow more time for a structured give and take among the participants.

Instream (Ecological) Flows

We were very pleased to see the pre-conference paper acknowledge important concepts such as instream flows, the surface-groundwater connection, and ecosystem services. Discussions during the conference itself, however, did not address the environmental needs of maintaining flow in streams. While the tight schedule limited our ability to discuss this more fully, the panels also lacked a person versed in the science of instream flows. We would be glad to provide expertise in this subject area in future discussions.

One of the biggest obstacles to protecting instream flows is one of perception. Most people, if they think about it at all, have the perspective "How much water can we leave in the stream to sustain

[26] Comments were submitted voluntarily by several conference attendees and represent author and agency opinions where identified.

fish?" This approach is lacking because it assumes: aquatic organisms need only enough water to survive; the amount left in the stream is a static number; and, the existing aquatic community is fully functioning and robust. We believe the more appropriate perspective is "How much water can people remove from the stream while fully protecting (or restoring) the ecosystem?" This view assumes: organisms need sufficient flow to survive, migrate, feed, reproduce, increase their numbers, etc.; flow variability on a seasonal and interannual scale is key to sustaining a diverse aquatic community; and, most of our existing aquatic communities are only a shadow of their historic numbers and diversity, and improving flow is one way to help them return to that historic condition. Not to overstate the difference in these two perspectives, the first can result in a stream having only ten percent of its natural flow, while the latter should result in a stream having no more than ten percent of its natural flow removed from the channel.

Legal Framework

Many people at the conference agreed that regulatory mechanisms are essential to producing a desired outcome. We believe that part of that outcome should be fully functioning ecosystems and aquatic communities. A quick review of North Carolina statutes (see attachment) suggests to us that ecosystem values are overlooked when it comes to water management. Most statutes are explicit that water is to be "developed" or put to "beneficial use." At best, the public trust language dealing with water resources gives mixed messages of preservation and development. The few statutes that specifically deal with flow take the first perspective described above, so that only minimal water is left in the stream. Finally, statutes either ignore the ecosystem services provided by streams and wetlands or the statutes are contradictory.

While we understand the desire by some to work within the existing legal framework, or to let it slowly evolve, we believe that a more radical approach should at least be investigated as part of a comprehensive approach to water management in North Carolina. A proper legal framework should clearly recognize instream flow as a (the) primary "use" of water. It also should drop the language of "minimum" and "maintenance" flow in favor of "ecosystem" or "environmental" flow. It may be too soon to tell whether or not a revolution in water law is appropriate, but it should not be dismissed out of hand.

Conclusion

This is a most important and timely topic – one that is ultimately at the core of our ability to effectively manage aquatic wildlife resources for future generations. We thank the Nicholas Institute for initiating the dialogue and including a diverse group of experts and stakeholders. We are hopeful that these conversations will continue and result not only in better water management, but in aquatic ecosystems, as well. The Wildlife Resources Commission should be included in any future discussions dealing with water management and can make available staff with expertise in this subject matter. If you have any questions about these comments, please contact Mr. Chris Goudreau (828-652-4360 x223; chris.goudreau@ncwildlife.org) or Ms. Shannon Deaton (919-707-0222; shannon.deaton@ncwildlife.org).

Summary of North Carolina Statutes Related to Water

Public Trust

- "It is hereby declared to be the public policy of this State to provide for the conservation of its water and air resources. Furthermore, it is the intent of the General Assembly, within the context of this Article and Articles 21A and 21B of this Chapter, to achieve and to maintain for the citizens of the State a total environment of superior quality. Recognizing that the water and air resources of the State belong to the people, the General Assembly affirms the State's ultimate responsibility for the preservation and development of these resources in the best interest of all its citizens and declares the prudent utilization of these resources to be essential to the general welfare." (§143-211) [1951, 1967, 1973, 1977, 1979, 1989, 1997, 1998]

Water Resources

- Encourages development of state's waterways (§143-215.38 thru 143-215.43) [1969]

- "The purpose of this Article is to create a State agency to coordinate the State's water resource activities; to devise plans and policies and to perform the research and administrative functions necessary for a more beneficial use of the water resources of the State, in order to insure improvements in the methods of conserving, developing and using those resources." (§143-352) [1959]

- "It is hereby declared that the general welfare and public interest require that the water resources of the State be put to beneficial use to the fullest extent to which they are capable, subject to reasonable regulation in order to conserve these resources and to provide and maintain conditions which are conducive to the development and use of water resources." (§143-215.12) [1967]

- Comprehensive planning of regional water supply systems, so as to make possible the most efficient use of water resources and to help realize economies of scale in water supply systems. (§162A-23) [1971]

Flow

- Defines "minimum flow" as that sufficient in the judgment of DENR and to maintain aquatic habitat in the length of the stream that is affected (§143.215.25) [1967, 1973, 1977, 1983, 1987, 1993]

- Allows for withdrawal of excess water from an impoundment. (§143.215.44) [1971, 1987]

- The presumed flow without an impoundment is considered to be the 7Q10 flow (§143.215.48) [1971, 1973, 1987]

- "[I]t is the public policy of the State that the cumulative impact of transfers from a source river basin shall not result in a violation of the antidegradation policy set out in 40 Code of Federal Regulations and the statewide antidegradation policy adopted pursuant thereto." (§143-211) [1951, 1967, 1973, 1977, 1979, 1989, 1997, 1998]

- Allows miner to divert water to or from the mine across other landowners (§74-25) [1871]

- Aquaculture facility must not withdraw water beyond point of destroying fish habitat (§106-763) [1993]

Connectivity

- Requires that at least 25% of the stream, including the deepest part, be left for fish passage. If dammed, must determine the period of year left open for passage (§77-3) [1787]

- Obstructions in streams are illegal, but can block up to 66% of width (§77-12 thru 14) [1796, 1872-3, 1953, 1957, 1959, 1961, 1969, 1975, 1977, 1979, 1987, 1989, 1991, 1993, 1994, 1997]

- Intent is to minimize flooding. Defines channel and portion of floodplain. Floodway can't be obstructed except as provided. (§143-215.51 thru 215-61) [1971, 1973, 2000]

- Promotes drainage of wetlands and clearing of streams – in general (§156-135 [1909]) and for public health (§156-139 [1943])

Other

- Defines navigable water, excluding power generation reservoirs (§76-40) [1784, 1811, 1833, 1842, 1846, 1969, 1973, 1977, 1989, 1993, 1994, 1997]

- Defines submerged land, state land, and navigable water (§146-64) [1854, 1891, 1959, 1969, 1995]

Comments from Cynthia Van der Wiele

Issue 1: Green Infrastructure

I would advocate a statewide land use plan in concert with a statewide water budget and green infrastructure plan. However, in order to work, there must be harmonization/buy-in with local land use plans and other planning (e.g., local watershed plans, etc.). For example, the Triangle GreenPrint has had implementation issues. Dr. Toddi Steelman & Dr. George Hess at NCSU College of Natural Resources examined this plan in terms of conservation and policy. I believe they may have published some findings from their research.

Provide technical outreach to state and local governments to examine planning policies with regard to water usage and recharge opportunities. This should be done in concert with Issue 3-- new regulatory leverage points. Incentivize water resource stewardship. This will be detailed below under the 3rd issue.

Funding for green infrastructure is limited. Besides using mitigation funds from NCEEP, there could be some through FEMA grants (natural hazard mitigation planning grants). Other planning that should/could coincide with a statewide green infrastructure plan are the local watershed planning efforts taking place through NCSU Cooperative Extension WECO program (Christy Perrin and others), and the SeaGrant program.

Pilot Projects: target fast-growing urban-wildland interface areas of the state (e.g., mountains and inner coast). This would probably not be feasible, but in examining the issue of ecosystem services, one may wish to consider the ecological cost of a significant removal of wetlands, streams, and dewatering of aquifers (e.g., proposed expansion of PCS Phosphate in Aurora, NC or the proposed outlying landing field (OLF)) vs. the economic benefit of that expansion/new construction.

Issue 2: Valuing Water (ecosystem services to efficiency)

It seems that the role of design-- urban planning and associated ordinances-- were under-examined issues during the conference. Land use patterns have a significant impact on sustainable water yield-- both at the watershed and site level. Further consideration should be given to restructuring ordinances to promote groundwater recharge, LID (low impact development) design, etc. Areas of conservation should be matched with soils that have the highest infiltration rates.

Issue 3: New Regulatory Leverage Points

While your preconference paper recognized the role of streams and wetlands in water quality and quantity, there was no discussion on these resources at the conference. The US Army Corps of Engineers 404 Nationwide Permits are up for renewal. Simultaneously, the NC 401 general Water Quality Certifications will be revised and sent out for public notice next week (I am the author of these changes). The thresholds for written approval and mitigation requirements can have a significant impact on design (i.e., when the threshold was dropped to 150' of stream impacts, site planners responded by minimizing impacts). Additionally, while the science supports mitigation for intermittent streams due to biological significance, there has been reluctance to change policy to reflect this new knowledge.

Secondly, your preconference paper noted on page 3 that watersheds decline in quality when impervious surfaces increase. This was based largely on the studies of Tom Schueler (Center for

Watershed Protection). Newer studies have indicated that it's not necessarily the amount (or percentage) of impervious surfaces, but whether or not those impervious surfaces are connected and what types of treatment (if any) the stormwater runoff from those surfaces are receiving. See: Center for Watershed Studies-- research conducted by Horner and May. If disconnected, runoff characteristics are significantly different than connected impervious surfaces. Thus, requiring LID to the maximum extent practicable before resorting to conventional methods can have a major influence on the watershed in urbanizing areas.

Phase II requirements, and the stormwater requirements for the 401 Water Quality Certifications (See General Certification 3402 and 3404 for developments and road crossing) are areas to target as new regulatory leverage points. At present, stormwater management is not required for developments with impervious surface areas of under 30% (a very low bar), no provisions for LID, etc.

Support sustainable development via model ordinances that link land use patterns with incentivized water management.

Water Conservation, Harvesting, and Reuse Techniques:Use of techniques that reduce impervious surfaces, allow greater infiltration of rainwater, and/or capture and reuse waste and storm water are typically more cost-effective than increasing water supplies or expanding treatment facilities. Provide assistance to state and local governments to develop and implement feasible solutions for reducing withdrawals while developing these alternative sources of water. Add dual-delivery (potable and non-potable) systems when expanding utilities to new areas. Identify barriers at state and local levels to adoption of low impact development practices (state and local stormwater management practices requirements (often the hurdle is the peak flow and peak volume mitigation requirement and the lack of understanding that LID practices should be examined in terms of continuous flow models rather than peaks; they can also be designed for peak reductions). Target water harvesting/reuse systems strategically for applications where non-potable water can be substituted and substantially reduce demand. Create incentives for new development and retrofit projects to incorporate practices that contribute to significant reductions in water supply demands (could be done at local level or NC Dept. of Commerce for larger projects). For example (at the small scale), a car wash that generates its own water thru cisterns and reuses that water should have incentives over a business that would require municipal sources of water. Residential and commercial developments that do not use potable water for irrigation (generated onsite through rainwater collection or wastewater reuse). For a large-scale case study, see the Kitsap SEED Project (http://www.kitsapseed.com/index_files/Page699.htm) and scroll down to Site Planning/Sustainable Infrastructure -- they are planning a zero import/export water management.

The other issue is that water quality and quantity are separate agencies within DENR, and they themselves have a myriad of units (stormwater, wetlands, groundwater, drinking water, planning, etc.). Programs should be examined in terms of how they can all support the common goal of sustainable water yield. I cringe to propose restructuring, but the water management district model used in Florida is a good one in that the state was divided by major basin and issues examined a bit more holistically than the NC structure.

Comments from Barnes Bierck, P.E., Ph.D.
Environmental Engineering Consultant

One big item is water reclamation and reuse, and I'm glad to see it in your summary. As an example of its importance in helping North Carolina: it's been pointed out that Florida has about the same area as North Carolina, but has a far larger population. Florida does not have much in the way of fresh water for drinking purposes, compared to North Carolina. How does Florida do it? Through water reclamation and reuse. I suggest you expand a bit on how water reclamation and reuse have potential, in order to help educate those who are not well-informed about it.

Another item to follow-up on is land-use planning. I mentioned it a time or two during questions/comments, and Bruce Babbitt's theme surrounds this topic. As I noted, the Coastal Area Management Act (CAMA) requires all coastal counties to have Land-Use Plans, and cities and towns in these counties can also have these plans, at their option. One response from one or two panelists was that many people in NC would not accede to this approach. However, I think that statement was made without a full appreciation of how Land-Use Plans are developed. Suffice it to say that there is a tremendous amount of citizen participation that is necessary, and there is a lot of information available on that from the state's Division of Coastal Management, much of it having been developed by fine people with the Institute of Government and other institutions. My understanding is that there have been attempts to get Land-Use Planning requirements for other counties, but that has been stopped. The salutary points of Land-Use Planning done well are many, and will help with water and many other problems.

Comments from Sydney Miller

Leverage Points: Improving Water Resources Management

Are there opportunities for North Carolina to improve regulatory leverage for water resources in the short term?

Translated: Can North Carolina's existing statutes and rules be implemented in a way that improves our management of water resources?

Present Situation

Current Planning & Regulatory Process

- Allocations of pollutant discharge are first-come, first-served
- Virtually no permitting or allocation of withdrawals
- Results in a de facto right of prior allocation
- Allocations continue until there is evidence of water quality impairment, then all dischargers in the watershed are subject to reductions; similarly for aquifer draw down, resulting in blanket reductions for all withdrawers
- No coordination between water supply and wastewater planning and permitting, except when an IBT certificate is required or a FERC relicensing occurs
- We have no process in place for insuring that our water resources are allocated to the highest and best uses

- Current approach was acceptable when population was small and demands were low – which is no longer the case
- NC is headed for a train wreck in managing its water resources. Such recent spectacles as the recent Catawba Basin IBT are but symptoms of the more fundamental problem.

Need

Comprehensive Water Resources Management Plans

- By river basin, across the state
- 50-year planning horizon
- Consider both projected demands for water supply withdrawals and projected demands for wastewater discharge
- Hydrologic modeling to analyze the impacts of withdrawals and discharges on water quantity, stream flows and lake levels
- Hydrologic model output used as water quality model inputs to analyze impacts of withdrawals and discharges on water quality
- Comprehensive management plans would at least provide an indication of whether water resources demands in a given basin are approaching its carrying capacity, and if so, when that limit might be reached.
- Such information could be used to make decisions about allocations and management strategies, and if necessary, declare capacity use areas for increased regulation

NC Toolbox

NCDENR Implementation

- Comprehensive Basinwide Water Resources Management Plans could be developed along the lines of the current Basinwide Water Quality Plans and the Cape Fear River Basin Long Range Water Supply Plan
- Would require hydrologic models for each river basin
- Would require at least a generalized water quality model for each river basin

Basinwide Water Quality Plans – "a nonregulatory, watershed-based approach to restoring and protecting the quality of North Carolina's surface waters"

- Snapshots of water quality taken every five years, by major river basin
- Assessments of the present
- No projection of the future

State Water Supply Plan – "provides a comprehensive assessment of water supply needs, water use, and water availability across the state; identifies the major water supply issues facing the citizens and elected officials of North Carolina now and in the near future; and provides guidance for sound water supply planning"

- A compilation of over 500 Local Water Supply Plans developed by local government water systems
- Projections of future demand are based on local desires for growth

- Estimations of available supply are largely based on reservoir "safe" yields, 20% of a stream's 7Q10 flow, or well pumping tests
- No plans for nongovernmental entities
- No assessment of cumulative surface or ground water impacts
- Recently adopted a new planning strategy: developing river basin water supply plans for each major basin merging the data submitted by water withdrawers in each river basin with a computer-based hydrologic model to analyze the cumulative effects of long range projections of water withdrawals and returns on the surface waters of the basin being evaluated

NPDES Permitting

- Ad hoc and incremental
- First to submit a request for speculative limits is first to establish an allocation
- Each facility requesting a permit is examined to determine its own incremental impact on the receiving surface waters
- No evaluation of cumulative NPS impacts

Water Supply Withdrawal Permitting

- Nothing comprehensive
- Permits withdrawals only in Capacity Use Areas
- Allocates water supply storage in Jordan Lake
- Conducts instream flow needs assessments when required by an environmental review process
- Assumption that withdrawals of amounts less than 20% of a stream's 7Q10 flow constitute insignificant impacts

Regulation of Surface Water Transfers

- a/k/a Inter Basin Transfers
- Requires analysis of the withdrawal and discharge impacts in the source and receiving basins associated with large transfers of water between legislatively defined river basins
- IBTs are inevitable, given mismatch between basin boundaries and political boundaries and given an interest in building communities in higher ground
- IBTs will only become more prevalent, given population growth and given regionalization
- IBT is the closest the state comes to in requiring a comprehensive look at water supply and wastewater over some future planning horizon (other than FERC relicensing)
- This mechanism is too piecemeal to be relied upon as the sole mechanism for comprehensive water resources planning and management

Monitoring

- Currently we have an incomplete picture of the present
- Lack complete information on water withdrawals – locations, amounts, uses; e.g., LWSPs do not include private purveyors of community water (Heater Utilities)
- Lack complete information on surface and ground water sources – sparse network of stream gages and monitoring wells
- Sporadic information on distribution and collection systems

- No information about agricultural withdrawals – locations and amounts
- Very infrequent and coarse land use/land cover data

Alternative Tool

Watershed Authority Implementation

- Comprehensive planning is of interest to DENR, but may be a long way off
- Regional partnerships of local governments and interested stakeholders could form Watershed Authorities
- DENR could write watershed-wide NPDES permits
- Watershed authority would conduct the planning, analyses and management necessary to coordinate the activities of the local governments within the watershed in collectively meeting the requirements of the watershed-wide permit.
- Could incorporate wastewater discharges, stormwater management, and water supply withdrawals
- But, would likely be implemented in the areas that already do a better job of planning, and could still result in large gaps across the state.

What are barriers to more effective regulation of water resources in North Carolina?

Translated: What are barriers to more effective management of water resources in North Carolina?

- History – The current regulatory system has its origin in the natural abundance of fresh water in North Carolina.

- Agriculture – North Carolina has been unwilling to subject agricultural operations to the same level of scrutiny and regulation it has applied to other activities.

- Budget – The State's most effective tool in environmental management has been its financial budget. It is difficult to know whether the current regulatory framework is truly ineffective, because the State does not adequately fund its existing regulatory programs. The lack of monitoring and enforcement is just one obvious example.

- Information – We need a better picture of the current and future water resources conditions before we can develop a better water resources regulatory system. We need a more extensive stream gauging and monitoring well network. We need water quality monitoring coalitions throughout the state. We need to collect land use/land cover data more frequently and at higher resolution across the state. We need to collect water withdrawal data as thoroughly as we collect wastewater discharge data.

Should we continue to focus on evolving our existing regulatory structure, or would North Carolina be better off with revolution, a new regulatory structure?

- The American Society of Civil Engineers has published the *Regulated Riparian Model Water Code* which offers some reasonable guidance.

- Revolution in environmental regulation only occurs in times of obvious crisis.

- There are things we can do now, either within the existing framework of statutes and rules or with minor changes to those regulations that would allow us to make meaningful improvements to our management of water resources.

How does North Carolina's economic prosperity depend upon clean, healthy water resources?

- How does it not?
- We should conduct environmental suitability analyses for all of the areas in North Carolina that the Department of Commerce would like to target for industrial recruitment.
- We should then identify which industries would be best suited to which locations.
- The Department of Commerce could then focus its efforts on recruiting industries that are appropriate for any given area.
- This would help to prevent future Nucor scenarios (Chowan River, 2000).

How might clarifying or making water management more comprehensive help North Carolina address the potential impacts of climate change?

- If climate change would have an impact on North Carolina's water resources, it is likely that any impact would be widespread, and long-term.
- Hydrology is highly variable, naturally. Only through better monitoring and modeling would we know whether there were impacts.
- Only through longer-range and more comprehensive water resources planning would we be able to manage the impacts of climate change.

Can climate change itself be used as a leverage point?

- I doubt it.
- Climate change is too nebulous and temporally distant to serve as a crisis for revolutionizing North Carolina's environmental regulations.
- We are rebuilding Princeville in the same place where it was devastated by flooding in 1999.

the Nicholas Institute

The Nicholas Institute for Environmental Policy Solutions at Duke University is a nonpartisan institute founded in 2005 to engage with decision makers in government, the private sector and the nonprofit community to develop innovative proposals that address critical environmental challenges. The Institute seeks to act as an "honest broker" in policy debates by fostering open, ongoing dialogue between stakeholders on all sides of the issues and by providing decision makers with timely and trustworthy policy-relevant analysis based on academic research. The Institute's staff leverages the broad expertise of Duke University as well as public and private partners nationwide.

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