Report of the Estuarine Policy Steering Committee

Management Strategies for North Carolina's Estuarine Shoreline

Sea Grant Law Center

Sea Grant North Carolina

North Carolina Coastal Resources Law, Planning, and Policy Center

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Cover photos represent the four key topics of this report (clockwise from top right): Estuarine Shoreline Stabilization (Photo: N.C. Division of Coastal Management); *Groundwater Resources* (Photo: Robin Wienke); *Sanitary Sewer Overflows* (Photo: U.S. Environmental Protection Agency); *and Monitoring and Enforcement of Environmental Laws* (Photo: Courtesy of City of Raleigh, N.C.).

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Glossary of Acronyms

ASCE	American Association of Civil Engineers
ASR	Aquifer Storage and Recovery Facilities
BIMS	Basinwide Information Management System
CAMA	Coastal Area Management Act
CCPCUA	Central Coastal Plain Capacity Use Area
CDBG	Community Development Block Grant
Center	North Carolina Coastal Resources Law, Planning and Policy Center
CFC	Commerce Finance Center
CHPP	Coastal Habitat Protection Plan
CIP	Capital Improvements Plan
CMOM	Capacity, Management, Operation and Maintenance
CRC	NC Coastal Resources Commission
CWA	Clean Water Act
CWMTF	Clean Water Management Trust Fund
DCA	Division of Community Assistance
DCM	NC Division of Coastal Management
DEMLR	Division of Energy, Mineral and Land Resources
DENR	NC Dept. of Environment and Natural Resources
DMF	NC Division of Marine Fisheries
DOA	Department of Administration
DWI	NC Division of Water Infrastructure
DWM	NC Division of Waste Management
DWQ	NC Division of Water Quality
DWR	NC Division of Water Resources
E&SC	Erosion and Sedimentation Control
EDA	Economic Development Administration
EFH	Essential Fish Habitat
EMC	NC Environmental Management Commission
EPA	US Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
GCD	Groundwater Conservation Districts
GMA	Groundwater Management Area
GPD	Gallons Per Day
HQW	High Quality Waters
IBT	Interbasin Transfer
IFS	Infrastructure Finance Section
LEED	Leadership in Energy & Environmental Design
LGC	Local Government Commission
LRC	Legislative Research Commission
LWSP	Local Water Supply Plan
MDE	Maryland Department of the Environment
MGD	Millions of Gallons per Day
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOD	Notice Of Deficiency
NOV	Notice Of Violation
NPDES	National Pollutant Discharge Elimination System
NSW	Nutrient Sensitive Waters
NWASA	Neuse Regional Water and Sewer Authority
ORC	Operator in Responsible Charge
ORW	Outstanding Resource Waters
PWSS	Public Water Supply Section
REDD	Rural Economic Development Division
RIA	Rural Infrastructure Authority
RO	Reverse Osmosis
RUS	Rural Utilities Loan Service
SLR	Sea Level Rise
SNWA	Southern Nevada Water Authority
SRF	State Revolving Fund
SSO	Sanitary Sewer Overflow
SSS	Sanitary Sewer System
SWIA	State Water Infrastructure Authority
SWIC	State Water Infrastructure Commission
TAGD	Texas Alliance of Groundwater District
TCEQ	Texas Commission on Environmental Quality
TGPC	Texas Groundwater Protection Committee
TPWD	Texas Parks and Wildlife Department
TWDB	Texas Water Development Board
USACE	United States Army Corps of Engineers
USDA	US Department of Agriculture
VIMS	Virginia Institute of Marine Science
WET	Water Efficient Technologies
WMD	Water Management District

Introduction and Summary of Recommendations

From 2007-2009, the North Carolina Coastal Resources Law, Planning and Policy Center (Center), North Carolina Sea Grant College Program and North Carolina Division of Coastal Management (DCM) partnered to study emerging issues for managing the state's ocean shoreline. This study was known as the Ocean Policy Study. This two-year effort, which included input from a statewide steering committee and the public, resulted in a final report that was submitted to the North Carolina Coastal Resources Commission (CRC). The Ocean Policy Study's final report, "Strategies for North Carolina's Coastal Ocean," identified five major emerging issues – sand resource management, renewable energy development, ocean outfalls, marine aquaculture and comprehensive ocean management – and developed policy recommendations for each issue. During the Ocean Policy Study, the Center received requests from the public to conduct a similar study for the state's estuarine shoreline. This study is the outcome of those discussions, thus completing a comprehensive study of the emerging management and policy issues for the entire North Carolina coast.

North Carolina's estuarine, or inner coastal, system consists of approximately 23 inlets,[1] approximately 12,000 miles of estuarine shoreline,[2] and more than 3,000 square miles of brackish-water estuaries.[3] Some of these areas are rapidly developing, and those communities are experiencing the impacts. Issues such as habitat degradation, water quality and quantity changes, erosion and land loss, aging infrastructure, and conflicts over access are a few examples.

Coastal areas in North Carolina can expect to continue to experience one or more of the following: (1) increased levels of flooding; (2) increased erosion; (3) loss of wetlands and other coastal habitats; (4) invasion of saltwater into freshwater sources; (5) increased economic losses due to flooding and storm damage; and (6) damage to and loss of infrastructure.[4] However, each impact could be exacerbated by sea level rise (SLR). Estimates for SLR vary, and at local sites SLR may be higher or lower due to factors such as land subsidence, sediment compaction or geological uplift. Other groups, such as the Albemarle-Pamlico Conservation and Communities Collaborative, reported that North Carolina is expected to be one of the major three areas in the U.S. most affected by SLR because more than 2,000 square miles of the coast is less than three feet in elevation.[5]

In response to the issues presented by subsidence and any rise in sea level, and in order to protect life and property, some property owners along the estuarine shoreline are resorting to hardening their shoreline. In addition, local governments are considering solutions to protect infrastructure from flooding and coastal change. Developing and implementing solutions require careful examination of the science and the legal and policy obstacles that are in place. This study will add to the discussions already taking place at the state and local levels and in the homes and businesses of those living on the coast.

The three major objectives of this study were to: (1) identify the emerging natural resource issues that will impact North Carolina's estuarine coastline for the next 15-20 years; (2) provide technical information on the factors associated with them; and (3) recommend management strategies on how the state may address the issues.

To assist the Center, a steering committee was convened to provide technical expertise and to work with the Center to develop policy recommendations. This steering committee was

comprised of 17 members from state agencies, the private sector and academia. Together, the Center and steering committee identified four emerging resource issues for the coastal counties and municipalities near North Carolina's estuarine shoreline areas. These areas are referred to as the "inner coast" throughout this report to distinguish them from the oceanfront shoreline areas of North Carolina that were the focus of the Ocean Policy Study.

- Water availability
- Estuarine shoreline stabilization
- Monitoring and enforcement of environmental laws
- Sanitary sewer overflows (SSOs)

The Center and steering committee worked from summer 2010 through summer 2013 to research these issues and develop policy recommendations for how the State of North Carolina might address them. Below is a summary of these recommendations. Not all of the recommendations presented in this report were fully endorsed by every member of the steering committee. Where that occurred, it is noted in the report.

Water Availability

- The State of North Carolina should improve groundwater data collection.
- The N.C. General Assembly should increase funding for the N.C. Division of Water Resources' (DWR) monitoring well network to allow for an increase in the number of monitoring wells in the inner coast.
- The N.C. Department of Environment and Natural Resources (DENR) should establish a central water database.
- DENR should enhance public understanding of the state's water resources and water conservation methods.
- The State of North Carolina, its municipalities and water providers should encourage more efficient water use through water harvesting, gray water reuse and conservation.
- The State should encourage increased regional cooperation.
- The State should create a comprehensive surface water and groundwater program.

Estuarine Shoreline Stabilization

- The State's Marsh Sill General Permit conditions should be revised to ensure all estuarine shoreline stabilization structures are subject to comparable application and evaluation processes.
- The State of North Carolina should incorporate a hierarchical system for issuance of permits for activities related to shoreline stabilization along estuarine shorelines.
- The State of North Carolina should continue discussions with the Wilmington District of the U.S. Army Corps of Engineers (USACE) and other federal review agencies with the goal of drafting a USACE Regional General Permit or other regulatory mechanism for marsh sills, thus placing federal marsh sill permits on a level playing field with other erosion control structure permits.
- There should be an expansion of education and outreach to estuarine shoreline property owners, developers and contractors to increase awareness of all stabilization techniques, including marsh sills and vegetative plantings.

- DCM should facilitate classroom and field training for field agency staff on evaluation of all shoreline stabilization techniques, including marsh sills. Other state and federal agencies should be given the option to receive training.
- DCM should provide sufficient expertise and training support to educate and assist property owners with design and evaluation of all shoreline stabilization measures for the estuarine environment.
- Together with appropriate partners, the marine construction industry should be encouraged to develop a voluntary certification program and/or training for marine contractors in alternative shoreline stabilization techniques.

Monitoring and Enforcement of Environmental Laws

- In order to have a complete and effective permitting cycle to safeguard North Carolina's water supply and public waters and resources, the N.C. General Assembly and DENR should provide additional funds for water supply and quality compliance monitoring and enforcement efforts, including the implementation of a systematic inspection program.
- The N.C. General Assembly and DENR should establish a department-wide electronic system for sharing compliance and permitting information, both internally and with the public.
- The N.C. General Assembly and DENR should coordinate and streamline compliance monitoring and enforcement through the use of tablets, laptops, smartphones and similar technology in the field.
- DENR should grant each division, particularly the DWR and N.C. Division of Energy, Mineral, and Land Resources (DEMLR), the authority to develop expedited enforcement procedures for minor violations to streamline the enforcement process.

Sanitary Sewer Overflows

- The N.C. Environmental Management Commission (EMC) and DENR should incorporate into existing rules the requirement that municipal wastewater collection systems with 100,000 gallons per day (GPD) or higher have a certified operator as an Operator in Responsible Charge (ORC).
- The EMC and DENR should revise Title 15A Rule 02T.0403 to require that a minimum of 10% of a deemed permitted collection system's lines be cleaned on an annual basis.
- The N.C. General Assembly should put in place a dedicated fund for water and wastewater infrastructure maintenance and repairs.
- The State should establish a working group of experts to discuss and develop recommendations to address the issues associated with SSOs, as well as broader water and wastewater infrastructure issues, in North Carolina's rural counties and municipalities.
- Local governments should focus on capital improvements planning and asset management planning, to aid in budgeting for improvements that will avoid and minimize the effects of wastewater collection system failures.

Endnotes – Introduction and Summary

[1] S.R. Riggs, S.J. Culver, *et al*., East Carolina University, North Carolina's Coasts in Crisis: A Vision for the Future 3 (2008). Although this study focuses on North Carolina's estuarine shoreline, please note that the state has approximately 325 miles of ocean shoreline as well.

[2] Kevin McVerry, N.C. Dep't of Env't and Natural Res., Div. of Coastal Mgmt., North Carolina Estuarine Shoreline Mapping Project: Statewide and County Statistics 17–18 (2012), *available at* http://dcm2.enr.state.nc.us/estuarineshoreline/ESMP%20Analysis%20Report%20Final%2020130117.pdf

[3] S.R. Riggs, S.J. Culver, et al, East Carolina University, North Carolina's Coasts in Crisis: A Vision for the Future 3 (2008).

[4] S.R. Riggs and Dorothea V. Ames, North Carolina Sea Grant, Drowning the North Carolina Coast: Sea Level Rise and Estuarine Dynamics 64 (2003).

[5] Albemarle-Pamlico Conservation and Communities Collaborative, Public Listening Sessions: Sea Level Rise and Population Growth in N.C. Report 29 (2009), *available at* http://portal.ncdenr.org/c/document_library/get_file?uuid=a756e1a5-1ece-4ae7-99c1-59b58cc7f076&groupId=61563.

Chapter 1: Promoting the Sustainable Use of Inner Coast Groundwater Resources

The availability of adequate, inexpensive potable water supplies is critical to meeting the needs of North Carolina's projected population growth and the associated development of the inner coast region over the next 20-30 years.[6] In one sense, water is plentiful. Eight major groundwater aquifers lie under various portions of the inner coast region. Coastal river flow is good, with groundwater supplying a strong base flow.[7] With desalination, estuarine and ocean waters sit ready to be tapped.[8] Rivers, estuaries and ocean water, however, require significant, costly treatment before they can be used to meet municipal, industrial or agricultural needs.[9] So, historically, the major source of *inexpensive, high-quality* water to serve the areas along the inner coast has been groundwater.[10]

Groundwater – the collection of water beneath the surface in saturated layers of rock or aquifers – is a finite, somewhat invisible, resource. The public can see and sense when surface water supplies from rivers, streams and lakes are being contaminated, over-utilized, and perhaps mismanaged. This is not necessarily the case with groundwater because it lies beneath the surface and can easily be taken for granted. The public assumes that its groundwater use is both sustainable and safe – unless their wells must be drilled deeper, there is a dramatic increase in water rates, or there is notification of contamination. But population growth, increased development, climate change, and contamination from a variety of sources jeopardize the long-term quality and sustainability of the resource. The goals of this chapter are to: (1) identify the groundwater resources for North Carolina's inner coast; (2) discuss the limits on their sustainability; (3) describe the state's current groundwater regulatory program; and (4) make recommendations for future management of these groundwater resources in order to ensure their long-term sustainability.

Dynamics of Inner Coast Groundwater Resources

Groundwater is contained in natural aquifers, or more accurately, aquifer systems – rock units comprised of sand, limestone and fractured rock that hold water in sufficient quantity and with sufficient mobility to be useful as a water source.[11] Aquifers can be localized, isolated formations or part of a larger underground system. Most aquifers are created by water entering at the surface through rainfall, then slowly traveling through the voids in between particles, and eventually collecting in these formations. As water is withdrawn from the aquifer, the aquifer will be recharged as new water enters the system at the surface. The recharge rate depends on the porosity and permeability of the underlying sediment or layers of sediment, which vary from aquifer to aquifer. In the North Carolina coastal plain, deeper aquifers are usually comprised of one to several layers of limestone and sandstone, while shallower aquifers contain unconsolidated sediments made up of sand, shell materials, limestone and combinations thereof. These layers of sediments act as natural filters, with the smallest particle-layered aquifers producing high-quality water.

Aquifers vary in form and water-producing capabilities. A confined aquifer is sandwiched between two impermeable membranes, creating a pressurized aquifer that allows well water levels to rise above the levels of the aquifer.[12] An unconfined aquifer has an impermeable membrane underlying it with a permeable or semi-permeable membrane above it, which allows water levels

to fluctuate with the water table. As naturally occurring formations, aquifers are also categorized by their age. Older aquifers are deeper beneath the surface; newer aquifers are closer to the top. As illustrated below, the aquifers are separated by sediments similar to cake layers.

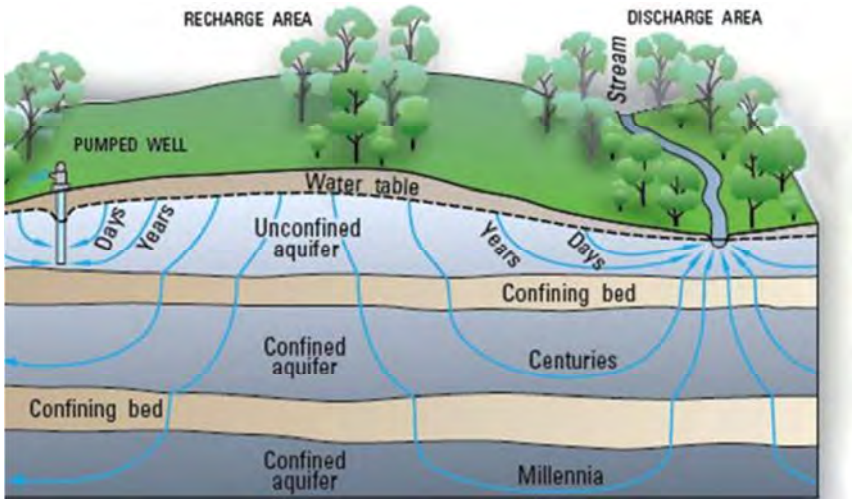


Figure 1: Layers of an Aquifer[13]

The groundwater within an aquifer is never static and is in constant motion, flowing from areas of recharge to areas of discharge.[14] As water is withdrawn for municipal, industrial, agricultural or household uses, normal precipitation will penetrate the soil and percolate into the aquifers and recharge them. If the two processes are in balance, the aquifer will be sustainable.

The recharge rate is not always the same as the discharge rate. The recharge rate can be very slow. The number of layers, types, and permeability of the overlying rock is one factor that determines the recharge rate. Rainwater availability is the other factor that will significantly impact the recharge rate. A very small percentage of rainfall filters into the confined aquifer system. Most rainfall is lost to evaporation, runoff, or infiltration into the shallow groundwater system which discharges into local rivers and streams. The discharge rate depends on the amount of water municipalities, industries, agricultural operations and individual households are extracting from the resource.

There are eight large-volume regional aquifers in the coastal regions that are heavily utilized in municipal, industrial and agricultural applications. The Peedee, Black Creek, Upper Cape Fear and Lower Cape Fear aquifers are Cretaceous aquifers, while the Beaufort, Castle Hayne, Yorktown and surficial aquifers are all comprised of younger age deposits.[15]

The most-utilized aquifers are the Castle Hayne, Upper Cape Fear and Black Creek. The Castle Hayne aquifer covers the eastern half of the coastal plain and has the highest production in the state.[16] The southern and western portions are closer to the surface than the deeper eastern sections, which are more than 300 feet thick in certain areas. The rate of recharge for the Castle Hayne aquifer is approximately one inch to one foot per day, which equals an estimated 280 million gallons of water. Much of this is from the 40 inches of rainfall per year in the area around

the aquifer.[17] However, wells withdraw significant amounts from the Castle Hayne aquifer daily.[18] As of 2012, the maximum daily permitted withdrawal from all users is more than 340 million GPD, *60 million gallons more* than the estimated amount of daily recharge.[19]

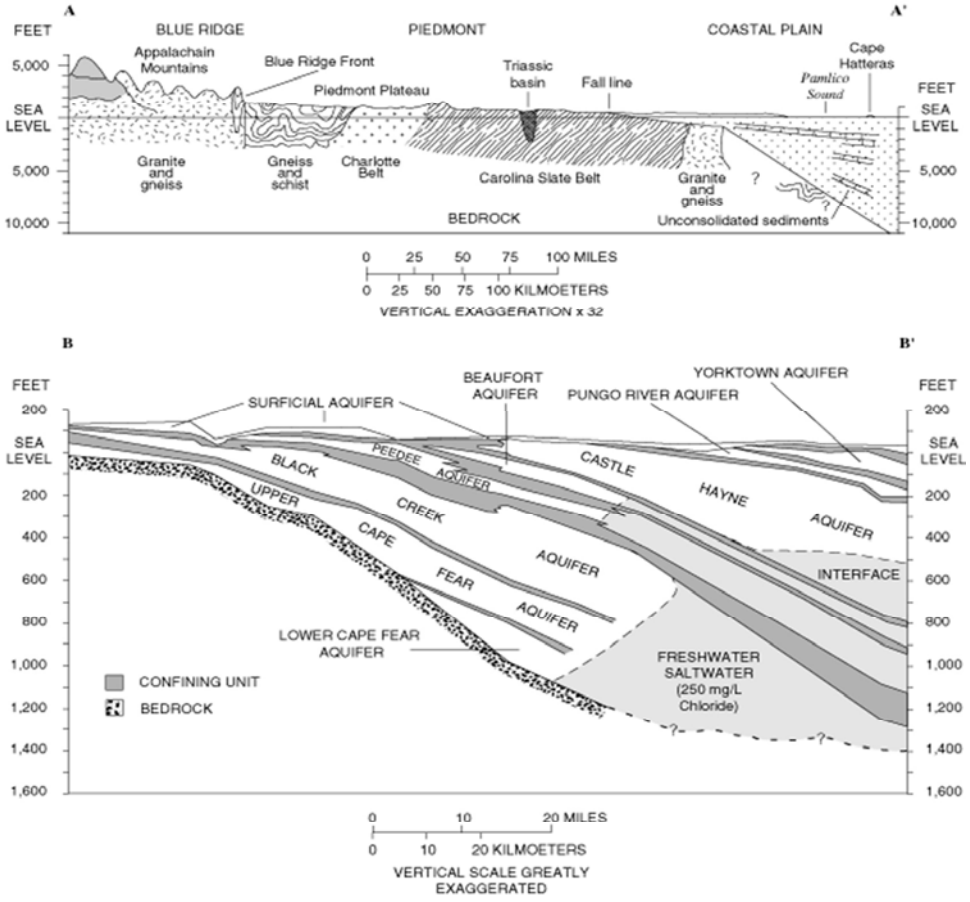


Figure 2: Major Groundwater Aquifers of the Inner Coast (Geologic section A-A' across North Carolina and hydrogeologic section B-B' in the Coastal Plain region).[20]

The Upper Cape Fear is a late-Cretaceous period aquifer,[21] and it stretches across the eastern part of the state, running through Northampton County in the north to Richmond and Moore Counties in the south.[22] This aquifer is "particularly sensitive to pumping because it is well confined by thick overlying clay beds" that limit recharge.[23] While the exact rate of recharge is unknown for the whole coastal plane, the DWR estimates that out of 50 inches of rainfall per year, only one inch reaches confined aquifers as recharge.[24]

The Black Creek aquifer is another late-Cretaceous period aquifer, and it underlies the central and southwestern regions of North Carolina's coastal plain.[25] The average thickness of the aquifer is 159 feet, although it is as thick as 448 feet in some areas.[26] Because of the high water quality, this aquifer has been the most heavily used aquifer in the central coastal plain.[27] In 2011, nearly four million more gallons than the permitted daily maximum were withdrawn from the Black Creek

aquifer.[28] The combination of agricultural, industrial and municipal demand pressure on the Black Creek aquifer has caused dewatering to occur in some areas.[29]

The Yorktown aquifer is the second-closest aquifer to the surface. The layers are mostly fine sand, silt, and clay with shells. At its shallowest, it is less than five feet thick, with the thickest point being nearly 1000 feet.[30] The Yorktown aquifer yields hard water and contains lower quality water than deeper aquifers;[31] as a result, users withdrew less than eight percent of the daily permitted maximum.[32] The Beaufort aquifer ranges from 10 to 253 feet thick and consists of medium glauconitic sand, clay sand, and sporadic limestone beds with shells.[33] The Peedee aquifer averages 141 feet thick and generally has low rates of recharge; it is the primary aquifer in Brunswick County is and also used in New Hanover County.[34] The Lower Cape Fear aquifer averages 392 feet thick consisting of fine to coarse sand. The water levels in the aquifer have been declining up to two feet annually, due to leakage induced by pumping in the Black Creek and Upper Cape Fear aquifers.[35]

The surficial aquifer is closest to the surface before the first layer of confining bed.[36] Shallow wells provide a good source of groundwater with high infiltration rates, but are most susceptible to contamination because they are closer to the surface.[37] The recharge rate varies across the surficial aquifer, with areas underlying Brunswick County receiving four inches of recharge annually, while the area underlying the coastline of Pender, New Hanover and Brunswick counties may receive up to 20 inches.[38] Water quality tends to be poor, so large-scale industrial, agricultural and municipal uses are not practicable, and usage is primarily domestic.[39]

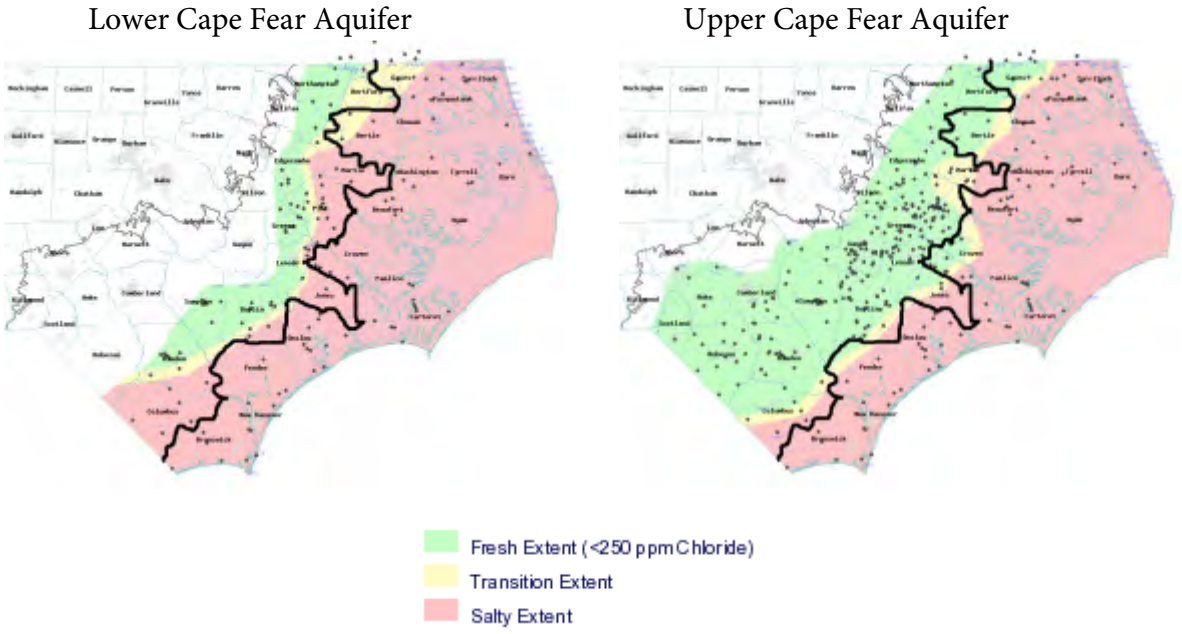


Figure 3: Aquifers of North Carolina's Inner Coast
(The black line represents the western boundary of the coastal counties)

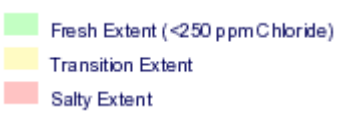
Black Creek Aquifer

Peedee Aquifer

Beaufort Aquifer

Castle Hayne Aquifer

Yorktown Aquifer



Aquifers of North Carolina's Inner Coast (continued)*[40]

Groundwater Sustainability Concerns

A major threat to coastal groundwater aquifers is saltwater intrusion. Coastal aquifers extend beyond the coastal land mass. As a result, the upper portion of the aquifer lying under the coastal land mass will contain freshwater and the lower part lying under ocean waters will contain saltwater. Somewhere in between – an area that varies from aquifer to aquifer and place to place – lies the freshwater/saltwater interface. If sustained withdrawals of freshwater exceed the natural freshwater recharge rate, then the pressure balance between freshwater and saltwater will be upset and saltwater will move into areas previously filled with freshwater. With wells becoming salty, additional water treatment is necessary, and eventually, wells may have to be abandoned.

Excessive removal of groundwater may cause saltwater intrusion, but also raises other concerns. The over-pumping of groundwater may cause the water levels to drop below the top of the aquifer, creating a void. With nothing to support the layers of sediment above, eventually the ceiling of the aquifer becomes too heavy and compresses down to the current, lower water level. This results in lower water yields from the aquifer because water retention capabilities are permanently diminished. Other consequences of over-pumping are the slowing of groundwater movement, and in more extreme cases, groundwater-related subsidence. Subsidence can potentially cause thousands of dollars in damages depending on where the sinkhole manifests itself. In fact, excessive pumping of groundwater is a major cause of subsidence in the United States.[41]

Groundwater also has a natural directional flow towards natural discharge areas in streams, rivers or the ocean. Redirection occurs from over-pumping when a cone of depression forms around the well, redirecting the water to the lower density area of the cone. Redirection can cause a greater risk of contamination and of saltwater intrusion of deeper confined aquifers in the coastal plain, as run-off that is contaminated or from saline water bodies might be redirected away from its regular course and seep into groundwater systems.

Present Usage

As a result of the increased population, related development, the impact of changes in groundwater extraction rules, and shifts from surface to greater groundwater use during North Carolina's periodic droughts, overuse of aquifers is a pressing issue for the inner coast, especially the central coastal plain. The counties that fall under the Coastal Area Management Act (CAMA) and comprise the estuarine shoreline areas referred to in this document as the "inner coast" have seen a steady increase in population as well as a significant jump in groundwater use. In 1995, the inner coast counties were home to 762,730 inhabitants and used approximately 105 million GPD of groundwater.[42] By 2005, the combined population of the inner coast counties totaled just less than 900,000 people, and the daily groundwater use grew to approximately 219 MGPD.[43] This data indicates that in 10 years, the population of the inner coast counties grew by 16 percent, while the daily demand for groundwater grew by 109 percent. Future increases may be even more dramatic, e.g., The News & Observer reported in 2006 that "more than 34,000 homes in nearly 100 subdivisions and condominium projects are planned or are now going up" and that "more are expected."[44]

A hint of what may lie in the future is the Central Coastal Plain Capacity Use Area (CCPCUA). Overuse of the deep Cretaceous aquifers necessitated both the creation of the CCPCUA and the

restriction on withdrawals from the Cretaceous aquifers.[45] The CCPCUA Rules detail a 16-year plan that mandates decreased use of the deeper Cretaceous aquifers. Because the CCPCUA Reduction Rules do not apply to the Castle Hayne aquifer (a non-Cretaceous aquifer),[46] the water demand has shifted to it,[47] raising the potential for overuse of this aquifer as well. [48] Other aquifers facing a similar danger of overuse include parts of the Black Creek[49] and Upper Cape Fear aquifers. For these aquifers, the danger is significantly higher because of their lower permeability and lower recharge rates. Maintaining the health of these aquifers may require expanding the coverage of the CCPCUA.

Seasonal droughts exacerbate the potential overuse of inner coast aquifers. Even though the statewide rainfall averages 115 billion GPD, the reality is that rain does not fall at the same rate every day.[50] Seasonal precipitation causes floods as well as droughts, and North Carolina has experienced periodic drought episodes since 2000.[51] During drought conditions, a lack of available surface water and a reduced rate of recharge increase the demand for water from the inner coast's confined aquifers. These conditions also decrease their ability to replenish what is taken, with much lower levels of rainfall available for recharge.[52]

The Future: Increased Water Treatment?

Rising coastal populations have increased demand for water. As a result it has become necessary to tap deeper aquifers of lower quality or use brackish or salty surface waters requiring treatment before the water is suitable for use. Typically, the treatment uses a reverse osmosis (RO) process to remove salt and other harmful materials.[53] The disposal of the wastewater from RO could lead to an environmental issue.

Wastewater from RO either requires costly treatment or expensive transportation to an area where it will not have an environmental impact. One solution, saltwater evaporation, does not appear to be feasible.[54] The discharge wastewater from RO plants has four times the natural levels of substances such as fluoride and copper, and it is unclear whether the salt can be utilized with this additional contamination. Also, the turnover rate to evaporate the large amount of discharged water is too slow.[55]

Disposing the discharge into coastal rivers, estuarine waters, and other water areas may be an environmentally acceptable solution. A recent study of the saline water discharge from water treatment plants in the northeastern part of the North Carolina coast gave promising initial results. At the request of counties in the area, Dr. Roger Rulifson and colleagues at East Carolina University conducted a three-year ecological assessment of the Pasquotank County water treatment plant.[56] The study compared the discharge area of the Pasquotank County RO plant to the Camden County RO plant. The results of the study found similarities in water quality and organisms. Also, the proposed area had high movement energy, enhancing dilution prospects from the proposed Pasquotank RO plant. Species of fish common to both discharge sites remained, and the relative abundance of benthic organisms showed no effect from the discharge plume. Although the results showed minor impacts, the comparison focused on effects of water in Albemarle Sound. A follow-up study of this encouraging, but limited, study was recommended, but it has not been conducted yet due to a lack of funding.

Another method used to treat saltwater is the distillation process. During the distillation process, untreated water is heated to the point of boiling when it begins to vaporize. Water separates from other contaminants through the boiling process because it boils at a lower temperature than salt

and other minerals. The vaporized water travels through a condenser where it is cooled into liquid water and collected in a separate container. The entire process is then repeated until the remaining water is purified to desired standards.

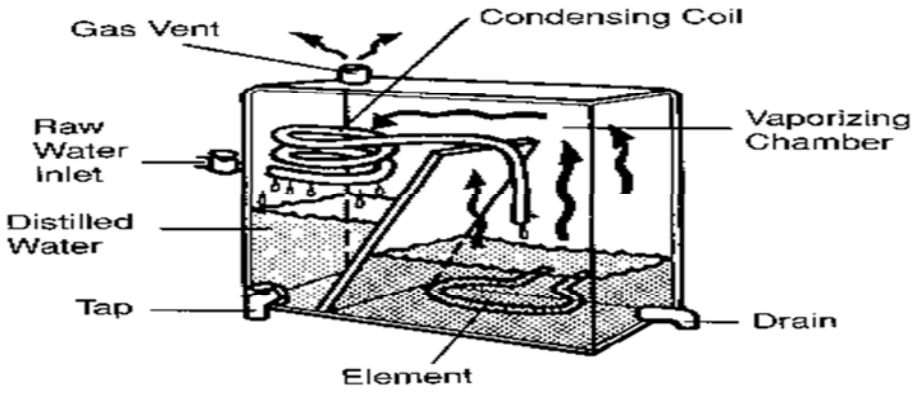


Figure 4: Distillation Process[57]

In comparing RO against the distillation process, RO is the more cost-efficient treatment for saline water, primarily because of the amount of energy required to heat the water in the distillation process.[58] However, both can have adverse environmental impacts caused by the discharge during the treatment process.

Current North Carolina Law Regulating Groundwater Withdrawals

Central Coastal Plain Capacity Use Area

Demonstrated over-pumping of water from the Cretaceous aquifers, which are the principal source of water for the central coastal plain counties, prompted the EMC to create the CCPCUA in 2002.[59] The 15 counties involved are: Beaufort, Carteret, Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pamlico, Pitt, Washington, Wayne and Wilson.[60] The designation as a CCPCUA county means that there is a non-sustainable extraction of groundwater from the underlying Cretaceous aquifers to meet the area's present water demands.[61] The primary goal of the CCPCUA is to reduce these withdrawals from the Cretaceous aquifers to sustainable levels by forcing water users to increase their use of alternative resources. Alternative resources include surface waters and elevated use of non-Cretaceous aquifers, such as the Castle Hayne.

To eliminate the over-pumping of the already stressed Cretaceous aquifers, the CCPCUA Rules require a reduction in their use. This reduction is to take place in three stages over a 16-year period. During the first phase, which ended in 2008, pumping base rates were established and extractions reduced by 10-25%. The second phase ends in 2013 and with the goal of 20-50% reduction. The final phase ends in 2018, at which time there would be a 30-75% reduction in extractions from the Cretaceous aquifers. The variance in reduction levels at each phase corresponds to the area in which users are located. Higher levels of reduction are required of users in the dewatering and salt-water encroachment zones, while users in the declining water level zone are subject to lower levels of reduction.[62]

Control over groundwater withdrawals is exercised through withdrawal permit systems. Such permits are required for the extraction of groundwater withdrawals within the CCPCUA. Under existing CCPCUA Rules, extracting more than 100,000 gallons of groundwater per day from any aquifer within the CCPCUA requires a permit,[63] and users must report usage data four times annually.[64] Those who extract more than 10,000 gallons of groundwater per day, but less than 100,000, must register with the DWR and report withdrawals once per year.[65]

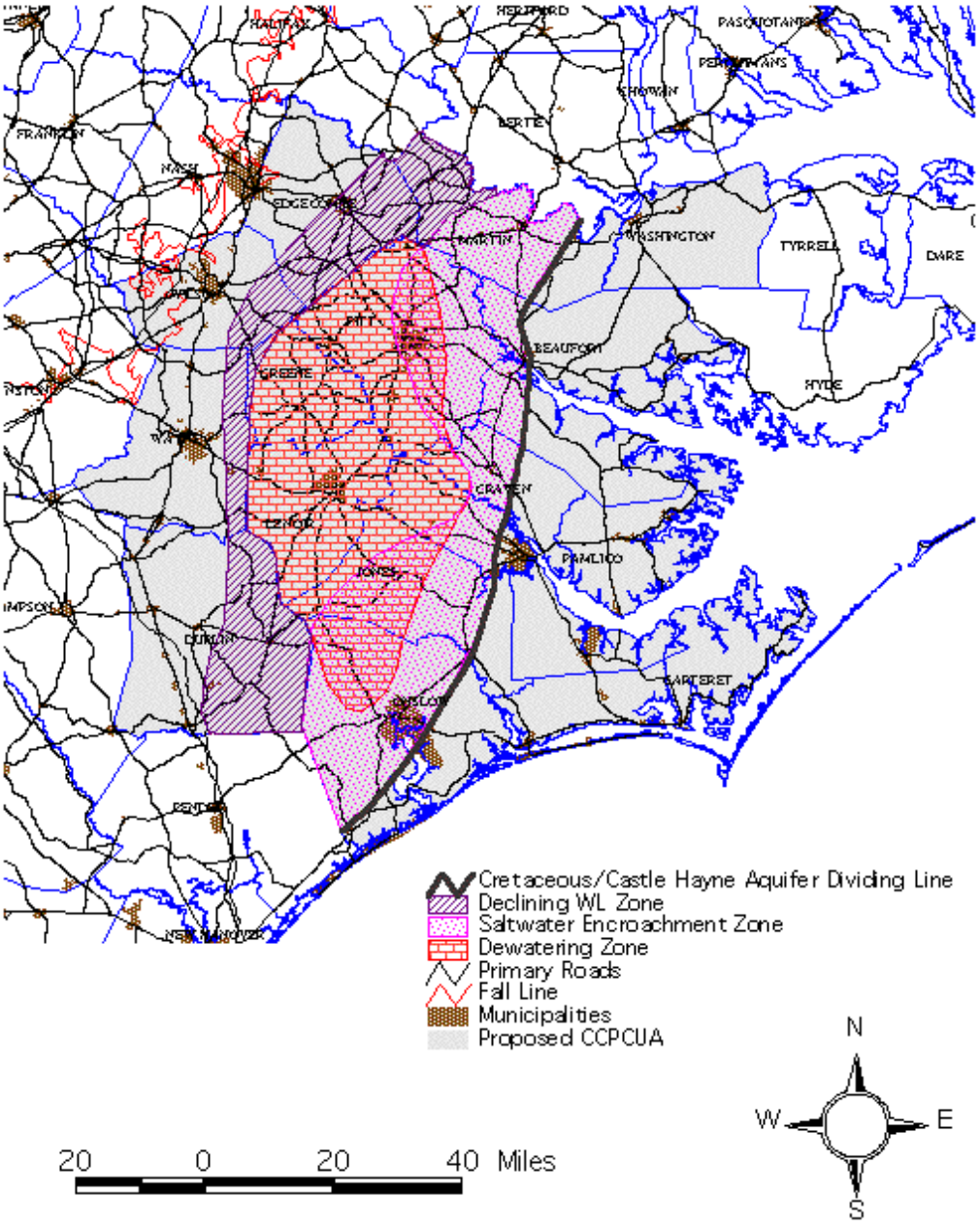


Figure 5: CCPCUA Cretaceous Aquifer Zones[66]

Impact of the CCPCUA Rules

In response to the CCPCUA groundwater reduction plan, several towns and corporations created a cooperative partnership called the Neuse Regional Water and Sewer Authority (Neuse Regional WASA, or NWASA) to investigate and develop alternative water resources.[67] NWASA reduced groundwater withdrawal and turned to the Neuse River to satisfy local demands. Construction of a high-quality water treatment plant was completed in 2008 and currently treats an average of 44 million GPD.[68] According to NWASA, the Neuse River Basin shows water level improvements in the aquifers surrounding the plant.[69] But while the CCPCUA Rules require that public water systems "adopt… a water conservation-based rate structure, such as: flat rates, increasing block rates, seasonal rates or quantity-based surcharges,"[70] water rates from 2008 suggest that the CCPCUA utilities have been lax in adopting pricing structures that encourage conservation. In many cases, prices in the CCPCUA have been less expensive than prices outside of the area.[71] While some pricing schemes suggest an effort to follow the CCPCUA Rules guidance, it appears there is much room for improvement.[72] Failure to adopt these pricing strategies will limit incentives to reduce water consumption and impair the effectiveness of the CCPCUA Rules.

The transfer demand from the Cretaceous to other aquifers does not solve issues of non-sustainable withdrawals from existing groundwater resources. Originally, Marine Corps Base Camp Lejeune used the Castle Hayne aquifer, while the rest of the county relied on the Cretaceous aquifers. The City of Fayetteville and Cumberland County dug new wells to tap into the Castle Hayne aquifer after the State required a 75% reduction in use of the Cretaceous aquifers over the 16-year period per the CCPCUA Rules. Camp Lejeune's plans to increase the size of the base to accommodate 11,000–50,000 more people means that, in the future, the marine base will require more water from existing water supplies. These actions risk over-pumping of the Castle Hayne aquifer and may result in greater saltwater intrusion of that aquifer. Demand pressure also appears to have shifted to the Yorktown aquifer raising concerns about the continued health of that aquifer. There is evidence that current pumping rates are outpacing recharge rates and salinity is rising in the Yorktown aquifer.[73]

Outside the CCPCUA

Outside CCPCUA locations/areas, there are no legal restrictions on water use other than "reasonableness."[74] Reasonableness recognizes that anyone whose property lies above an aquifer has the right to use the water in the aquifer. All such property owners have equal rights with respect to the removal and use of water. These rights are not without limits. Property owners are limited in their use to similar rights of other owners who own land above the aquifer. An owner has a right to extract water from the aquifer as long as he does not pollute it or use so much of the water as to prevent other people from having equal enjoyment of the resource. Although "reasonableness" is meant to be an objective standard, it obviously is not always consistent or easy to implement.

Outside of the CCPCUA, large volume water users do not need permits. However, in some limited circumstances they are required to register withdrawals exceeding certain thresholds.[75] For non-agricultural users, the threshold is 100,000 gallons or more in any one day. For agricultural users, the threshold is 1,000,000 gallons or more in any one day.[76]

Local Water Supply Planning

Groundwater in North Carolina is divided into western and eastern regions. The mountains and piedmont make up the western region while the coastal plains are in the east. In 2001, DWR created the North Carolina Water Supply Plan, which is the state's first and only document of its kind.[77] The plan was created using 500 local water supply plans (LWSPs) and includes water supply needs, uses, availability in the state, and major issues over the next 20 years. DWR is currently working on corresponding plans for each major river basin in the state.[78] Current legislation requires all local governments and community water systems that have at least 1,000 connections or serve more than 3,000 citizens to create a LWSP and update it once every five years. Each LWSP is meant to provide information on its current system, water use, water supply, wastewater and planning.

Proposed Legislation

During the 2011-2012 session of the N.C. General Assembly, Senate Bill 668 was introduced to create a water/wastewater central database.[79] As part of this legislation, North Carolina would require a central database that consolidates and integrates statewide information on water and wastewater infrastructure as a resource for government agencies, policy-makers, and applicants. The bill was introduced in the Senate and referred to the Committee on Agriculture, Environmental and Natural Resources on April 20, 2011, but did not move out of committee.[80]

Alternative Sources to Groundwater

Available groundwater resources will not be sufficient to meet the needs of a growing inner coast. For their long-term viability and growth, inner coast municipalities and industrial, commercial and agricultural operations will need to look to alternative water sources. Increased water treatments and utilization of surface water are the leading alternative sources of groundwater for the state. Interbasin water transfers may be a feasible means of meeting inner coast water needs on a large scale. On a small scale, individuals and businesses may consider greater water conservation and increased use of rain barrels and cisterns to alleviate conservation burdens. Technology, of course, may also help meet the inner coast's water needs. The following section explores these potential alternative sources of water and the environmental issues and challenges presented by each. In the world of water, there are no easy solutions.

Interbasin Transfers

As concerns regarding aquifer overuse and its effects continue to rise, large-scale movement of surface water from areas of relative abundance to areas in need provides another solution that may be utilized as an alternative to groundwater extraction. This movement of water from one river basin to another is referred to as an interbasin transfer (IBT).[81] In North Carolina, such a transfer often occurs as a result of a withdrawal from one community's public water supply – a reservoir, river or other surface water site – into another community's surface water site.[82]

Although IBTs hold the prospect of answering the water needs of some communities, this method is not without environmental costs. Environmental impacts of IBTs vary due to differences in localities, but potential adverse effects include induced seismic activity, changes in water temperature and chemistry, alteration or destruction of habitats, and altered water flow.[83]

More Efficient Water Use: Water Harvesting, Reuse and Conservation

Water Harvesting: Rain Barrels and Cisterns

Rain barrels are large containers set up to catch rainwater from rooftops, while cisterns are larger containers that are stored above or below ground.[84] Rainwater collected from either receptacle is used for watering lawns, washing clothing, washing cars, or as toilet water. In general, this form of water harvesting is used on an individual level, and the benefits range from local advantages such as reducing municipal water demand or reducing stormwater runoff to broader gains such as increasing groundwater recharge. The greatest obstacles facing governments promoting water harvesting are negative public perceptions of rainwater and increased homeowner responsibility in managing a water harvesting system.

Homeowners must regularly check the system to ensure it is functioning properly. During winter months when temperatures are below freezing, homeowners must check rain barrels to ensure barrels are not damaged if the water freezes or backs up into down spouts. Moreover, open barrels during summer months can attract disease-carrying insects such as mosquitoes. Although homeowners have some additional burdens, the effective utilization of water harvesting has substantial monetary and environmental benefits.

Legislation passed in 2008 allows citizens to save and reuse rainwater.[85] But, currently there are no statewide rain barrel distribution systems or mandated use of rain barrels or cisterns. Some local governments, however, do promote rain barrel and cistern use.

To encourage the saving and reuse of rainwater, North Carolina could, as some other states have done, offer financial incentives through exemptions from sale tax in acquiring or installing such equipment as well as exemptions in property taxes.[86] Developers could be encouraged to include such systems in newly constructed homes, apartments and office buildings. And the State could be an example through modeled use in state government buildings.

Encouraging Reuse (Gray Water)

There are currently no tax breaks, credits or other incentives to use gray water.[87] In fact, residential gray water use is illegal in North Carolina because it is considered "sewage."[88] However, gray water is significantly different than toilet waste and other types of "black water" and, under appropriate guidelines, may be safely used for irrigation and even some indoor purposes, such as flushing toilets. Utilizing gray water use could have a significant impact on a community's water demands because "gray water sources in an average household comprise more than half of the water used indoors."[89] Tapping all gray water sources in a household could meet most home landscape watering needs, helping to offset groundwater demand and reducing household water bills.[90] Clearly, a new way of thinking about gray water is needed, incentives to use gray water should be created, and current rules require modification. Public education, statistics on the amount of water and energy use, and greenhouse gas reductions can be persuasive in playing a role in this effort.

Conservation: Responsible Water Use

Conservation, while not an alternative water source, can help alleviate current strain on groundwater availability. In the town of Cary, for example, current conservation methods are estimated to reduce water demand by 4.6 million GPD by 2028, delaying two water treatment plant expansions.[91] Unfortunately, summer droughts and increased population were the catalyst for this conservation initiative.[92]

There are two types of conservation methods: short-term and long-term. Short-term conservations methods are often used during emergency situations, such as droughts. These initiatives usually include restriction of water use to essential activities or times during the day with accompanying fines for violations. Long-term conservation methods seek more efficient water use.[93]

In North Carolina, conservation methods are implemented through local governments, but the data suggest there is room for improvement in the state's embrace of these methods. According to submitted LWSPs, 31% of water systems have created a leak detection program, with an additional 26% pursuing this conservation tactic.[94]

Even if North Carolina and its citizens recognize the importance of water conservation, some utility companies may resist taking steps to promote conservation efforts. For example, the cost of creating a water treatment facility is expensive, often financed through federal loan and private investment programs. The revenue to repay loans or pay returns to investors depends on daily water use of the facilities customers. Therefore, these utility companies may not promote conservation because any decreased customer water use would reduce that revenue stream or require the raising of water rates.[95] But, a loss of short-term revenues may in fact be offset in the long run if conservation efforts reduce or delay the need to construct expensive, additional treatment facilities. And, of course, conservation helps protect the groundwater resource upon which the companies' business depends.

Recommendations

The State of North Carolina should improve groundwater data collection.

The steering committee recommends increasing groundwater use data collection. As previously noted, groundwater in the inner coast is a finite resource, and it is anticipated that future demand will increase. Currently, the lack of information regarding groundwater usage of *all* users in the inner coast prevents the true impact of such usage from being fully understood. Gaps exist in data collection currently, due to the structure of the reporting requirements and lack of sufficient number of monitoring wells.

By expanding current reporting requirements to all groundwater users within the inner coast that withdraw more than 100,000 GPD, many of the current gaps in information noted throughout this report could be filled.[96] Increasing these reporting requirements would support the goal of greater data collection and monitoring without restricting use. Upon collection and analysis of more comprehensive usage data, further regulation could be imposed if found necessary to ensure sustainable groundwater availability.

The N.C. General Assembly should increase funding for the DWR's monitoring well network to allow for an increase in the number of monitoring wells in the inner coast.

The steering committee recommends that the number of monitoring wells in the inner coast be increased. DWR has a monitoring well network that includes 587 wells throughout the state. This network can be used to monitor drought conditions and water level changes in the inner coast. Edgecombe County has just one monitoring station, while Martin County has two; some counties in the coastal plan have no such stations. It would be ideal to double or triple the number of monitoring wells in the region. Each deep-well monitoring station, which consists of several wells and can assess multiple aquifers, would cost $100,000-$120,000 to build and could be done in stages over the next 10 years. This is being done on an annual basis currently, and it is important to maintain a systematic program to drill additional monitoring wells through consistent funding from the General Assembly.

DENR should establish a central water database.

The steering committee recommends that DENR establish a centralized water database system. Such a system would provide one common, comprehensive source of information as to the current status of the state's water resources. Such a database is essential to the making of well-informed policy decisions and the education of the public about the proper management of the State's water resources. The database should be in a user-friendly format, readily accessible to the public, applicants, government agencies and policymakers, and provide information as to the current status of the State's surface and groundwater resources and projected future needs. The database should also provide information about current and proposed infrastructure projects, including the project cost, amount of State funding, and the identification of any other funding sources. Such a centralized system would provide transparency and promote inter-agency cooperation and comprehensive regional and statewide cooperation in planning.

DENR should enhance public understanding of the state's water resources and water conservation methods.

The steering committee recommends that DENR take steps to enhance the public's understanding of the state's water resources and water conservation methods. Public awareness and co-operation are pivotal to the future sustainable use of the state's water resources. This will require more extensive efforts to educate the public about the nature of, present and future demands for, and current and projected status of the state's water resources and about what the public can do to assist in maintaining the long-term health of the resources.

Currently, the Environmental Protection Agency (EPA)[97] and the State of North Carolina[98] mandate water quality reports to be distributed to most users on an annual basis. These bill inserts and pamphlets also can be an effective medium for information about groundwater use and conservation. Having more data available due to increased collection will enable water providers to offer specific information on usage levels and encourage more responsible use in specific target areas. For easy-to-use and accessible information, maintaining a website with integrated social media accounts to provide tips, alerts and updates can be part of an effective public outreach system that would not incur printing or postage costs.

The State of North Carolina, its municipalities and water providers should encourage more efficient water use through water harvesting, gray water reuse and conservation.

The steering committee recommends that the State, municipalities and water providers take steps to encourage water harvesting, reuse and conservation. Educating the public about the nature, extent and need for sustainable use of the state's groundwater resources naturally leads to encouraging the public to take actions to reduce the demand placed upon this resource. Water harvesting and water reuse are two such practical, low-cost actions. Water providers can play an important role in encouraging the sustainable use of the state's water resources by educating the public about more efficient water use and by taking the steps necessary to make sure that their water delivery systems are efficient. Therefore, the committee recommends that the State encourage water harvesting and water reuse by the public and more efficient delivery of water by water providers by providing appropriate financial incentives and by authorizing and setting standards for the reuse of gray water.

The State of North Carolina should encourage increased regional cooperation.

As mentioned earlier in this chapter, although Session Law 2011-374[99] provides an incentive for greater regional cooperation, the steering committee recommends that additional steps be taken to encourage such cooperation. Presently, planning and resource management varies widely, from tighter restrictions in the CCPCUA and in the CAMA counties to very few limits in other regions. With different priorities and policies, cooperation is challenging.

By setting up a system in which there is statewide coordination and cooperation, supply and water treatment issues can be handled more efficiently. Such a system would also help communities avoid creating duplicative infrastructure; neighboring regions might also be able to share a treatment center rather than having two individual, underutilized facilities, for example. Regional cooperation will encourage consistency in planning and make it easier for communities to work together to solve problems. Such consistency will also allow smaller communities to

emulate the success of larger communities by following set examples of planning and infrastructure as they grow. Increased cooperation and awareness of groundwater management in other regions could also spur innovation and allow communities to share best practices. Appendix A details regional cooperation efforts in Texas, Florida and City of Las Vegas that could serve as models for North Carolina.

The State of North Carolina should create a comprehensive surface water and groundwater program.

The steering committee recommends establishment of a comprehensive groundwater and surface water management program. Presently, North Carolina lacks such a program. Surface water and groundwater are managed separately. Meeting the future water needs of the inner coast will require effective management of both water sources. Restrictions on the use of groundwater inevitably led to attempts to utilize any available surface water resources, thereby putting additional environmental stress on those resources. Comprehensive management could significantly reduce this stress as well and is crucial for meeting statewide needs as North Carolina grows.

Session Law 2011-374 was signed into law on June 26, 2011, and section 1.1 specifically addressed the situation in which a local community may seek a new water supply reservoir.[100] The new law directs DWR to cooperate with local governments to identify water supply needs and alternatives for meeting those needs. The alternatives are of course surface water, groundwater, and perhaps even conservation. This means that DWR would be involved in making realistic population projections and predictions of future industrial and agricultural use in the water service area. Most importantly, all reasonable alternative sources for meeting the projected water needs would be evaluated. Finally, the preferred alternative identified by DWR becomes binding on all other state agencies.[101] This bill is a first step to greater state-level involvement in identifying sustainable water usage and reasonable alternative water sources to meet the needs of North Carolina's citizens.

Endnotes – Chapter 1

[6] *See* Jay Price, *Coastal Boom Moves Inland*, The News & Observer (Raleigh, N.C.), June 4, 2006, at 1A ("More than 34,000 homes in nearly 100 subdivisions and condominium projects are planned or are now going up, a News & Observer tally shows. Other projects are further along or completed. More are expected.").

[7] *See* Stephen M. Webb, N.C. Dep't of Env't and Natural Res., Div. of Water Res., A Survey of Ground Water Resources in the Cashiers, North Carolina Vicinity 5 (2005), http://www.ncwater.org/Reports_and_Publications/GWMS_Reports/cashiers.pdf.

[8] N.C. Rural Econ. Dev't Ctr., Water Woes in Eastern North Carolina: Facing the Facts, Reaching Solutions 9 (2002), *available at* http://www.ncruralcenter.org/images/PDFs/Water2030/capacityuse.pdf.

[9] *See generally* Robin Kundis Craig, *Water Supply, Desalination, Climate Change, and Energy Policy*, 22 Pac. Mcgeorge Global Bus. & Dev. L.J. 225, 238–43 (2010) (discussing economic and environmental costs of desalination); Paul Delphos, *Desalination Trends and Impacts to NC* (2010), (describing desalination and its potential for North Carolina).

[10] Keith J. Robertson, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., North Carolina Ground Water Resources Monitoring Well Network: 2007 Annual Report 1 (2007). Due to saltwater intrusion, some aquifer waters also require pre-use treatment.

[11] Luke W. Harris & Christopher J. Sanchez, *Considerations for Analyzing Colorado Groundwater: A Technical Perspective*, 15 U. Denv. Water L. Rev. 105, 106–15 (2011).

[12] A water table is the top of the water surface in the saturated part of an aquifer. *Water Science Glossary of Terms,* U.S. Geological Survey, http://ga.water.usgs.gov/edu/dictionary.html#W (last updated July 15, 2013).

[13] Image courtesy of the Gulf of Mexico Educational Alliance, *available at* http://www.gulfallianceeducation.org/educatorresources_bytopic.php.

[14] "Aquifer recharge areas are areas in which precipitation, seepage from lakes and rivers, surface water irrigation, or other events contribute water to an aquifer. Natural discharge areas are areas where springs and seeps are the result of an aquifer contributing water to surface water." Gary S. Johnson, *Hydrologic Complications of Conjunctive Management*, 47 Idaho L. Rev. 205, 207 n.22 (2011).

[15] The term Cretaceous refers to a geologic age of the aquifer rock from 63-138 million years old.

[16] *Ground Water Atlas of the United States: Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, West Virginia HA 730-L*, U.S. Geological Survey, http://pubs.usgs.gov/ha/ha730/ch_l/index.html (last visited Aug. 28, 2013).

[17] PCS Phosphate, Castle Hayne Aquifer and PCS Phosphate, *available at* http://www.bipac.net/pcs/castle.pdf.

[18] Wells typically yield 200–500 gallons per minute, and sometimes as much as 2,000 gallons per minute. *North Carolina Aquifers*, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., http://www.ncwater.org/Education_and_Technical_Assistance/Ground_Water/aquifercharacteristics/ (last visited Aug. 22, 2013).

[19] *Central Coastal Plain Capacity Use Area 2012 Water Withdrawal Summary Tables*, N.C. Dep't of Env't and Natural Res., Div. of Water Res., http://www.ncwater.org/Permits_and_Registration/Capacity_Use/Central_Coastal_Plain/ccpcuatables_reported.php (last updated Aug. 5, 2013).

[20] Image courtesy of the U.S. Geological Survey, *available at* http://pubs.usgs.gov/wdr/wdr-nc-01/icons/GW_2001_fig2.pdf.

[21] *North Carolina Aquifers*, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., http://www.ncwater.org/Education_and_Technical_Assistance/Ground_Water/aquifercharacteristics/ (last visited Aug. 22, 2013).

[22] *Upper Cape Fear Potentiometric Surface Map*, N.C. Dep't of Env't and Natural Res., Div. Of Water Res. (May 17, 2013), http://www.ncwater.org/Education_and_Technical_Assistance/Ground_Water/aquifercharacteristics/potmaps/ucf/ucf2011.pdf.

[23] Jeff C. Lautier, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., Hydrogeologic Framework and Ground Water Conditions in the North Carolina Southern Coastal Plain 23 (2006), *available at* http://www.ncwater.org/reports_and_publications/GWMS_Reports/SCP_Framework/1scpframebody.pdf.

[24] *Water Budget for NC Coastal Plain*, N.C. Dep't of Env't and Natural Res., Div. Of Water Res. (Aug. 2002), http://www.ncwater.org/Education_and_Technical_Assistance/Ground_Water/What/budget.html.

[25] *North Carolina Aquifers*, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., http://www.ncwater.org/Education_and_Technical_Assistance/Ground_Water/aquifercharacteristics/ (last visited Aug. 22, 2013).

[26] *Id.*

[27] Jeff C. Lautier, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., Hydrogeologic Framework and Ground Water Conditions in the North Carolina Central Coastal Plain 27 (2001), available at http://www.ncwater.org/Reports_and_Publications/GWMS_Reports/CCP_Framework/1ccpframebody.pdf.

[28] *Central Coastal Plain Capacity Use Area 2011 Water Withdrawal Summary Tables*, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., http://www.ncwater.org/Permits_and_Registration/Capacity_Use/Central_Coastal_Plain/ccpcuatables_reported.php?&year=2011 (last updated Aug. 5, 2013).

[29] Jeff C. Lautier, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., Hydrogeologic Framework and Ground Water Conditions in the North Carolina Central Coastal Plain 28 (2001), *available at* http://www.ncwater.org/Reports_and_Publications/GWMS_Reports/CCP_Framework/1ccpframebody.pdf.

[30] *North Carolina Aquifers*, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., http://www.ncwater.org/education_and_technical_assistance/ground_water/aquifercharacteristics/ (last visited Aug. 28, 2013).

[31] Jeff C. Lautier, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., Hydrogeologic Framework and Ground Water Conditions in the North Carolina Central Coastal Plain 20 (2001), *available at* http://www.ncwater.org/Reports_and_Publications/GWMS_Reports/CCP_Framework/1ccpframebody.pdf.

[32] *Central Coastal Plain Capacity Use Area 2011 Water Withdrawal Summary Tables*, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., http://www.ncwater.org/Permits_and_Registration/Capacity_Use/Central_Coastal_Plain/ccpcuatables_reported.php?&year=2011 (last updated Aug. 5, 2013).

[33] *Id.*

[34] Jeff C. Lautier, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., Hydrogeologic Framework and Ground Water Conditions in the North Carolina Southern Coastal Plain 35 (2006), *available at* http://www.ncwater.org/reports_and_publications/GWMS_Reports/SCP_Framework/1scpframebody.pdf.

[35] Jeff C. Lautier, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., Hydrogeologic Framework and Ground Water Conditions in the North Carolina Central Coastal Plain 34 (2001), *available at* http://www.ncwater.org/Reports_and_Publications/GWMS_Reports/CCP_Framework/1ccpframebody.pdf.

[36] The surficial aquifer is also commonly referred to as the water table aquifer because the water table forms the upper boundary of this unconfined aquifer. Jeff C. Lautier, N.C. Dep't of Env't and Natural Res., Div. Of

Water Res., Hydrogeologic Framework and Ground Water Conditions in the North Carolina East Central Coastal Plain, at v (2009), *available at* http://www.ncwater.org/reports_and_publications/GWMS_Reports/ECCP_Framework/1eccpframebody.pdf

[37] *See* Thomas C. Winter et al., U.S. Geological Survey, Ground Water and Surface Water: A Single Resource (U.S. Geological Survey Circular 1139) 3 (1998), *available at* http://pubs.usgs.gov/circ/circ1139/pdf/circ1139.pdf.

[38] Jeff C. Lautier, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., Hydrogeologic Framework and Ground Water Conditions in the North Carolina Southern Coastal Plain 13 (2006), *available at* http://www.ncwater.org/reports_and_publications/GWMS_Reports/SCP_Framework/1scpframebody.pdf.

[39] *Id.* At 14.

[40] Images courtesy of the North Carolina Division of Water Resources, *available at* http://www.ncwater.org/Education_and_Technical_Assistance/Ground_Water/aquifercharacteristics/.

[41] *Land Subsidence*, U.S. Geological Survey, http://ga.water.usgs.gov/edu/earthgwlandsubside.html (last updated Aug. 15, 2013). Another potential effect is the disturbance of aquifers above the compressed aquifer, such as the surficial aquifer, which is the aquifer closest to the surface.

[42] *Total Water Withdrawal, by Source, Use, and County, in North Carolina, 1995,* U.S. Geological Survey (1997), http://nc.water.usgs.gov/infodata/wateruse/data/1995/Source_totals_by_county_1995.txt.

[43] *Water Use in North Carolina*, U.S. Geological Survey, http://nc.water.usgs.gov/infodata/wateruse.html (last updated Dec. 19, 2012).

[44] Jay Price, *Coastal Boom Moves Inland*, News & Observer (Raleigh, N.C.), June 4, 2006, at 1A.

[45] *See* 15A N.C. Admin. Code 2E.0501 (2012).

[46] There are, however, other regulatory controls on the portions of the Castle Hayne aquifer that are located in the Central Coastal Plain Capacity Use Area, such as the required permitting for use of more than 100,000 GPD.

[47] For example, usage of the Castle Hayne aquifer has increased in Onslow County. *See Onslow County Region Groundwater Flow Model*, U.S. Geological Survey, http://nc.water.usgs.gov/projects/onslow_gw/overview.html (last updated Dec. 19, 2012).

[48] Data collection from monitoring wells of the Castle Hayne aquifer do not show uniform declines in water levels. Subcrop areas in the eastern coastal plain are not covered by confining units, and therefore have a higher recharge rate. Other areas in Beaufort County show fluctuations in water levels over 70 feet. Jeff C. Lautier, N.C. Dep't of Env't and Natural Res., Div. Of Water Res., Hydrogeologic Framework and Ground Water Resources of the North Albemarle Region (1998), *available at* http://www.ncwater.org/reports_and_publications/gwms_reports/northalbemarlesep98.pdf. In some areas of the coastal plain, long-term records indicate that the recharge of the aquifer is less than the amount withdrawn. The least expended areas experienced 20 feet declines from pre-pumping levels, with greater depletions at 80 feet. Vincent T. Depaul, Donald E. Rice & Otto S. Zapecza, U.S. Geological Survey, Water-Level Changes in Aquifers of the Atlantic Coastal Plain, Predevelopment to 2000 (Scientific Investigations Report 2007-5247) 14 (2008), *available at* http://pubs.usgs.gov/sir/2007/5247/pdf/sir2007-5247.pdf.

[49] Water levels at the Black Creek aquifer declined at a rate of 4 feet per year until 1998, when the well began to moderately recover. However, long-term data collection showed a decline of about 80 feet between 1972 and 1997. For more information regarding water resource conditions, see *Water Resources Data Report for North Carolina for WY 2001: Summary of Water-Resources Conditions*, U.S. Geological Survey, http://pubs.usgs.gov/wdr/wdr-nc-01/summary_gw.html (last visited Aug. 25, 2013).

[50] Richard Whisnant, Univ. of N.C. Sch. Of Gov't, 2010 Report of the Water Allocation Study of the Environmental Review Commission 5 (2010), (on file with the UNC School of Government).

[51] *Id.*

[52] *Water Resources Data Report for North Carolina for WY 2001: Summary of Water-Resources Conditions*, U.S. Geological Survey, http://pubs.usgs.gov/wdr/wdr-nc-01/summary_gw.html (last visited Aug. 25, 2013).

[53] Reverse osmosis is a filtration process by which a solution is pressed through a membrane to remove larger molecules and ions. Normally, osmosis is the movement of molecules across a permeable membrane to reach equilibrium. In reverse osmosis, the solution is pretreated to mix with saline feed water and then pushed through a high-pressure pump to move the desired solvent through the membrane. On one side of the membrane is a concentration of brine discharge. On the other side is a concentration of the desired solvent, pure water. The best RO membrane will remove 99% of bacteria and 90% of inorganic ions; however, RO membranes vary in filtration abilities and are not as effective at eliminating organic compounds, such as trihalomethanes (thms), which are sometimes found in high levels in wastewater. Another element that affects the process is the efficiency of the system, which is primarily dependent on the feed water used in pretreatment.

[54] Evaporation is the process by which a liquid is heated, naturally or artificially, and transforms into a gas. As part of the water cycle, the gas collects and eventually returns to the earth in the form of precipitation. The byproduct is salt.

[55] San Francisco provides the most notable example of saltwater evaporation and its economic feasibility, but even these areas are being transformed for wetland restoration projects. For satellite footage of the San Francisco Bay salt ponds as well as the history of salt mining in the area, see *Salt Ponds, San Francsico Bay*, NASA, Earth Observatory, http://eol.jsc.nasa.gov/earthobservatory/SALT_PONDS,SOUTH_SAN_FRANCISCO_BAY.HTM (last visited Aug. 25, 2013).

[56] *See* Roger A. Rulifson, Terri L. Woods & Katharine E. Kleber, Inst. For Coastal and Marine Res., E. Carolina Univ., Ecological Assessment of the Pasquotank County Reverse Osmosis Water Treatment Plant Discharge Site, Albemarle Sound, North Carolina, (2006), *available at* http://core.ecu.edu/geology/woods/pasquotankpreconstructionpreport-12.htm.

[57] Image courtesy of the North Dakota State University Department of Agriculture, *available at* http://www.ianrpubs.unl.edu/epublic/live/g1493/build/.

[58] *See* Fawzi Banat, *Economic and Technical Assessment of Desalination Technologies* (2007), http://www.desline.com/Geneva/Banat.pdf.

[59] *See* 15A N.C. Admin. Code 2E.0501 (2012).

[60] *Id.*

[61] Not all of the CCPCUA counties are within the inner coast and the CCPCUA does not include the entire inner coast. Additionally, there are currently two other areas under the direct observation of the EMC. The Eno River Voluntary Capacity Use Area was created in 1988 and the Lumber River Council of Governments Region in 2004.

[62] *See* 15A N.C. Admin. Code 2E.0503.

[63] *Id.* 2E.0502(b).

[64] *Id.*

[65] *Id.* 2E.0505.

[66] Image courtesy of the U.S. Geological Survey, *available at* http://sc.water.usgs.gov/projects/gwavailability/.

[67] The City of Kinston is one example of a city that decreased its reliance on groundwater through the Neuse WASA.

[68] The plant is an advanced or tertiary water treatment facility. Here, Neuse River water undergoes a primary treatment to remove solids, secondary treatment to remove microorganisms, and finally advanced treatment to disinfect using ultraviolet light. For additional information, see *Upgrade, Expansion, and Energy Cost Savings: 60-mgd Neuse River WWTP*, Hazen and Sawyer, http://www.hazenandsawyer.com/work/projects/neuse-river-wwtp/ (last visited Aug. 28, 2013).

[69] N.C. Dep't of Env't and Natural Res., Div. Of Water Res., Neuse River Basin Water Resources Plan 1-7 (2010), *available at* http://www.ncwater.org/reports_and_publications/Basin_Plans/neuse.php.

[70] 15A N.C. Admin. Code 2E.0502(d)(5)(A)(i) (2012).

[71] Univ. of N.C. Sch. Of Gov't, *Water Pricing in the Central Coastal Plain*, (Sep. 22, 2008), (on file with author).

[72] *Id.*

[73] David S. Vinson et al., *Evaluating Salinity Sources of Groundwater and Implications for Sustainable Reverse Osmosis Desalination in Coastal North Carolina, USA*, 19 Hydrogeology J. 981, 985, 993 (2011), *available at* http://fds.duke.edu/db/attachment/1634.

[74] Webster's Real Estate Law in North Carolina describes reasonable use of water rights as follows:

> The doctrine embodies the principle that all riparian owners on a watercourse have equal rights with respect to the removal and use of water from the watercourse. Every riparian owner has a property right in the reasonable use of water flowing in a natural watercourse as it passes through or along his land, such right being qualified, however, by an accompanying requirement that it must be enjoyed with reference to similar rights of other riparian proprietors who own land on the stream. A riparian owner has a right to make all the use he can of a stream flowing through his lands so long as he does not pollute it or divert it from its natural channel and abstract so much of the water as to prevent other people from having equal enjoyment with himself, or does not use the same in such an unreasonable manner as to materially damage or destroy the rights of other riparian owners. The rights of riparian owners in a running stream above and below are equal; each has a right to the reasonable use and enjoyment of the water, and each has a right to the natural flow of the stream, subject to such disturbance and consequent inconvenience and annoyance as may result to him from reasonable use of the waters by others. There may be a diminution in quantity or a retardation or acceleration of the natural flow indispensable for the general valuable use of the water perfectly consistent with the existence of the common right, and this may be done so long as the retardation and acceleration is reasonably necessary in the lawful and beneficial use of the stream.

2 James A. Webster, Jr., Patrick K. Hetrick & James B. Mclaughlin, Jr., Webster's Real Estate Law in North Carolina § 16.07 (6th ed. 2011) (footnotes omitted).

[75] See N.C. Gen. Stat. § 143-215.22H (2011).

[76] *Id.*

[77] North Carolina State Water Supply Plan, N.C. Dep't of Env't and Natural Res., Div. Of Water Res. (2011), *available at* http://www.ncwater.org/Reports_and_Publications/swsp/swsp_jan2001/final_pdfs/mainbody.pdf (last visited Nov. 26, 2013).

[78] There are 17 river basins in NC. For more information about North Carolina's river basins, see *NC DENR-DWR River Basin Water Supply Planning*, N.C. Dep't of Env't and Natural Res., Div. Of Water Res. http://www.ncwater.org/basins/ (last visited Nov. 26, 2013).

[79] *See* S.B. 668, 2011–2012 Gen. Assemb., Reg. Sess. (N.C. 2011).

[80] *See Senate Bill 668 Information/History*, N.C. Gen. Assemb., http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2011&BillID=s+668&submitButton=Go (last visited Nov. 26, 2013).

[81] Barry Gullet, NC AWWA-WEA, Interbasin Transfers 1 (2006), *available at* http://www.ncsafewater.org/Pics/ResourcesLinks/interbasintransfer_1206.pdf.

[82] UNC-Chapel Hill School Of Government, *Interbasin Transfers: NC-AWWA's Summary,* (2010), (on file with author).

[83] Deepak Kumar Das, *Environmental Impact of Inter-Basin Water Transfer Projects: Some Evidence from Canada*, 41 Econ. And Pol'y Wkly. 1703, 1705 (2006).

[84] Karen Sands and Thomas Chapman, U.S. Envtl. Prot. Agency, Rain Barrels–Truth or Consequences, *available at* http://www.epa.gov/owow/NPS/natlstormwater03/32Sands.pdf.

[85] An Act to Improve Drought Preparedness and Response in North Carolina, § 10, 2008 N.C. Sess. Laws 563, 576–77 (codified as amended at N.C. Gen. Stat. § 143-355.5 (2011 & Supp. 2012)).

[86] Tex. Water Dev't Bd., The Texas Manual on Rainwater Harvesting 53–54 (3d ed. 2005), *available at* http://www.twdb.texas.gov/innovativewater/rainwater/doc/RainwaterHarvestingManual_3rdedition.pdf.

[87] Gray water is wastewater used in homes that can be reused on-site. These uses include laundry, dishwashing, and bathing. It is sometimes spelled "graywater" or "grey water."

[88] *See* N.C. Gen. Stat. § 130A-335(b)(4) (2011 & Supp. 2012).

[89] Bahman Sheikh, White Paper on Graywater 5 (2010), *available at* http://www.watereuse.org/files/s/docs/Graywater_White_Paper.pdf.

[90] *Id.* At 6.

[91] U.S. Envtl. Prot. Agency, Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs 12 (2002), *available at* http://www.epa.gov/watersense/docs/utilityconservation_508.pdf.

[92] Conservation methods include public education, landscape and irrigation ordinances, toilet flapper rebates, residential audits, conservation rate structure, new home water efficiency rating program, landscape water budgets, and water reclamation facility. *Id.* At 13.

[93] *See generally* N.C. Dep't of Env't and Natural Res., Report on Water Conservation and Water Use Efficiency (2004), *available at* http://www.ncwater.org/Reports_and_Publications/hb1215/HB1215_Sec5_Report.pdf.

[94] *Id.* At 6.

[95] *Id.* At 15–16.

[96] See the "Present Usage" section beginning on page 6, which discusses information gaps regarding groundwater reporting requirements.

[97] The EPA requires that community water systems that serve the same consumers year-round distribute Consumer Confidence Reports on an annual basis. *Water: Consumer Confidence Report Rule – Frequent Questions*, U.S. Envtl. Prot. Agency, http://water.epa.gov/lawsregs/rulesregs/sdwa/ccr/frequentquestions.cfm#two (last visited Nov. 26, 2013).

[98] DENR mandates that community water systems provide customers with annual reports including information on the type of water (e.g. Surface water or ground water), name of the body of water used, and levels of contaminants in the water. *See* 15A N.C. Admin. Code 18C.1538 (2012); 40 C.F.R. § 141.153(b) (2012).

[99] The full text of Session Law 2011-374 is available in Appendix C.

[100] An Act to Promote Water Supply Development/Efficiency, § 1.1, 2011 N.C. Sess. Laws 1519, 1519 (codified at N.C. Gen. Stat. § 143-355(b)(16) (2011 & Supp. 2012)).

[101] *Id.* § 1.2 (codified at N.C Gen. Stat. § 143-355.7(b)).

Chapter 2: Estuarine Shoreline Stabilization

Waterfront property along our rivers and sounds is highly sought-after and is generally purchased at a high premium. Within the same development, advertised prices for waterfront residential building lots may be four to five times higher than for similar-sized landlocked lots.[102] Ironically, the natural processes that sustain and shape this environment are viewed by many property owners as an issue in need of solutions. While property lines on a map are fixed, estuarine shorelines erode and accrete over time, dependent on the season, degree of wave action, storm activity, and sediment supply. Some stretches of shoreline erode, while others accrete as currents deposit sediment. This normal pattern creates a variety of estuarine habitats within a dynamic shoreline system. Although shoreline loss to erosion is normal, property owners often view it as a threat to their enjoyment and use of their land and also to the economic value of an expensive investment. Between 2000 and 2009, North Carolina issued permits to stabilize an estimated 168.5 miles of estuarine shoreline against erosion. Given the demand for waterfront property and the proliferation of new waterfront developments, the demand for shoreline stabilization is not likely to decline over the next 10 to 20 years.

Of the approximately 12,319 miles of estuarine shoreline in North Carolina, approximately 600 miles are considered "modified" (defined as areas where natural shoreline features are backed by stabilizing structures), with approximately 521 miles modified by bulkheads.[103] Bulkheads are an attempt to "hold the line" against erosion, so to speak, by halting it at a fixed point. These vertical structures provide effective erosion control at the cost of habitat loss (wetlands and shallow intertidal habitat) and potentially increased erosion on neighboring properties.[104] Despite these potential adverse impacts, the review process of applications for a permit to construct a bulkhead allows for the issuance of a permit within one to two days, frequently on-site.

To mitigate the adverse ecological impacts of shoreline stabilization, the trend is for North Carolina's and other coastal states' development rules to discourage use of bulkheads in favor of alternative methods of shoreline stabilization. A marsh sill, a type of "living shoreline," is a method of protecting the shoreline while preserving or creating marsh habitat in estuarine waters, but rarely is used by shoreline property owners. Despite the growing preference for such methods, the reality in North Carolina is that existing state and federal permit requirements and longer review times for marsh sill permit applications make implementing these alternatives challenging. In addition, property owner preferences, lower costs, easier installation, and greater familiarity among contractors with hardened structures combine to make bulkheads the erosion control method of choice.

While balancing property rights and environmental concerns along the shoreline will always be challenging, alternative shoreline stabilization techniques provide a means of slowing erosion, while preserving or better approximating natural shoreline processes. If property owner preferences can be shifted and regulations changed to assure similar levels of permit review for all stabilization techniques, the balance may shift away from the dominant hardening preference. If such a shift occurs, it is possible to accommodate future shoreline development while better preserving the natural environment that will continue to attract residents and tourists.

Erosion and the Natural Environment

Erosion and accretion (deposition) of sediments on shorelines are a normal part of the sediment movement within an estuary. Generally, wind-driven waves provide most of the energy for sediment transport on estuarine shorelines. The amount of wave energy striking the shoreline is a function of the wind strength, wind duration and wave fetch (distance a wave can travel across open water).[105] Estuaries are often called "fetch-limited" and exhibit reduced wave energy compared to ocean shorelines. While wind-driven wave energy can be predictably calculated, waves from passing boat traffic are unpredictable and can provide greater energy than wind-driven waves. The normal wave environment is periodically interrupted by storm events that can dramatically alter shorelines and change sedimentary patterns.

In addition to the short-term processes described above, shoreline change is also driven by long-term SLR and subsidence. Gradual SLR moves the water-land interface landward. Wave-driven erosional effects occur on top of this gradual landward encroachment. In some of North Carolina's coastal counties, large areas at or below three feet in elevation border the estuaries. Even one to two feet of SLR would inundate portions of these counties.

The most common technique currently employed to limit shoreline erosion is the replacement of a vegetated shoreline with hardened structures, such as bulkheads or revetments. However, this comes at a cost. Typically, the replacement of a natural vegetated shoreline with a hardened shoreline reduces many of the existing ecosystem services.[106] Vegetated shorelines provide surface water storage and reduce run-off of sediments and pollutants. Additionally, the surface roughness of vegetation slows the velocity of wave action and buffers storm waves. For example, marsh vegetation (*Spartina alterniflora*) has been shown to reduce wave energy by 50% in the first 2.5 meters.[107] As wave energy is reduced, suspended sediments and particulates settle out of suspension and may be deposited on the vegetated shore. Primary production, detrital supply to secondary production, and food webs may be altered by a conversion from vegetated to hardened shoreline. Loss of vegetated habitat alters the biological community structure and eliminates shelter, nursery and foraging area. Numerous studies have noted reductions in species richness, diversity and biomass near hardened structures when compared to natural shorelines.[108] The interaction of natural processes with non-living or hardened shorelines ultimately may result in the conversion of an inter-tidal vegetated community to open-water (muddy bottom) habitat. While open-water habitat also provides ecosystem services, this conversion results in the expansion of an adjacent habitat and the loss of the existing vegetated habitat. The cumulative effects of hardening contiguous stretches of shoreline appear to be more detrimental than hardening spatially separated stretches.[109]

Estuarine Shoreline Stabilization Methods

Estuarine shorelines vary considerably. In a 2006 study, the North Carolina Estuarine Biological and Physical Processes Work Group (organized by DCM) identified 11 types of shoreline commonly found in North Carolina's estuaries.[110] The selection of stabilization technique for a particular location is very dependent on site conditions and the desired degree and duration of protection. The shoreline stabilization method that is effective and appropriate for one type of shoreline may not be appropriate for another. As a general rule, the less structural techniques are more appropriate for areas with low wave energy, while more structural methods are appropriate in high-energy and long-fetch areas.

While there are, in fact, an array of non-structural, structural and hybrid techniques available,[111] the reality is that bulkheads are the most common method employed by estuarine shoreline property owners in North Carolina,[112] followed by sloped hardened structures such as riprap revetments.[113] What is troubling is that there is not a stated regulatory preference for the use of living shorelines, especially marsh sills, nor is there a strong inclination on the part of property owners to install them.[114]

Bulkheads

A bulkhead is a vertical wall aligned closely parallel to the shoreline and anchored to the shoreline with fill material placed between the structure and the shoreline. Vertical structures slow erosion by deflecting wave energy with a vertical wall at the land/water interface. Wood and vinyl are the most common construction materials. Bulkheads offer property owners predictable installation costs, good (and immediate) erosion protection, and a straight shoreline.

Bulkhead (Photo: N.C. Division of Coastal Management)

While bulkheads may be an effective means of maintaining a stable boundary between the uplands and water, this protection comes at the cost of inter-tidal habitat and natural shoreline function. Bulkheads tend to have less initial direct impact on submerged lands than non-vertical alternatives, due to their small footprint and location landward or within five feet of the mean high water line. The most obvious direct impact of bulkheads is the burial of one to two (sometimes up to five) feet of inter-tidal habitat behind the structure with backfill. This area is backfilled to the height of the existing shoreline and is permanently converted from inter-tidal to upland habitat. Beyond this habitat conversion, use of a hard vertical wall to block normal wave action and halt erosion of bank sediments has significant detrimental effects on the shoreline. The following list is adapted from the National Research Council's report entitled "Mitigating Shore Erosion Along Sheltered Coasts."[115]

1. **Permanent removal of the sediment supply** - The bulkhead impounds upland sediment behind the structure and puts it beyond the reach of wave action, preventing the transport of sediment from the uplands to the water through erosive action. This effectively removes a sediment supply from the littoral cell. Once impounded by a bulkhead, the sediment is no longer available to nourish any on-site or down-drift beaches. This sediment starvation is likely

to increase erosion on neighboring properties and contributes to a domino effect of hardening along a segment of shoreline.

2. **Steepened shore profiles and increased water depth** - The loss of sediment to nourish the on-site beach is compounded by the increased energy of waves reflected off the bulkhead. A bulkhead reflects nearly 100% of oncoming wave energy.[116] This increases the wave energy directed both upward (splashing) and downward toward the base of the structure. The increased downward wave energy causes "toe scour" – the removal of sand at the base of the structure as the water recedes. Over time, toe scour steepens the shoreline profile in front of the bulkhead. If the bulkhead is fronted by open water, scour will increase the water depth.[117] This, in turn, may alter the biological communities present along the shoreline. Additionally, the displaced sediment may increase turbidity near the structure.[118]

3. **Loss of intertidal habitat** - Intertidal habitat is lost as the bulkhead blocks the natural landward migration of eroding shoreline. As the intertidal area in front of the structure erodes, it grows narrower as its shoreward migration is blocked. Over time, the intertidal area narrows until it disappears and the bulkhead is fronted by open water. Reflected wave energy will continue to scour the sand at the bottom of the structure. This valuable intertidal habitat is replaced by less valuable open water habitat.[119] When bulkheads are constructed landward of existing vegetated wetlands, undercutting of marsh roots and increased turbidity can cause significant mortality rates in vegetation.[120] These effects are dependent on marsh width and wave energy striking the bulkhead.

Revetments

Riprap revetments are another type of solid structure, most often found in high-energy wave areas in North Carolina. These structures are built of rock riprap laid over a graded, sloped shoreline. The rough surface and sloping face of the revetments are designed to absorb wave energy by allowing waves to run up the slope and also to partially penetrate the riprap surface. The sloped design reduces deflected wave energy and toe scour in front of the structure when compared to a bulkhead.

Revetment (Photo: N.C. Division of Coastal Management)

Although a properly designed revetment may provide good erosion control, there are habitat trade-offs. The hardening of the shore limits the sediment transport from the uplands and reduces sediment supply to the littoral cell. The footprint (base width) of a revetment may be 10 feet or more. The inter-tidal habitat under the footprint of the revetment is buried, and its habitat functions are lost. Some degree of toe scour and steepening of the profile may occur. The complex surface of the sill[121] introduces a new hard-surface habitat that may be colonized by new aquatic communities. Like bulkheads, revetments also block the landward migration of eroding intertidal habitat and may result in eventual habitat loss.

Living Shorelines, Including Marsh Sills

"Living shorelines are an increasingly popular approach to erosion control that uses strategically placed plants, stone, bagged oyster shells and/or sand to reduce wave action, conserve soil and provide critical shoreline habitat."[122] The term describes an array of techniques that slow or prevent shoreline erosion without fully hardening the shoreline with a revetment or wall. Living shorelines range from "soft" techniques such as vegetative planting and bioengineering to hybrid structures such as marsh sills. In areas with very low wave energy and small fetch (< 0.5 mile), vegetative[123] or bioengineering techniques may provide an acceptable level of protection.[124] A typical site for these techniques would be a sheltered shoreline in a tidal creek.[125] Vegetative techniques include planting naturally occurring vegetative species to diminish wave energy and retain sediment. Where the existing vegetation is too narrow or the bank slope is inappropriate for vegetative growth, some bank grading or fill may be appropriate.

In areas with fetch between 0.5 and 1.0 mile, some minor structural elements such as those used in bioengineering are necessary.[126] The most common bioengineering technique is placement of fiber logs (also called coir logs or biologs). These biodegradable "logs" are made from natural fibers and are staked in place along planted marshes or undercut banks to slow wave energy and capture sediments.[127] Fiber logs will degrade over time and must be replaced if the planted vegetation is insufficient to slow erosion. Where wave energy is moderate or fetch is greater than one mile, some degree of hard structure will likely be necessary to slow erosion and maintain any vegetative plantings.

In North Carolina, hybrid structures like marsh sills and marsh toe revetments are being installed, but in limited numbers. A marsh toe revetment is a riprap revetment placed directly adjacent to a marsh with a bank that is (or is at risk of) being undercut. The revetment reduces wave energy, but is constructed low enough that water can flow over the structure and circulate in the existing marsh with tidal action.

Marsh sills, in contrast, use a low-profile, trapezoidal configured structure to provide shelter for a constructed marsh. A low-profile riprap sill is constructed offshore with drop-downs or staggered openings to allow the exchange of water and movement of aquatic fauna. The sill reduces wave energy, creates a sheltered area behind the sill, and reduces the waterward transport of sediment through wave action. In the sheltered area landward of the sill, vegetation may be planted to establish a fringing wetland. If an adequate gentle slope is not present, the design may include either landward grading of the upland or the placement of fill material in the inter-tidal area. The fill material is only placed to the degree needed to establish the slope necessary for marsh creation. While most marsh sills in North Carolina utilize riprap, marl or granite, wooden or vinyl sheetpile sills and oyster bags increasingly are being used in living shoreline projects.[128]

Marsh Sill (Photo: N.C. Division of Coastal Management)

Marsh sills have the primary benefit of creating or preserving a fringing marsh habitat. If properly designed, these fringing marshes can provide many of the ecosystem services typical of a vegetated shoreline, but cannot fully match the ecosystem value of an unaltered shoreline.[129] The design allows marsh migration and accommodation for SLR, while creating valuable habitat. Additionally, the sheltered wetland protects the boundary between the inter-tidal and riparian zones. The trade-off for this gained habitat is the burial of inter-tidal habitat under the footprint of the sill and any deposited fill. The burial of this habitat eliminates the natural inter-tidal or open-water habitat and converts a portion of a non-vegetated intertidal zone to a fringing wetland. Further, the sill can cause toe scour and deepening of the water and introduces a hard-structure habitat to the shoreline. If the sill traps sediment behind the structure, down-drift shorelines may be starved of that sediment and exhibit increased erosion.

Estuarine Habitat and Shoreline Stabilization

National Research Council Report

The habitat issues surrounding each of these shoreline stabilization techniques are common subjects in policy documents and reports both in North Carolina and at the national level. The most prominent related national policy report is the "Mitigating Shore Erosion Along Sheltered Coasts" report published in 2007 by the National Research Council.[130] This report, compiled at the request of several federal agencies,[131] reviewed the effects of sheltered shoreline management techniques on the coastal environment and made recommendations for strategies to minimize negative effects on coastal resources. The project drew together 32 professionals with an array of expertise in legal and regulatory issues, science, planning and engineering for a workshop to advise the NRC's study committee on shoreline issues. Ultimately, the report issued recommendations on how to improve erosion control techniques for sheltered shorelines. Among the findings of this report are the following:[132]

> Some [shoreline stabilization] techniques, such as the combination of a planted marsh fringe with a sill, have been tested and proven effective under well-characterized physical settings.

The report recommended, among other things, that:

> (1) The national dialogue should be used to develop guidelines for mitigating erosion on sheltered coasts that give deference to ecologically beneficial measures…
>
> (2) The regulatory preference for permitting bulkheads and similar structures should be changed to favor more ecologically beneficial solutions that still help stabilize the shore.

Coastal Habitat Protection Plan

In North Carolina, there have been a number of reports and policy documents that address the relative merits of various shoreline stabilization techniques. Perhaps the most well-known is the Coastal Habitat Protection Plan (CHPP). The Fisheries Reform Act of 1997 requires DENR to prepare a comprehensive plan for maintaining the long-term health of the habitats essential to North Carolina's fisheries. DENR is tasked with drafting the plan, and the CRC, EMC and Marine Fisheries Commission are required to adopt and implement it with the goal of achieving coordinated agency management of essential habitat resources. The plan makes a limited number of recommendations, including:

> Protect estuarine and public trust shorelines and shallow water habitats by revising estuarine and public trust shoreline stabilization rules to include consideration of estuarine erosion rates and prefer alternatives to vertical shoreline stabilization that maintains shallow nursery habitats.[133]

N.C. Estuarine, Biological and Physical Processes Work Group

In 2006, the North Carolina Estuarine, Biological and Physical Processes Work Group published a report entitled "Recommendations for Appropriate Shoreline Stabilization Methods for the Different North Carolina Estuarine Shoreline Types."[134] This Work Group, a science-based panel of experts in estuarine system processes, was organized by the Estuarine Shoreline Stabilization Subcommittee of the CRC to identify the biological and physical effects of different shoreline stabilization techniques on the various shoreline types found in North Carolina's estuaries.

The Work Group identified the ecological functions (hydrologic, biogeochemical, plant and animal community) of each shoreline type and assessed the environmental effects (both positive and negative) of each stabilization method on those functions. They used the results to rank the stabilization methods for each shoreline type. For every shoreline type, land planning was the preferred alternative. Vegetative plantings were typically the second preferred alternative. Where some structure was necessary, sills were the preferred structural technique. Ranking of the remaining structural techniques, including bulkheads, varied by shoreline type. For some shorelines, hard structures were not recommended. Ultimately, the Work Group recommended land planning / no action as the preferred shoreline strategy, with vegetation control as the second recommendation. When some hardening is required by site conditions, marsh sills and toe revetments were the most preferred options. Bulkheads and revetments consistently ranked among the least preferable techniques[135] in most scenarios and were not recommended at all for some shoreline types. See Appendix E for more information.

North Carolina / Federal Agency Evaluation of Living Shoreline Projects and North Carolina Estuarine Shoreline Mapping Project

In 2011, DCM released a final report of its "Assessment of 27 Marsh Sills in North Carolina."[136] This assessment, commissioned by the CRC, was conducted using surveys and interviews of marsh sill property owners and neighboring owners in conjunction with site visits to 27 completed marsh sill projects. Representatives from 10 organizations, including state and federal agencies, academia and non-profits conducted field assessments of existing sill projects to determine their effectiveness. The findings were as follows:[137]

- Marsh sills were not found to pose a hazard to navigation.
- Marsh sills were observed to provide erosion protection to the property on which they were installed.
- Marsh sills were often built in combination with other structures.
- Marsh sills that utilized the gap or overlap design were observed to provide better water, fish and other nekton access to the area behind the sill compared to ones utilizing the drop-down design.
- It was unclear whether marsh sills cause erosional impacts on adjacent property.
- After completion of the field aspects of this project, the resource agencies still prefer to review and comment on marsh sill permits on a case-by-case basis.
- The mound material used in the marsh sills is often colonized with oysters.
- The marsh sills visited support marsh grass and do not appear to be creating new uplands.
- Marsh sills were observed to be free from damage.
- No marsh sill related impacts to water quality were observed.

On Oct. 31, 2012, the North Carolina Estuarine Research Reserve and the National Oceanic and Atmospheric Administration (NOAA) Center for Coastal Fisheries and Habitat Research released a report entitled "Sustainable Estuarine Shoreline Stabilization: Education and Public Policy in North Carolina."[138] Initiated in 2009, the goal of this project was to quantify the ecological impacts of using bulkheads in coastal salt and freshwater marshes, and translate the results through education and outreach to stakeholders, such as coastal policy managers, marine contractors and estuarine property owners. Key findings include:

- Bulkhead sites with no fringing marsh were at least 0.5 m lower in elevation than sites with marsh.
- Fringing marsh in front of bulkheads provided effective wave attenuation during storm events, whereas wave energy at unvegetated bulkheads is equal to or higher than incident wave energy.
- Bulkheaded sites, with and without marsh, supported a lower abundance of birds compared to natural marshes. Bulkheads without marsh had much lower bird diversity and numbers.
- Small, narrow marshes in front of bulkheads provided a higher level of ecosystem services than expected, per unit area.
- Both waterfront property owners and marine contactors desired outreach materials be available online.
- Based on monitoring to date, shoreline stabilization using oyster reef with marsh plantings is a viable, cost-effective alternative to vertical bulkheads.

- Longer-term evaluation of elevation and vegetation is needed to determine the impact of bulkheads on fringing marsh sustainability.[139]

In 2013, DCM released its report of the North Carolina Estuarine Shoreline Mapping Project. The goal of the project was to classify North Carolina's estuarine shoreline by type and delineate all shoreline structures. The report includes a geospatial representation of the complete estuarine shoreline and structures for North Carolina's coastline, which made it possible for DCM to generate statewide and county-level statistics. This data provides crucial information on the nature of shoreline types and frequency of shoreline structures. Shoreline data is available on DCM's website. DCM plans to update and maintain the shoreline data as future imagery becomes available. The benefit of having this data is that it will help DCM keep pace with changes along the estuarine shoreline and monitor future development trends.[140]

Virginia Living Shorelines Summit Conference Proceedings

In 2006, the Virginia Institute of Marine Science (VIMS) and other organizations held a "Living Shorelines Summit" with the goal of bringing together regulators, scientists, coastal engineers, marine contractors, non-profit organizations, policy-makers and property owners to assess the state of living shoreline science, identify areas where more information is needed, and explore strategies for promoting living shoreline implementation. While focused on the Chesapeake Bay states, the Conference Proceedings contain a wealth of documentation on the policy, design and science of living shorelines that may be useful to agencies, marine contractors and property owners in North Carolina.[141]

These different policy documents recognize that there is a time and place for all types of shoreline stabilization. While hardened structures are appropriate on some high-energy shorelines, many sites could be effectively protected by living shoreline or hybrid techniques and retain a greater degree of ecological function.

Regulatory Agency Staff Concerns with Living Shorelines

An informal survey of staff from North Carolina agencies and non-profit organizations familiar with living shoreline projects identified a number of concerns either voiced by staff or attributed to the public. The following draws from information gained from telephone interviews with agency and non-profit staff in Virginia, Maryland and Delaware, who have experience with permitting and implementing living shorelines and hybrid structures and thus can provide insight into the validity of the concerns raised.[142]

Fill of Nearshore Habitat

Marsh sill projects involve some burial or fill of intertidal or nearshore habitat, with the fill amount dependent on design. Area filled by a project ranges from only the footprint of the sill itself to thousands of square feet of fill. The filling of inter-tidal and sub-tidal areas is a concern shared by every state agency staff member interviewed. The fill material buries the benthic habitat and converts shallow nearshore habitat to uplands or vegetated wetlands. This causes loss of the benthic biological community, altered nutrient cycling, shifts in species, and potential loss of submerged aquatic vegetation, shell bottom habitat or mud flats.

While agency staff in Virginia, Maryland and Delaware all expressed these concerns, a common refrain was heard in all interviews: habitat trade-off. While benthic communities are buried and shallow nearshore habitat is lost, fringing marsh habitat is created. Fringing marsh is one of the most rapidly vanishing habitats on the Atlantic coast due to normal erosion, hardening and SLR. The interviews yielded the same sentiment repeatedly: the loss of open water habitat is regrettable, but is offset by the gain of fringing wetlands.

Intrusion into Public Trust Waters

In North Carolina, all navigable waters and submerged lands up to mean high water or normal water level (and some artificial water bodies) are public trust areas held by the State for the public. Sill construction and fill can intrude into the public trust areas and potentially may require a lease or conveyance by the State Property Office. In addition, there may be conflict with shellfish leases or other submerged lands claims. The allowable distance of sill placement offshore (seaward edge up to 45 feet beyond normal water line) suggests the marsh sills are not constructed to regain land lost to erosion over the past year and, therefore, are dissimilar to the bulkhead back-fill authorized by state statutes. This is largely a legal matter to be resolved according to specific state law and the experiences of neighboring states are of little help. Despite the technical nature of the issue, it is a concern that should be addressed. To date, North Carolina has not required such an easement, but if this concern becomes more significant in the future, it may need to be settled by the Office of the Attorney General.

Another, related concern is the conversion of public trust areas to uplands either naturally by sedimentation or intentionally by a property owner. In addition, if the land changes ownership after construction of the sill, the new owners could unintentionally fill in behind what they believe to be a flawed revetment. The Marsh Sill General Permit includes a statement that the filled area shall not be filled above mean high water, nor will it be considered private property. For marsh sill projects that are reviewed as a Major Permit, there is no similar language, but the clear intent expressed in the General Permit should settle the issue.

Structural Maintenance and Longevity

This concern involves two sides of the same coin. The vegetative plantings and fill may die or be lost to storms, erosion, chance or poor design. If a project is not re-planted, refilled or maintained, its effectiveness and ecological value will be compromised. On the other hand, rock sills have the potential to remain in place for decades and pose a risk, as abandoned or failed projects may create navigation hazards or infringe upon riparian access and public trust rights. These are concerns shared by policymakers in North Carolina's neighboring states, and they agree that long-term monitoring presents a challenge.

Lack of Skilled Contractors

This is a concern not just from a design perspective, but also as a factor contributing to the dominance of bulkheads in North Carolina. Marine contractors are usually the first point of contact for property owners experiencing erosion. Marine contractors in North Carolina are experienced with bulkhead and revetment installation. By default, they tend to recommend the techniques with which they are familiar. A common theme noted by policymakers from neighboring states is that education and outreach to marine contractors is an essential step in shifting the momentum

towards "soft" stabilization techniques in appropriate locations. An additional concern is that marine contractors unfamiliar with marsh sills may overbuild or install structures poorly suited to site conditions. These issues can only be resolved through education and perhaps Best Management Practices.

Agency Burden and Cost to Property Owners

In this season of budget and staff reductions, the additional administrative and field requirements of permitting, site inspections and training sessions may strain agency resources. This did not arise as a concern in conversations with staff in other states.

The per-foot cost of bulkheads and revetments are well known and generally consistent, while costs of marsh sills are unpredictable and site-specific. Marsh sill projects may be more expensive than bulkheads in high-energy environments and less expensive in low-energy environments, but this is dependent on the design parameters, geographic location and site conditions. Non-profit organizations in North Carolina and other states have experimented with cost-share programs, as their budgets have allowed, with positive results.

Homeowner Concerns

Agency staff voiced the following concerns relayed to them by homeowners: (1) higher number of snakes, (2) aesthetic preferences, (3) decreased water access and (4) lower property values. The fear of a higher number of snakes on a homeowner's property may arise from the more visible presence of snakes on riprap revetments or in wetland areas. Aesthetic preferences may reflect a cultural bias toward bulkheads similar to that reported in the neighboring states. Shifting these preferences requires time, increased public familiarity, demonstration projects, and outreach and education. Decreased water access concerns may be addressed through design adaptations (i.e., pier over marsh and sill). Concerns about property values are more difficult to quantify. For instance, a homeowner may wonder whether the lack of a bulkhead or other hardened structure on property that borders an estuarine shoreline may lower property values, either as a reflection of aesthetic preferences or concern that lack of hardened structure means the less protection for the property. However, property values are dependent on many factors, including neighborhood and buyer preferences.

Shoreline Stabilization Regulation in Other States[143]

To promote alternative stabilization techniques such as marsh sills, some of North Carolina's neighboring states along the east coast have adopted stronger policy statements and changed their regulations.[144] In evaluating the current North Carolina rules, the steering committee examined neighboring states' approaches to shoreline stabilization and their agency staff experiences in implementing their rules.

Delaware

Delaware has regulated bulkheads and living shorelines since the early 1990s, when the state codified a clear policy preference for living shorelines over bulkheads.[145] The current regulations allow structural stabilization methods only where the owner can demonstrate that soft stabilization would not be effective. The regulations establish a hierarchy of preferred techniques

depending on the site conditions, with soft techniques most preferred and vertical structures available as a last resort.[146] Vertical structures are permitted only where other techniques are ineffective, not feasible or would have serious negative effects.

Despite the regulations, Delaware has seen mixed results in the transition toward softer shore stabilization. Bulkheads are permitted only in a few specific locations or to replace existing bulkheads. While new bulkhead installation has been almost eliminated, the public preference has shifted to the hardest type of structure still available: riprap revetments.[147] While there is a clear policy to discourage riprap revetments in favor of living shorelines or hybrid techniques, an estimated 40% to 60% of new projects are revetments.[148] This reflects an entrenched landowner preference for: (1) the highest perceived level of storm protection, (2) manicured lawns, and (3) neat shorelines that can be installed for a predictable cost.[149] While Delaware's small group of marine contractors is well-informed and capable of designing and installing marsh sills, the aesthetic values of some property owners, in addition to the desire for guaranteed levels of protection, have slowed the shift away from hardened structures. There are indications that Delaware's political momentum may be shifting away from living shoreline efforts.

Maryland

Maryland appears to have significant political momentum toward living shorelines. The state's Living Shorelines Act of 2008 makes a clear policy statement that:

> "Living shorelines" are the preferred method of shore protection… and that shoreline protection practices, where necessary, consist of nonstructural "living shoreline" erosion control measures wherever technologically and ecologically appropriate.[150]

The act limits structural methods only to those areas designated on a map as suitable for hard structures or cases where the owner gains a waiver by showing that non-structural methods are not feasible. Despite this clear policy preference, the regulations to implement it have yet to be approved after more than three years. Agency staff is still enforcing the existing regulations, which include a hierarchy of preferred methods, while encouraging voluntary compliance with the spirit of the 2008 Act.[151] Living shorelines policy appears to be a significant state priority with considerable agency resources being utilized for draft regulations and guidance, permit review and consultation, shoreline mapping, and public education. Despite these efforts, agency staff has noted lingering property owner preference for hard techniques that they believe will "stop erosion."[152]

Virginia

In 2011, Virginia passed into law a state policy with a clear preference for living shorelines. The new law mandates: (1) adoption of technical guidance for local decision-making boards; (2) development of shoreline stabilization plans for individual reaches of shoreline; and (3) the creation of a new general permit for living shorelines.[153] While the state's regulatory agencies already have invested significant resources into research and promotion of living shorelines, passage of the law illustrates the high-level political support for these measures in Virginia.

Guidance regulations and a new permit process to implement the new law are under development. When completed, they should streamline the process that is currently hindered by over-complexity, as stated in the VIMS report. Currently, a property owner who wishes to install a marsh sill must obtain approval from the Virginia Marine Resources Council (submerged lands from mean low water seaward), the local Wetland Board (mean low water to 1.5 time tidal range), and the Chesapeake Bay Board (100 feet riparian buffer),[154] and each entity operates under its own regulations. A new general permit process would streamline the current multi-jurisdiction framework. VIMS, in conjunction with various state entities, devotes remarkable resources to research, consultation, contractor and public education and demonstration projects. VIMS staff has noted a strong public preference for bulkheads and the challenge of shifting public attitudes in favor of unfamiliar new techniques.[155]

N.C. Permitting Process for Shoreline Stabilization

All types of shoreline stabilization may be permitted in North Carolina under current CRC rules, with streamlined permitting available for some techniques. Although bulkheads, revetments or other hardened structures may be the only practical choice for certain shoreline types and conditions, many other sites may be better served with marsh sills or other alternative stabilization. However, elements of the permitting requirements make hardened structures the fastest and simplest stabilization option for property owners. Thus, the realistic outcome of the current rules is that virtually all projects will include bulkheads or revetments.

Under current CRC rules, new structural shoreline stabilization projects require either a general permit or major permit. Typically, General Permits are intended to be expedited permits issued for classes of activities that are fairly standardized in design (not site-specific) and are deemed to have only minimal impacts on the coastal environment. Theoretically, the adverse impacts of these projects are well understood and predictable across a variety of settings. The CRC streamlined the permitting process to avoid expenditure of agency resources on individual review of these routine projects.[156] Through consultation with the 10 state agencies and up to four federal agencies that would normally review CAMA Major Permits, the CRC drafted a set of General Permit conditions to address the issues most common in these projects. Agency consultation during the drafting stage pre-empts the need for agency review of each individual permit. As long as the proposed project meets the specific requirements of the General Permit, *a DCM field representative may issue a General Permit in one to two days* for some activities. If the project cannot meet the General Permit conditions, then it must instead be reviewed for a Major Permit. Major Permits are the default permit and are required for all activities not falling within the limits of a General Permit or Minor Permit. These receive the highest level of agency scrutiny, require consultation with 10 state agencies,[157] and are open to public comment.

General Permits exist for bulkheads, riprap revetments, marsh sills and other structures. Whether a particular requested bulkhead, riprap revetment or marsh sill may be put in place under the authorization of the applicable general permit or must first obtain a major permit depends on its size, location, and whether it meets other specific conditions of the general permit. There is no regulatory disparity between bulkheads or revetments and marsh sills in the sense that all of these shoreline stabilization techniques may be undertaken under the authorization of a general permit. The major difference is that the general permit conditions are more numerous for marsh sill projects compared to bulkhead or revetment projects. Whereas the Bulkhead and Revetment General Permit has 13 specific conditions,[158] the Marsh Sill General Permit has 29 specific

conditions.[159] Many of these pertain to specific design parameters (i.e., dropdowns, slope, height, markings), but the final three conditions impose a permitting burden not found in any other CAMA General Permit:[160]

> (aa) In order to ensure that no adverse impacts occur to important fisheries resources, the Division of Marine Fisheries shall review and concur with the location and design of the proposed project prior to the issuance of this general permit.
>
> (bb) Prior to the issuance of this general permit, Division staff shall coordinate with the Department of Administration's (DOA) State Property Office to determine whether or not an easement shall be required for the proposed activity.
>
> (cc) Following issuance of this general permit, **the permittee shall contact** the N.C. Division of Water Quality and the U.S. Army Corps of Engineers to determine any additional permit requirements. Any such required permits, or a certification from the appropriate agency(s) that no additional permits are required, shall be obtained and copies provided to the Division of Coastal Management prior to the initiation of any development activities authorized by this permit (emphasis added).

These final three conditions require three state agencies to consult on a marsh sill project.[161] Condition (bb) requires an agency consultation with the DOA to determine the need for a lease agreement for the impact to state-owned submerged lands from structures extending up to 30 feet beyond mean high water. However, under the General Permit system, bulkheads and revetments can extend up to five or 10 feet, respectively, beyond mean high water without any similar required submerged lands consultation. In addition, neither the bulkhead nor the revetment general permits contain conditions similar to (cc) of the marsh sill general permit.

As a result of these differences, it takes much longer to satisfy the conditions of the Marsh Sill General Permit than the Bulkhead or Revetment General Permits. A General Permit for a bulkhead or revetment may be obtained within one to two days, but for Marsh Sill General Permits the DCM approval process alone may take two to three weeks or longer.[162] In addition, the marsh sill applicant must either obtain a certification that no permit is necessary from DWR and the Corps or obtain the necessary permits.[163] The time required to engage in the required agency consultation for every marsh sill project not only lessens the likelihood that property owners will elect to construct a marsh sill but is inconsistent with the rationale for general permits; that is, to streamline permitting of routine projects with minimal impacts.[164]

While agencies in some neighboring states have adopted clear statutory and regulatory preferences for living shorelines and hybrid techniques, North Carolina's current permitting practices run counter to the policy efforts to encourage use of alternative techniques. The permitting disparity is most apparent when North Carolina permitting times for bulkheads versus alternative methods are compared with those of the neighboring states.

State	Average Bulkhead Permit Time	Average Revetment Permit Time	Average Marsh Sill Permit Time
Delaware	90 days	90 days	90 days
Maryland	90 days	90 days	90 days
Virginia	90-105 days	90-105 days	90-105 days
North Carolina	1-2 days	1-2 days	15-20 days (up to 120) (CAMA General Permit only) 75-80 days (Major)

Table 1: Multi-State Comparison of State Permit Processing Time

Federal Agency Permitting Process for Shoreline Stabilization

The USACE Permit Structure

The questions surrounding the appropriate degree of review for shoreline stabilization applications are complicated by the interaction with federal permitting requirements. Most shoreline stabilization methods require the deposition of fill material (including structures) into the water. Any deposition of fill material into the waters of the U.S. or adjacent wetlands requires a permit from the USACE under Section 404 of the Clean Water Act (CWA).[165] The Section 404 permitting authority is exercised through a system of General Permits and Individual Permits. Some of these permits require distribution to commenting agencies, while others do not have such a requirement.[166] General Permits grant blanket authority to classes of activities deemed to have only minimal impacts and are classed as either Nationwide (with regional conditions) or Regional Permits. Individual Permits are for all activities with more than minimal impacts and receive extensive review.[167] The Corps Individual Permit (and some other permits) applications are required to be distributed to the EPA, U.S. Fish and Wildlife Service and NOAA National Marine Fisheries Service (NMFS) for comment.[168] Additionally, Individual Permits must be published and opened to public comment. These comment procedures have statutory time limits that may be extended, but cannot be reduced. As a result, there are restraints on the minimum length of time in which these permits can be processed.

The most complex consultation is with NMFS, which requires an Essential Fish Habitat (EFH) consultation under the Magnuson-Stevens Act.[169] Any activity that may affect EFH[170] that is located in an area within the Corps District's jurisdiction must be reviewed by NMFS, and NMFS and the Corps District office must come to an agreement over any mitigation or alteration needed to address EFH concerns. The complexity of this process depends on the scope of the permit application under review, the dynamics of the specific Corps District office and NMFS office, and is based on the best professional judgment of the parties.

Variation in the Corps Permitting Process among Different Corps Districts

In applying federal permitting statutes to marsh sills, differences exist among Corps districts. Corps Districts in Delaware, Maryland, Virginia and North Carolina each review and authorize marsh sill projects under different types of permits.

- Philadelphia (Delaware): Nationwide Permit 13 with Regional Conditions
  - Encourages nonstructural methods like rip-rap or vegetation
  - A structural project should explain why nonstructural will not work
  - No more than 500 feet
  - Not to exceed an average of one cubic yard of fill beyond the mean high water per linear foot
- Baltimore (Maryland): Maryland State Programmatic General Permit 3
  - No more than minimal impact
  - No more than one acre of direct or indirect impacts
  - Less than 35 feet waterward of mean high water
  - Linked to state permit – Permitting authority delegated to state for some categories, while other categories require Corps consultation process
  - No more than 500 linear feet
  - Hierarchy of preferences
- Norfolk (Virginia): Regional Permit 19
  - Activity 10: submerged sills for beach nourishment; requires vegetation
  - Activity 11: low breakwaters for beach nourishment; requires vegetation
  - Alternative permitting: Nationwide Permits 27 and 13
- Wilmington (North Carolina):
  - Programmatic General Permit 291: for stone sill projects that require a CAMA Major Permit
  - Individual Permits: required for stone sill projects that qualify for a state General Permit

Despite the array of different permits used, it is notable that the varying Districts are fairly consistent in permitting time.[171] Nonetheless, a question one might ask is why the Wilmington District currently requires an Individual Permit (for a marsh sill project that qualifies for a state General Permit), while some other Corps Districts such as Philadelphia and Baltimore review these projects under a Regional Permit or State Programmatic General Permit.

In part, a Corps District's regulatory choices are shaped by the comprehensiveness and character of state regulations also in effect within the District. The rationale behind the Wilmington District's preference to review marsh sill permit applications on an individual basis is to fulfill their legal obligations under laws such as the Magnuson-Stevens Act, Rivers and Harbors Act and Endangered Species Act. These acts require review of potential adverse impacts to EFH, endangered species, cultural resources, public safety and navigation; potential destruction of submerged aquatic vegetation; and conversion of productive shallow water habitat to other uses.[172] Due to the potential impacts of marsh sill projects, the Wilmington District supports regulatory review on a case-by-case basis rather than deferring to a Regional General Permit or Programmatic General Permit.[173]

Wilmington District Permit Process for Bulkheads, Revetments and Marsh Sill Projects

A major time impediment to marsh sill projects in North Carolina is obtaining the necessary authorization from the local Corps District office. Currently, projects authorized under the CAMA General Permits for: (1) Bulkheads and Riprap, (2) Groins and (3) Marsh Toe Revetments (15A N.C. Admin Code 07H. 2400) can be permitted under the Wilmington Corps District's Regional General Permits.[174] The Corps General Permit conditions largely parallel the CAMA General Permit

conditions for these projects. The Corps also has a Programmatic General Permit 291 that can be used to authorize projects being considered for CAMA Major Permits. This permit, while more expedited than an Individual Permit, requires public notice and a multi-agency comment period.

Marsh sill projects permitted under the CAMA Marsh Sill General Permit cannot be permitted under the Corps Regional General Permits or the 291 Programmatic General Permit and must be processed as Individual Permits. They receive stringent and lengthy federal review. If property owners applying for a CAMA General Permit for a marsh sill project wait to independently seek a Corps Individual Permit until receipt of the CAMA permit, the application delay may add several months to the permitting time.

The availability of the Wilmington District's Regional General Permits for bulkheads and revetments reinforces the appeal to many property owners of hardened structures over other alternatives for most stabilization projects. A Corps permit for a bulkhead is obtained at the same time as the CAMA General Permit (one to two days). Under the Wilmington District's regulations, a marsh sill requested through a CAMA Major Permit (60-90+ days) may receive a 291 Programmatic General Permit (45-60 days) while sill projects requested through a CAMA Marsh Sill General Permit must receive an Individual Permit from the Corps (90-120 days). This disparity in the treatment of bulkheads/revetments and marsh sills encourages hardened structures in locations where soft or hybrid techniques may protect the shoreline while retaining better ecological function.

District	Average time to 404 permit for marsh sill
Wilmington (NC)	45-60 days (291 GP); 90-120 (individual)
Norfolk (VA)	60 days
Baltimore (MD)	60+ days
Philadelphia (DE)	60 days

Table 2: Multi-State Comparison of USACE Permit Processing Time

The N.C. Multi-Agency Shoreline Stabilization Initiative

In December 2011, the directors of DCM and the North Carolina Division of Marine Fisheries (DMF) met to discuss proposing a DENR-level strategy to coordinate efforts to encourage living shoreline techniques and streamline permitting. After the December 2011 meeting, representatives from DCM, DMF and DENR jointly developed a proposal for more efficient permitting and other recommendations to advance marsh sills and other alternative stabilization structures. Below are the proposed key action items:[175]

- Work with the CRC to revise the Marsh Sill General Permit (15A N.C. Admin Code 7H.2700) to eliminate conditions that require other DENR divisions to review and concur with all project proposals before the General Permit can be issued.
- Investigate the development and implementation of a comprehensive education and training effort on the benefits of alternative shoreline stabilization approaches.

- Investigate financial incentives and cost reductions for individuals seeking to utilize alternative stabilization approaches.
- Support continued staff advocacy through enhanced information, training and outreach materials on the benefits of alternative shoreline stabilization approaches.
- Develop a pre-hurricane and post-hurricane study project that would: (1) develop baseline information about constructed marsh sill projects and (2) establish a methodology that would allow for an analysis of how well these structures functioned and/or survived during a hurricane.
- Continue to map, monitor and research coastal shoreline stabilization in North Carolina.

DENR endorsed the proposal in May 2012, and DCM reprogrammed grants funds to provide partial staff support to implement the action items and conduct further research and analysis.[176] DCM staff met with VIMS staff in October 2012, to compare living shorelines initiatives and permitting procedures between North Carolina and other states.[177] DCM staff also met with staff from the Wilmington District of the Corps of Engineers in October 2012 to discuss potential streamlining of the marsh sill permitting procedure, including use of Nationwide Permits, Regional General Permits and the 291 Programmatic General Permit.[178] DCM proposed the possibility of modifying the Marsh Sill General Permit design standards to address the Corps' concerns.[179] Wilmington District staff reiterated that their legal obligations under existing federal law prohibited them from expediting permit review.[180] In light of these discussions, DCM staff recommended to the CRC at their November 2012 meeting that the existing General Permit for marsh sills remain in its current form, and they decided to not propose formal rulemaking for the foreseeable future.[181]

DCM also held meetings with DMF and DWR (when it was known as the Division of Water Quality (DWQ)) to discuss the potential to streamline the DENR coordination process to approve Marsh Sill General Permits. As mentioned previously, the General Permit process includes review requirements and consultation with DMF, DWR, the State Property Office and the Corps before a permit may be issued.[182] In March 2012, the DWR amended its Water Quality Certification No. 3900 and removed the requirement of written approval from DWR for activities authorized by CAMA General Permits, as long as the activities meet certain conditions.[183] In addition, DCM plans to move forward with its education and outreach efforts and will continue to investigate financial incentives and cost reductions for alternative shoreline stabilization approaches.[184] In addition, the directors of DCM and DMF have entered into a verbal agreement to eliminate the need for coordination between their respective agencies during the review process for a Marsh Sill General Permit.[185]

Note: This inter-agency effort was made public in June 2012; this steering committee has been formulating its recommendations since early 2011. Working independently, both the agency staff and the steering committee have reached similar conclusions regarding streamlined permitting and educational training and outreach. The members of this steering committee have expertise in a variety of fields and represent different constituent groups; agency staff acts according to their best professional judgment with the public interest in mind. The similarity in recommendations between this committee of experts and agency staff reinforces the importance of taking specific steps to address the hardening of our estuarine shoreline.

Discussion and Findings

The N.C. General Assembly authorized creation of the Marsh Sill General Permit in 2003. While this signaled a growing awareness of the benefits of living shorelines and hybrid structural stabilization, concerns within some North Carolina regulatory agencies resulted in a General Permit so burdened by special conditions that, for some projects, it is no more efficient than a standard Major Permit. In fact, the separate and non-concurrent state and federal permit applications and review processes for marsh sills may significantly extend the length of this General Permit authorization process beyond that for the CAMA Major Permit.

The habitat issues associated with the burial of inter-tidal or shallow water areas and site-specific habitat trade-offs make agency scrutiny of marsh sill projects appropriate. The appropriateness of a marsh sill project on a specific site is highly dependent on erosion rate, wave energy, fetch, shoreline type, bottom habitat type and other specific site conditions. These and other factors make some state and federal agencies reluctant to consider streamlining marsh sill permitting in any manner that eliminates site-specific review.[186] This is consistent with the experiences of our neighboring states. Site-specific review is the standard approach.

Comparison of the permitting burden shows a stark contrast between bulkheads and revetments and marsh sill projects, however. While there is general agreement that marsh sill projects need site-specific review, the question remains as to why bulkheads and revetments that fall within the permit design standards do not receive any site-specific review. Our neighboring states have adopted regulations promoting living shoreline and hybrid techniques over revetments, with bulkheads available in only limited circumstances. North Carolina's rules include a policy preference that some alternative techniques be used: "[W]here possible, sloping rip-rap, gabions, or vegetation shall be used rather than bulkheads."[187] Moreover, the permitting burden North Carolina places on marsh sill projects is not out-of-line with the permitting requirements of the other states. The Marsh Sill General Permit process appears burdensome only in comparison to the simpler, less time-consuming process of hardened structure permitting in North Carolina.

The streamlined permitting given to bulkheads and revetments in North Carolina results in adoption of the least environmentally sound techniques at the expense of alternative techniques. North Carolina's estuarine shoreline is a dynamic system with varied wave-climates, sediment processes and storm events. Hardened structures like bulkheads and revetments are appropriate for some sites and should remain available to property owners. More ecologically sound alternative techniques may provide erosion protection while preserving some approximation of natural function for other sites. Waterfront property owner preferences are ultimately what determine the choice of shoreline stabilization method. While permitting burdens, cost, and ease of installation all influence this choice, lack of familiarity is an important factor. Demonstration projects, contractor education and owner outreach are necessary to make marsh sills and other alternative stabilization techniques more than a novelty in North Carolina. Regulatory mandates alone will not drive a change in the trend of hardening our estuarine shorelines. Persuading the public that alternatives are both viable and available is an essential step to long-term change.

While there is some dissent within the steering committee, the majority favors revising the marsh sill permit review process at both the state and federal levels to establish comparable evaluation to that of other estuarine erosion control structures, rather than increasing review of bulkhead permits. A long-term goal should be to incorporate a hierarchy of shoreline stabilization

preferences into either the CRC rules or DCM guidance materials. This reflects the committee members' professional judgment, constituent interests, and consideration of the social and political realities. Beyond permitting concerns, education and outreach are necessary to create public demand for alternative stabilization and ensure that a capable group of trained marine contractors are available to meet that demand. Toward this goal of promoting marsh sills and alternative techniques as a solution to the issue of the hardening of our shoreline, the steering committee makes the following seven recommendations.

Recommendations

The State of North Carolina's Marsh Sill General Permit conditions should be revised to ensure all estuarine shoreline stabilization structures are subject to comparable application and evaluation processes.[188]

The current state and federal permitting structure may have the unintended side effect of encouraging property owners toward bulkheads and riprap revetments in locations that are appropriate for marsh sill installation. Despite policy statements and use standards that some non-vertical techniques should be used instead of bulkheads "wherever possible," bulkheads are the dominant stabilization technique in North Carolina. While many factors contribute to this, the current CAMA General Permit requirements are key. General Permits are designed for routine projects that pose little threat to the coastal environment. If a project meets the specific design requirements of the General Permit, state and federal permitting are streamlined. With a single application, property owners can get both state and federal permits for a typical bulkhead or riprap revetment within one to two days. A Marsh Sill General Permit, in comparison, can take weeks to process and requires the applicant to independently submit applications to the Corps of Engineers and DWR (in situations in which the project doesn't meet the agency General Certification conditions), in addition to the CAMA permit.[189] This permitting hurdle runs counter to the logic behind General Permits and has the unintended consequence of steering property owners to bulkheads or revetments as the most practical stabilization options. Although DCM is currently working with DMF and DWR to streamline the permit review process through General Certification and inter-division agreement, it would be ideal if official rule amendment was considered for the future despite the fact that the Corps' legal obligations do not allow them to expedite federal permitting.

While typical bulkheads and revetments are far simpler to permit than marsh sill projects, the North Carolina Estuarine, Biological and Physical Processes Work Group found that bulkheads and revetments were the least-appropriate technique for many of our estuarine shorelines. There are reasonable concerns that the large footprint and complex design of marsh sills merit site-specific review, but general permits are intended to simplify permitting for projects falling within specific pre-screened design and location parameters. The risk of harm from bad project design can be mitigated by clear design standards and site criteria. As with atypical bulkhead and revetment projects, marsh sills that cannot meet the design criteria should be processed as a CAMA Major Permit.

The State should incorporate a hierarchical system for issuance of permits for activities related to shoreline stabilization along estuarine shorelines.[190]

Erosion control rules should favor use of the least ecologically damaging technique that can provide adequate shoreline erosion protection. For many shoreline types and conditions, bulkheads and revetments are not necessary for effective erosion control. In these cases, vegetation or marsh sills can offer adequate property protection while maintaining a greater degree of ecological function. While the current system of issuing CAMA General Permits for project designs meeting specific criteria provides an admirable degree of predictability for property owners and marine contractors, there is no required nexus between the erosion control structure installed and the degree of protection needed for site conditions. Under this system, a property owner can receive a permit to install a bulkhead on a protected shore on a slow-moving

creek as long as the design parameters for bulkhead length and placement are satisfied. Under such conditions, erosion may be so minimal that "no action" or vegetative plantings alone could protect the property without sacrificing ecological function.

Virginia, Maryland and Delaware agencies (and at least one Corps of Engineers District office) have incorporated a "hierarchy of preferences" into their shoreline stabilization rules. While every state has a different regulatory structure and direct comparisons are not appropriate, such hierarchies are becoming increasingly common. Some hierarchies are specific and rank all stabilization options in order of preference, while others include only general statements requiring those applicants wanting a vertical structure to demonstrate why less structural techniques would not be feasible.

The Estuarine, Biological and Physical Processes Work Group ranked shoreline stabilization techniques for each shoreline type with the stated goal of maintaining the current shoreline type and preserving ecological function. The reconciliation of the current regulatory scheme and such a hierarchical system of preferences should provoke careful discussion and reassessment of the goals of the coastal program for the new century.

The State should continue discussions with the Wilmington District of the Corps of Engineers and other federal review agencies with the goal of drafting a Corps Regional General Permit or other regulatory mechanism for marsh sills, thus placing federal marsh sill permits on a level playing field with other erosion control structure permits.

Without coordination between the state and federal permitting systems, any unilateral effort to simplify the marsh sill permitting process will yield no real benefit for property owners. While this may seem to be a strong statement, it recognizes the fact that as long as there is a dual permitting system, the actual permitting time for an applicant is determined by the program with the slowest permitting process. Even if North Carolina reforms its Marsh Sill General Permit so it can be processed in a few days or even a few weeks, that expedited state permit will not allow the applicant to break ground any sooner if the federal permit process still requires several months. The only way to effect meaningful change on the permitting experience of a property owner is to coordinate expedited marsh sill permitting on both the state and federal level. Such coordination will require discussions not only with the USACE, but also with other federal agencies such as the U.S. Fish and Wildlife Service and NMFS.

There should be an expansion of education and outreach to estuarine shoreline property owners, developers and contractors to increase awareness of all stabilization techniques, including marsh sills and vegetative plantings.

Many property owners and marine contractors are not opting for marsh sill projects on appropriate sites because they are unaware that the option exists. While DCM and organizations such as the North Carolina Coastal Federation and North Carolina Sea Grant have produced outreach materials and conducted educational programs, these materials and classes have not reached each of the thousands of estuarine property owners who will be making shoreline stabilization decisions in the near or distant future. While ease of permitting is an important factor in the ultimate choice of stabilization method, many property owners remain unaware that there are available alternatives to bulkheads or revetments. Many are equally unfamiliar with the effects of bulkheads on the long-term health of the estuarine system. Marsh sills will not become

commonplace unless public awareness and demand is created. Beyond property owners, any educational outreach must also extend to marine contractors and developers. In some cases, these groups are the only source of information and advice a property owner encounters in making shoreline modification decisions. Ultimately, educational efforts must dovetail with a reform of the permitting process to achieve wider use of living shorelines. DCM's current plans to include increased outreach and education to property owners and marine contractors will be a valuable step in achieving this goal.

DCM should facilitate classroom and field training for field agency staff on evaluation of all shoreline stabilization techniques, including marsh sills. Other state and federal agencies and local permit officers should be given the option to receive training.

General Permits with expedited processing and limited or no site-specific review require agency staff charged with assessing site conditions and project design to be competent and well-versed in evaluating all stabilization techniques. The state reviewing agencies have expressed reluctance to forego site-specific review of marsh sill projects due to the importance of site and project evaluation in assessing the appropriateness of the design and placement. DCM field staff demonstrating a thorough understanding of the principles of the various stabilization techniques as well as ongoing training could alleviate these concerns.

DCM should provide sufficient expertise and training support to educate and assist property owners with design and evaluation of all shoreline stabilization measures for the estuarine environment.

DCM should ensure that it has staff members with expertise in design and evaluation of all types of estuarine shoreline stabilization methods. Beyond a capable field staff, there should be a DCM staff member with clear and demonstrable expertise in estuarine shoreline stabilization to assist and advise both the field staff and policymakers. The engineering challenges in an estuarine environment are different than those in an ocean environment. DCM should demonstrate its commitment to reforming estuarine shoreline stabilization in North Carolina by ensuring that it has adequate staff with appropriate knowledge and experience.

Together with the appropriate partners, the marine construction industry should be encouraged to develop a voluntary certification program and/or training for marine contractors in alternative shoreline stabilization techniques.

Marine contractors must have some incentive to learn new stabilization techniques that require a different skill set, materials and equipment. For many property owners, their marine contractor is their main source for advice on shoreline stabilization design. These contractors naturally tend to recommend techniques in which they specialize. Training contractors in living shorelines techniques is a critical step in expanding use of living shorelines throughout the state's coastal counties. Marine contractors are often unwilling to invest time and money in training and new equipment when their existing techniques are satisfying customer demand. While the customer demand can be addressed through education and outreach, additional incentive is necessary to expand "living shorelines contractor" beyond a niche market.

A voluntary, industry-controlled certification program similar to the Leadership in Energy and Environmental Design (LEED) Construction certification in home and commercial construction

could provide marine contractors with a means to build their reputation while ensuring competency for the customer. If successful, such a program could take the lead in developing industry standards for living shoreline construction and could serve as a model for other states. At present, there is no marine construction organization in North Carolina. Agency, industry and non-profit partnership may be necessary to initiate development of training programs and certification criteria.

Endnotes – Chapter 2

[102] *See* Beaufort Bluffs: Waterfront-Water View-Water Access, The Rich Company, http://www.therichcompany.com/property.asp?c=41&p=941 (last visited Aug. 30, 2013) (listing real estate properties for Beaufort Bluffs development in Beaufort County, N.C.).

[103] Kevin McVerry, N.C. Dep't of Env't and Natural Res., Div. of Coastal Mgmt., North Carolina Estuarine Shoreline Mapping Project: Statewide and County Statistics 17–18 (2012), *available at* http://dcm2.enr.state.nc.us/estuarineshoreline/ESMP%20Analysis%20Report%20Final%2020130117.pdf.

[104] Nat'l Research Council of the Nat'l Acads., Comm. on Mitigating Shore Erosion along Sheltered Coasts, Mitigating Shore Erosion along Sheltered Coasts 52–54 (2007), *available at* http://www.nap.edu/download.php?record_id=11764.

[105] *See id.* at 25–43.

[106] *See id.* at 78–97.

[107] Paul L. Knutson et al., *Wave Damping in* Spartina Alterniflora *Marshes*, 2 Wetlands 87, 100 (1982).

[108] Anne S. Deaton et al., N.C. Dep't of Env't and Natural Res., Div. of Marine Fisheries, North Carolina Coastal Habitat Protection Plan 310–314 (2010), *available at* http://ncfisheries.net/habitat/2011_CHPP_final_plan/CHPP_2010_final.pdf.

[109] Nat'l Research Council of the Nat'l Acads., Comm. on Mitigating Shore Erosion along Sheltered Coasts, Mitigating Shore Erosion along Sheltered Coasts 50–52, 96 (2007), *available at* http://www.nap.edu/download.php?record_id=11764.

[110] Bonnie M. Bendell & N.C. Estuarine Biological and Physical Processes Work Grp., Recommendations for Appropriate Shoreline Stabilization Methods for the Different North Carolina Estuarine Shoreline Types 4-1 (2006), *available at* http://dcm2.enr.state.nc.us/estuarineshoreline/EWG Final Report 082106.pdf. The Work Group was organized by the N.C. Coastal Resources Commission's Estuarine Shoreline Stabilization Subcommittee and was comprised of experts in estuarine shoreline processes. The shoreline types were categorized by physical factors such as bank height/slope, sediment type, wave climate and vegetation. Varied combinations of physical features create distinct shoreline types that respond differently to wave action, currents and water level. For instance, bank height and slope influence whether wave action undercuts a bank or is dissipated as it flows landward. The sediment type affects the degree of sediment removed or deposited by wave action; vegetation is important to stabilize shorelines and reduce wave energy. These shoreline types are:

- Swamp Forest
- Marsh
- Marsh with oysters
- Marsh with mudflats
- Low sediment bank with marsh
- Low sediment bank with swamp forest
- Low sediment bank with sand
- Low sediment bank with woody debris
- Low sediment bank with oysters-SAV
- High sediment bank
- Overwash Barrier/Inlet Area

See Appendix D for images and descriptions of the above shoreline types.

[111] The available methods of shoreline stabilization, in order from least structural to most structural, are:

- Land Planning: use of easements, buffers, setbacks and no action/retreat

- Vegetation: planting of vegetation to buffer wave energy and slow sediment loss. Projects may include landward grading, minor filling and/or bioengineering techniques
- Beach Nourishment: addition of sand to replace that lost to erosion
- Sills: low hardened structures built parallel to shore and designed to slow wave energy behind the sill. Projects may include fill and plantings behind the sills to establish or maintain intertidal marsh. Sills may be constructed with stone, oyster bags, or as a freestanding wall.
- Groins: narrow structures built generally perpendicular to the shoreline and designed to trap sand on the up-drift side. This usually causes erosion on the down-drift side of the groin.
- Breakwaters: freestanding hard structures built parallel to shore and designed to reduce wave energy behind the structure. Breakwaters may be either sloping or vertical-face. These are distinguished from sills by height, distance offshore, and lack of vegetative plantings and fill.
- Sloped Structures (riprap revetments): sloped structures built along the shoreline and designed to stop erosion and reduce wave energy. These are typically constructed of riprap. Smaller-scaled revetments may be used as toe protection for other structures or marshes.
- Bulkheads and Seawalls: vertical structures built onshore to block storm surge and waves.

[112] Kevin McVerry, N.C. Dep't of Env't and Natural Res., Div. of Coastal Mgmt., North Carolina Estuarine Shoreline Mapping Project: Statewide and County Statistics 19 (2012), *available at* http://dcm2.enr.state.nc.us/estuarineshoreline/ESMP%20Analysis%20Report%20Final%2020130117.pdf.

[113] *Id.*

[114] However, it must also be noted that existing CAMA estuarine waters use standards do state a policy preference for the use of some ecologically less intrusive means of erosion control over the use of bulkheads. CAMA rule 07H.0208(b)(7)(E) states that "where possible, sloping rip-rap, gabions, or vegetation shall be used rather than bulkheads."15A N.C. Admin. Code 7H.0208(b)(7)(E) (2012).

[115] Nat'l Research Council of the Nat'l Acads., Comm. on Mitigating Shore Erosion along Sheltered Coasts, Mitigating Shore Erosion along Sheltered Coasts 54 (2007), *available at* http://www.nap.edu/download.php?record_id=11764.

[116] *Id.*

[117] *Id.*

[118] *Id.*

[119] While both habitats are valuable, fringing wetlands are experiencing a net loss of area nationwide while open water habitat is increasing. Shoreline hardening can exacerbate the loss of fringing wetlands to sea level rise and natural loss, with erosion into steeper uplands that naturally halt migration. In North Carolina, bulkheads may only be built landward of fringing wetlands.

[120] *See* Edgar W. Garbich et al., Estuarine Research, Biotic Techniques for Shore Stabilization 405–07 (L. Eugene Cronin ed., 1973) (identifying a 63% mortality rate in vegetation post-construction of vertical stabilization).

[121] In this context, a sill is a structure parallel to a shore that can be made from rock, oyster shell, or vegetation. The structure is typically exposed at low tide and submerged at high tide to reduce wave action on the adjacent shoreline with the purpose of protecting or re-establishing marsh vegetation.

[122] Bhaskaran Subramanian et al., Current Understanding of the Effectiveness of Nonstructural and Marsh Sill Approaches, in Management, Policy, Science, and Engineering of Nonstructural Erosion Control in the Chesapeake Bay: Proceedings of the 2006 Living Shoreline Summit 35, 49 (Sandra Y. Erdle et al. eds., 2006).

[123] Vegetative techniques include marsh enhancement, marsh creation, and bank grading.

[124] Walter R. Priest, III, Design Criteria for Tidal Wetlands, in Management, Policy, Science, and Engineering of Nonstructural Erosion Control in the Chesapeake Bay: Proceedings of the 2006 Living Shoreline Summit 25–26 (Sandra Y. Erdle et al. eds., 2006).

[125] Telephone interview with Melanie Tymes, Envtl. Scientist, Del. Dep't of Natural Res. and Envtl. Control (Apr. 15, 2011).

[126] Walter R. Priest, III, Design Criteria for Tidal Wetlands, in Management, Policy, Science, and Engineering of Nonstructural Erosion Control in the Chesapeake Bay: Proceedings of the 2006 Living Shoreline Summit 42 (Sandra Y. Erdle et al. eds., 2006).

[127] Karen A. Duhring, Overview of Living Shoreline Design Options for Erosion Protection in Tidal Shorelines, in Management, Policy, Science, and Engineering of Nonstructural Erosion Control in the Chesapeake Bay: Proceedings of the 2006 Living Shoreline Summit 13, 15 (Sandra Y. Erdle et al. eds., 2006).

[128] Note that North Carolina's Marsh Sill General Permit does not allow oyster bags as a construction material; oyster bags are sometimes used in Major Permit projects. Anecdotally, some oyster bags are used in General Permit projects despite the permit criteria. Wooden and vinyl sheetpile sills are authorized under a separate General Permit.

[129] Nat'l Research Council of the Nat'l Acads., Comm. on Mitigating Shore Erosion along Sheltered Coasts, Mitigating Shore Erosion along Sheltered Coasts 87 (2007), *available at* http://www.nap.edu/download.php?record_id=11764.

[130] The National Research Council is a subdivision of the National Academy of Science and is an advisory body to the federal government on scientific and technical matters.

[131] The requesting agencies were the Environmental Protection Agency, U.S. Army Corps of Engineers, and the Cooperative Institute for Coastal and Estuarine Environment Technology (a partnership between NOAA and the University of New Hampshire).

[132] Nat'l Research Council of the Nat'l Acads., Comm. on Mitigating Shore Erosion along Sheltered Coasts, Mitigating Shore Erosion along Sheltered Coasts 6–7 (2007), *available at* http://www.nap.edu/download.php?record_id=11764.

[133] Anne S. Deaton et al., N.C. Dep't of Env't and Natural Res., Div. of Marine Fisheries, North Carolina Coastal Habitat Protection Plan 457 (2010).

[134] Bonnie M. Bendell & N.C. Estuarine Biological and Physical Processes Work Grp., Recommendations for Appropriate Shoreline Stabilization Methods for the Different North Carolina Estuarine Shoreline Types 4-1 (2006), *available at* http://dcm2.enr.state.nc.us/estuarineshoreline/EWG Final Report 082106.pdf.

[135] While consistently at the bottom end of rankings, groin, breakwater, revetment and bulkhead ranks varied by shoreline type with specific rank determined by shoreline type and specific site conditions. *Id.* at 8-1 to 8-13.

[136] John Fear & Bonnie Bendell, N.C. Division of Coastal Management Assessment of 27 Marsh Sills in North Carolina (2011), *available at* http://dcm2.enr.state.nc.us/estuarineshoreline/msfinalreport.pdf.

[137] *Id.* at 20.

[138] John Fear & Carolyn Currin, Sustainable Estuarine Shoreline Stabilization: Education and Public Policy in North Carolina (2012), *available at* http://www.nccoastalreserve.net/uploads/CICEET%20report%20only.pdf. Please note that John Fear is also a member of the steering committee that developed policy and management recommendations for this report.

[139] *See id.*

[140] *See* Kevin McVerry, N.C. Dep't of Env't and Natural Res., Div. of Coastal Mgmt., North Carolina Estuarine Shoreline Mapping Project: Statewide and County Statistics (2012), *available at* http://dcm2.enr.state.nc.us/estuarineshoreline/ESMP%20Analysis%20Report%20Final%2020130117.pdf.

[141] Virginia Institute of Marine Science, Proceedings of the 2006 Living Shorelines Summit (Sandra Y. Erdle et al. eds., 2006), available at http://www.vims.edu/cbnerr/coastal_training/recent_workshops/ls_summit.php.

[142] The following discussion draws on a number of telephone interviews with agency and non-profit staff in Virginia, Maryland and Delaware. Recordings of the interviews are on file with the N.C. Coastal Resources Law, Planning and Policy Center.

[143] Although this section will focus on North Carolina's neighboring states, it is worth noting some states in other regions of the U.S. endorse the principles of living shorelines through their permit programs. One such state is Alabama. *See* Ala. Admin. Code r. 220-4-.09 (2013). In addition, the Corps authorizes joint application review through the Mobile District's general permit program (ALG10-2011). *See General Permits for Minor Structures and Activities Within the State of Alabama*, U.S. Army Corps of Engineers, http://www.sam.usace.army.mil/Missions/Regulatory/SourceBook/AlabamaGeneralPermits.aspx (last visited September 7, 2013).

[144] New Jersey is also considering amending its coastal permit program rules to allow for the installation of living shorelines. *See* N.J. Dep't of Envtl. Prot., Mitigation Shoreline Erosion Along New Jersey's Sheltered Coast: Overcoming Regulatory Obstacles to Allow for Living Shorelines (2009), *available at* http://www.nj.gov/dep/cmp/docs/living-shorelines2011.pdf.

[145] "Vertical-walled structures shall be allowed only where a non-vertical structure, designed to equal standards, would be ineffective to control erosion." 7-7500 Del. Admin. Code § 4.10.1.4 (2013).

[146] 7-7500 Del. Admin. Code § 4.10 et seq. (2013).

[147] Telephone interview with Melanie Tymes, Envtl. Scientist, Del. Dep't of Natural Res. and Envtl. Control (Apr. 15, 2011).

[148] *Id.*

[149] *Id.*

[150] Md. Code Ann., Envir. § 16-201 (2013).

[151] Telephone interview with Joe Abe, Div. Chief, Coastal Planning, Md. Dep't of Natural Res. & Kevin Smith, Div. Chief, Riparian & Wetland Restoration Services, Md. Dep't of Natural Res. (Apr. 15, 2011).

[152] *Id.*

[153] Generally discussed as SB 964; codified as Va. Code Ann. § 28.2-1100 (2013).

[154] Primary Sand Dunes and Beach Act may impose additional restrictions on some projects.

[155] Telephone interview with Karen Duhring, Marine Scientist Supervisor, Wetlands Div., Va. Inst. of Marine Sci. (April 12, 2011).

[156] Note that the practical streamlining with these permits is the agreement between DCM and the Corps of Engineers to jointly expedite both state and federal permitting.

[157] These reviewing state agencies (or relevant division) are the State Property Office, Division of Archives and History, Division of Community Assistance, Division of Highways, Department of Environment and Natural Resources, Division of Environmental Health, Division of Land Resources, Division of Marine Fisheries, Division of Water Resources, and Wildlife Resources Commission.

[158] Number of Specific Conditions for other shoreline protection General Permits:

- Groin General Permit (15A NCAC 7H .1400): 8
- Sheetpile Sill General Permit (15A NCAC 7H .2100): 13
- Marsh Toe Revetment General Permit (15A NCAC 7H .2400): 13

[159] Of the 17 CAMA General Permits, only the Pier and Docks General Permit (15A NCAC 07H .1200) has a number of specific conditions (26) comparable to the Marsh Sill General Permit. The remaining General Permits generally have either a few (2-3) or a moderate (12-15) number of conditions.

[160] The only comparable condition is for consultation with either N.C. Division of Marine Fisheries or N.C. Wildlife Resources Commission for pier or dock construction over submerged aquatic vegetation or shellfish beds. *See* 15A N.C. Admin Code 07H .1200 (2012).

[161] The burden is on the applicant to initiate the consultation with the N.C. Division of Water Quality.

[162] There is a disparity in the permitting burden between bulkhead/revetments and marsh sills, in the context of the shorter time period it takes to get a General Permit to install a bulkhead versus a marsh sill. This disparity has the practical effect of steering property owners toward bulkheads and revetments over marsh sill projects. Between 2000 and 2009, permits were issued to protect 167 miles with bulkheads, but only 1.5 miles with marsh sills or any other alternative method. This trend is likely to continue into the future, given current property owner preference for bulkheads, with the potential for significant consequences to the health and function of the coastal environment.

[163] CAMA General Permits typically originate within the N.C. Division of Coastal Management (or the Coastal Resources Commission) and are drafted with consultation with other agencies. The N.C. General Assembly mandated the Marsh Sill General Permit in 2003 (Session Law 2003-427).

[164] Note: although permit fees impose a small disincentive to bulkheads and riprap revetments beyond mean high water (fee for each is $400, while other General Permits cost $200), this has not proven to be adequate to offset the permitting burden imposed on marsh sills.

[165] 33 U.S.C.A.§ 1344 (West 2013). Additional Corps authority is included in Section 10 of the Rivers and Harbors Act, codified at 33 U.S.C.A. § 403 (West 2013).

[166] This depends on the specific language of the permit and agreements worked out with the consulting agencies.

[167] A local Corps District Office also may tie federal permit approval to receipt of a state permit through a Programmatic General Permit.

[168] These requirements stem from various federal statutes and memoranda of agreement between the agencies.

[169] 16 U.S.C.A. § 1801(b)(7) (West 2013).EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." *See* 16 U.S.C.A. § 1802(10) (West 2013).

[170] Essential Fish Habitat is identified and designated by the Regional Fishery Management Councils, in coordination with NMFS. *See generally* 50 C.F.R. § 600.759 et seq.

[171] Note that the Philadelphia, New Orleans and Mobile Districts have adopted various measures for promoting living shorelines, including general permits and hierarchies of preferences.

[172] Letter from Colonel Jefferson M. Ryscavage, Dist. Commander, U.S. Army Corps of Engineers, Wilmington Dist., to Dee Freeman, Sec'y, N.C. Dep't of Env't and Natural Res. (Feb. 23, 2011) (on file with the N.C. Coastal Resources Law, Planning and Policy Center).

[173] *See id.*

[174] Groins: General Permit 197800056; Bulkheads, Riprap, Marsh Toe Revetments: General Permit 197800080.

[175] Memorandum from Braxton Davis, N.C. Div. of Coastal Mgmt. to the N.C. Coastal Res. Comm'n (June 21, 2012), *available at* http://dcm2.enr.state.nc.us/CRC/packets/CRC%20Meeting%20Packet%20June%202012.pdf.

[176] *See id.*

[177] Memorandum from Daniel Govoni, N.C. Div. of Coastal Mgmt. to the N.C. Coastal Res. Comm'n (October 31, 2012), *available at* http://dcm2.enr.state.nc.us/CRC/packets/November%202012%20CRC%20Packet.pdf.

[178] *See id.*

[179] *See id.*

[180] *See id.*

[181] *See id.*

[182] *See* 15A N.C. Admin Code 07H .1200 (2012).

[183] *See* N.C. Div. of Water Quality, Water Quality Certification No. 3900, *available at* http://portal.ncdenr.org/web/wq/swp/ws/401/certsandpermits/gcs.

[184] Telephone interview with Daniel Govoni, Assistant Major Permits Coordinator, N.C. Div. of Coastal Mgmt. (Dec. 10, 2012).

[185] Telephone interview with Daniel Govoni, Assistant Major Permits Coordinator, N.C. Div. of Coastal Mgmt. (Dec. 13, 2012).

[186] For agency comments on marsh sill projects, *see generally* John Fear & Bonnie Bendell, N.C. Division of Coastal Management Assessment of 27 Marsh Sills in North Carolina (2011), *available at* http://dcm2.enr.state.nc.us/estuarineshoreline/msfinalreport.pdf.

[187] 15A N.C. Admin. Code 7H.0208(b)(7)(E) (2012).

[188] Steering committee member Donna Girardot dissents from this recommendation.

[189] In committee member Tracy Skrabal's experience, however, her organization has never received a permit for a marsh sill in less than two to three months, and she says in some cases the permit process has taken longer. E-mail from Tracy Skrabal, Coastal Scientist, N.C. Coastal Fed'n, to Lisa Schiavinato, Co-Director, N.C. Coastal Res. Law, Planning and Policy Ctr. (Feb. 7, 2013, 10:52 AM EST) (on file with the N.C. Coastal Res. Law, Planning and Policy Ctr.).

[190] Steering committee member Donna Girardot dissents from this recommendation.

Chapter 3: Monitoring and Enforcement of Environmental Laws Affecting the Inner Coast

The protection of North Carolina's inner coast depends on the enforcement of rules promulgated by the EMC and CRC and implemented by DENR.[191] Enforcement efforts, in the form of specific inspection programs, take place both at the DENR level and within its multiple divisions.[192] However, a number of factors make it difficult to rate the success current environmental rules have achieved for either the inner coast or the state as a whole. State statutes create important environmental programs for the inner coast and establish a permitting process, but the statutes do not establish a system for mandatory monitoring and inspection of facilities or adequate means for enforcement of permits once they are issued. The lack of regular, systematic inspections and monitoring programs for state environmental programs means that information necessary for the proper evaluation of compliance efforts is missing. Without the information obtained through such programs, it may be hard to determine whether permit conditions are being followed, what types of violations are occurring, whether particular rules are achieving their intended environmental protection goals or are in need of revision, and whether some rules pose unnecessary burdens on the regulated community.

This chapter discusses the state compliance monitoring and enforcement methods in place for the stormwater programs that are administered by DENR and affect the communities along North Carolina's inner coast. By using stormwater programs as an example, this discussion is meant to serve as an in-depth illustration of the need for more effective environmental regulation, particularly the need for a more efficient use of resources to allow for more compliance monitoring inspections. In order to improve the environmental rules that protect public trust resources and human health, this steering committee recommends: (1) Increased funding for monitoring and compliance efforts, (2) increased availability of compliance data and information, (3) improved technology to carry out compliance monitoring and enforcement efforts and (4) streamlined enforcement procedures.

On August 1, 2013, DENR announced the consolidation of DWR and DWQ into one agency, the Division of Water Resources (DWR).[193] Previously, DWQ regulated water pollution and implemented rules under the CWA, while DWR focused on water quantity, including drinking water supplies and drought management. Now, the implementation of these programs will take place under one agency. The consolidation also transferred the stormwater pollution section from DWQ to DEMLR.[194] Therefore, many of the programs discussed in this chapter were formerly implemented by DWQ. In order to remain current, this report refers to DWR and DEMLR where appropriate, but citations may include references to information that was released when the water quality and stormwater permitting programs operated jointly as DWQ. In addition to the consolidation of agencies, senior DENR staff will perform an evaluation of all of DENR's water quality and water resources programming.[195] The goal is to assess outdated and inefficient practices and their fiscal impacts. The results of this evaluation are expected in 2014.[196]

Federal and State Stormwater Management Programs

Stormwater is generated when water that has accumulated through rain and snowmelt has not percolated into the ground.[197] As rainwater and snowmelt accumulate and flow over land, they pick up chemicals, debris, sediment and potentially harmful pollutants.[198] Stormwater that is left untreated may discharge into coastal surface waters, adversely impacting water quality and coastal water ecology. For example, increased concentrations of contaminants can lead to the degradation of fish and shellfish habitats and can raise the costs required to treat surface water to meet drinking water standards. For these reasons, a number of federal and state programs target and regulate stormwater management for water quality and pollution control.

Federal regulation of stormwater is primarily implemented through the CWA, specifically through the National Pollutant Elimination Discharge System (NPDES) program.[199] Myriad other federal laws, such as the National Environmental Policy Act, the Endangered Species Act and the Coastal Zone Management Act, play a role in shaping national stormwater program regulations.[200] North Carolina's stormwater program consists of rules promulgated by the EMC under the authority granted by the North Carolina General Assembly.[201] However, in North Carolina, DEMLR implements both the federal and state stormwater programs. A more detailed description of the NPDES stormwater program and state coastal stormwater programs, and their respective permitting processes, is included in Appendix F.

Enforcement of Stormwater Rules within the Inner Coast

Stormwater Management Compliance Monitoring and Enforcement

DENR charges its individual regional offices with stormwater management compliance monitoring and enforcement. The regional office may perform a file inspection, a field inspection or both. A file inspection verifies that the permit holder is complying with mandated reporting or other administrative conditions specified on individual permits. Field inspections are physical visits to a permitted site by an inspector to verify permit compliance and maintenance.[202] During these visits, non-compliance violations are categorized as "deficient," "minimal" or "significant. "If a violation is identified as either "deficient" or "minimal," the permit holder is given an opportunity to resolve the violation by a given deadline without incurring a penalty. To ensure compliance, DEMLR requires that the permit holder prepare a plan, which the agency must approve prior to implementation. This step ensures that any engineering designs or other measures needed to bring the facility into compliance are clearly identified by the permit holder, and the permit holder retains the responsibility for compliance with the permit. If the regulated entity properly responds and brings itself into compliance, the regional office likely will take no further action. If the regulated entity does not correct the violation, then DEMLR likely will proceed to a higher level of violation, which carries the possible assessment of a civil penalty. When implemented properly and regularly, this inspection system allows the agency to resolve violations and observe areas in which existing rules or permit conditions might be improved.

DENR's Inspection Priorities

Due to the large number of permitted entities[203] and the limited number of personnel available for inspections, DENR staff cannot perform regular comprehensive reviews of every permitted entity. Therefore, DENR has established a priority system for the inspection of permitted facilities.

Inspection priority is based upon: (1) the results of past inspections, (2) complaints, (3) self-reporting of violations, (4) monitoring of data that is provided by regulated entities, and (5) the results of ambient monitoring programs.[204] DENR also considers the degree of an entity's potential for harm to the environment.[205] As the regulated communities themselves are often in the best position to promptly identify and correct deficiencies through self-monitoring and self-reporting,[206] DENR has also incentivized self-reporting by limiting the potential civil penalty in those cases to any economic benefits that might be realized by the regulated entity through noncompliance.[207] As this priority system suggests, the conduction of inspections is not regular or comprehensive, but rather relies heavily on complaints and cooperation of the regulated entity.

DENR's Three-Tiered Enforcement Policy

In fall 2011, DENR formally recognized and announced a department-wide, "three-tiered approach to enforcement."[208] This policy classifies violations in terms of their potential or actual harm to the environment or public health.[209] The response to a violation or deficiency is proportional to its severity. Tier 1 violations are typically minor in duration and severity, yield no environmental harm, and warrant only a written notice of deficiency (NOD).[210] Examples of these minor violations include late reporting, small record-keeping errors and inadequate facility maintenance.[211] Tier 2 violations are more serious in nature, in that they have the potential to harm the environment or human health, and usually result in a written notice of violation (NOV).[212] Examples of Tier 2 violations include prior non-compliance and failure to comply with Tier 1 corrections in a timely manner.[213] Tier 3 violations are willful or intentional and create a situation with a high likelihood of harm or a situation in which actual harm has already occurred.[214] Examples include operating without a permit and maintaining a track record of non-compliance.[215] Tier 3 violations typically result in a notice of recommendation for enforcement action and a potential civil penalty assessment.[216] Although some DENR divisions, such as DCM, delegate enforcement efforts to regional staff,[217] DWR's enforcement scheme for its water quality programs states that only the DENR Secretary can issue notices of violation and assess civil penalties.[218] Without delegation of Tier 2 and Tier 3 enforcement to water quality programming staff, DENR requires DWR to expend time and resources to compile a full enforcement package for all violations in order to seek the oversight and approval of the central office.

DCM's regulatory scheme allows for an expedited "informal assessment process," which authorizes DCM staff to issue NOVs and assess penalties for rule violations outlined under an established set of penalty guidelines.[219] This allows DCM to quickly and effectively deal with the majority of violations. In contrast, the water quality programs currently have no set of established penalty guidelines and must send all potential civil penalty cases to its central office for consideration by the Director through the formal process. In the formal process, assessment amounts are not clearly defined, but rather vary from case to case in relation to the harm done, duration of violation and responsiveness of violator, among other factors.[220] Therefore, in order for the water quality programs in the regional offices to provide the central office with enough information and documentation to make an informed assessment in each case, they must prepare for each enforcement action with the same exhaustive efforts required to prepare for an administrative hearing.

Disposition of Fines

To avoid a potential conflict of interest, the majority of the funds received from violation penalties do not go back to the agency that assessed them. Civil penalty collections are distributed to the State Public School Fund pursuant to state law.[221] The agency is allowed to retain investigation costs and the cost of issuing the permit, but the fines do not support staff positions dedicated to enforcement.[222] As a result, DENR and the General Assembly would need to explore other sources to fund compliance monitoring and enforcement, should they decide to increase funding for these efforts.

Enforcement and Personnel

Although the state stormwater program began in the late 1980s, the current permit system was not established until 1995.[223] Under the existing program, only a fraction of the stormwater permitted entities are inspected by the stormwater permitting program staff at DEMLR.[224] This is a result of both the large number of permit holder entities and the low number of staff available for inspection duties. In fact, at the present time, the stormwater permitting program does not have any personnel in its regional offices tasked solely with monitoring and enforcing existing permits. Given the aforementioned crucial role of inspections in maintaining and improving coastal health, DENR and the General Assembly should explore ways to increase inspections by: (1) increasing funding for these efforts and (2) streamlining the process to decrease the amount of money and manpower required to conduct an inspection.

Measuring Program Effectiveness and Success

A critical purpose of compliance monitoring and enforcement efforts is to determine how well the present programs operate to assure that prohibited discharges to waters are prevented, and that those holding valid permits adhere to permit conditions. The current lack of relevant data makes that assessment very difficult.

DENR did not include stormwater compliance rates in its annual compliance activity reports until 2004, and the most recent available data was collected in 2008. Therefore, any extrapolation to specifically evaluate the coastal stormwater program's effectiveness may be unreliable. However, the collected statewide data does show some important trends. In the five years of collected data, the number of regulated entities increased almost every year. Unfortunately, the 2006, 2007 and 2008 reports show a decidedly downward trend in compliance. The compliance rates for inspected facilities were 51% (2006), 32% (2007) and 28% (2008).[225] As stormwater permitting program staff inspected more facilities, there also was a general increase in the number of penalties assessed for violations.[226] See Appendix G for graphics of these trends. An increase in inspections (coupled with an improved system by which to collect data from those inspections) would allow DEMLR and its stormwater permitting staff to identify and resolve more violations, and would also provide the division with a larger dataset with which to assess the effectiveness of existing rules and permit conditions.

Two recent studies help illustrate the scope of the problem. A 2005 study conducted by then-DWQ analyzed state stormwater compliance in *five* of the 20 coastal counties. From a random sample of 3,648 permits granted from 1988-2002, 524 permitted projects and facilities were investigated.[227] "[T]he combined full compliance for all 524 projects investigated was observed to be 30.7%."[228] A 2007 study, also conducted by then-DWQ, examined high-density residential sites

with 10-year permits. The 2007 study's goal was to evaluate the effectiveness of the current permitting and enforcement system for the first group of high-density sites that would have permits up for renewal.[229] At the time the report was published, only 34 of 74 permitted sites had been inspected. Two sites had not been built, three were in compliance, and 29 were out of compliance.[230] This report also highlighted the difficulties of using the permit-tracking database part of the stormwater permitting program, known as the Basinwide Information Management System (BIMS), because information was not always entered correctly.[231] It takes the stormwater staff nearly 10 hours to process one permit renewal application and to inspect and prepare a compliance report.[232] With limited staff available for monitoring and enforcement at the time of the 2007 study, "there [were] at least 121 outstanding inspections for the 2005-06 renewal term" and 585 High Density or High Density Wet Ponds that would require renewal between 2008-10.[233] The report recommended improving BIMS data entry, providing training for staff to properly use BIMS, and increasing the number of compliance staff members in coastal DENR regional offices.[234]

Consequences of Insufficient Compliance Monitoring and Enforcement

DENR's challenges in conducting enough compliance and enforcement inspections and evaluating the efficiency of existing rules can have negative implications for environmental, economic and recreational aspects of the State's coast. Stormwater runoff is the biggest source of water pollution in North Carolina,[235] and currently impairs 930 miles of assessed freshwater streams in North Carolina.[236] Stormwater runoff also affects North Carolina's sounds, wetlands, creeks and rivers, as the chemicals, soaps and sediment carried by the runoff can have adverse effects on wildlife.[237] For example, in 2005, the State found that stormwater pollution is the cause of 90% of all contaminated shellfish beds.[238]

Water bodies that are polluted due to unmanaged stormwater runoff also can impair recreational activities such as fishing, boating and swimming. In 2012, DMF's Recreational Water Quality Program issued 22 swimming advisories and 25 swimming alerts due to unsafe water contaminant levels.[239] Further, failure to properly manage stormwater runoff around developments with large impervious surfaces, such as parking lots, roofs and roadways, can lead to localized flooding with the potential to damage homes and businesses. North Carolina has regulated stormwater since the late 1980s in an effort to avoid these detrimental impacts, but, as this chapter has illustrated, the system is imperfect. The future health of the state's citizens, wildlife and economy depends on effective stormwater management. Thus, the need arises to determine whether the current rules are fulfilling the program's goals and whether they are cost-effective. This can only be accomplished when state agencies are able to adequately monitor the activities of regulated entities to both assess compliance with existing permit conditions and evaluate the overall effectiveness of current rules.

Recommendations

In order to have a complete and effective permitting cycle to safeguard North Carolina's water supply and public waters and resources, the N.C. General Assembly and DENR should provide additional funds for water supply and quality compliance monitoring and enforcement efforts, including the implementation of a systematic inspection program.

North Carolina places a strong emphasis on the issuance of permits, but a permitting system is incomplete without inspections to assess and enforce compliance at permitted sites. For example, the water quality and stormwater programs lack the personnel and financial resources to conduct regular inspections of each of its permitted sites; thus many inspections take place[240] when a complaint has been raised or when a permitted entity reports its own violation.[241] As noted in this chapter, low inspection rates often correspond with low compliance rates. The previously mentioned 2005 analysis of state stormwater compliance in five of the 20 coastal counties is instructive. From a random sample of 3,648 permits granted between 1988 and 2002, 524 permitted projects and facilities were investigated.[242] The analysis revealed that "the combined full compliance for all 524 projects investigated was observed to be 30.7%."[243] Therefore, in order to complete the process and effectively safeguard the state's water supply and public waters, this steering committee recommends that DENR and the General Assembly provide the resources necessary to implement a system that would allow regular, scheduled inspections for all permitted facilities.

How often compliance inspections should take place would, of course, vary with the nature of the particular permit program and the degree and type of harm to public resources that flow from permit violations. Under the existing DEMLR stormwater permitting program's system, issued permits are valid for 10 years and must be renewed. Stormwater program staff is only able to conduct compliance inspections when a complaint is filed or every 5-10 years as part of the permit renewal process, and sometimes not even that often. Even when permits are up for renewal, the agency may have to renew the permit without a physical examination of the permitted facility due to a lack of inspection personnel. The previously mentioned 2005 then-DWQ study illustrates the consequences of failure to conduct regular compliance inspections.

Funding a scheduled, systematic inspection program will allow inspectors to visit more sites and collect more compliance data. The additional compliance and monitoring data will provide regulatory agencies with a more complete understanding of the successes and shortcomings of current environmental rules, which serve the ultimate goal of increased compliance. In order to fund such a system, this committee recommends adjusting the permit fee program to place more financial responsibility upon permit holders to cover compliance and monitoring inspections. While current state stormwater permit applications require a processing fee corresponding to the size of the petitioned project, DEMLR does not charge a similar site adjusted fee for the future inspections of the permitted site.[244] Under the existing system, all state stormwater permit holders currently pay a flat renewal fee of $505, and renewed permits are valid for up to eight years.[245] It is, therefore, questionable whether this flat fee is sufficient to cover the cost of regular compliance monitoring and inspection. This committee thus recommends that DENR increase state stormwater renewal fees to at least $100 per year to allow for more inspections. DENR should also explore a graduated renewal fee system similar to that used for processing permits.

DWR's riparian buffer program illustrates the problem and the ways in which this recommendation works to solve it.[246] The riparian buffer program does not charge fees for permitting or for services such as follow-up inspections, buffer authorizations, minor variances and major variances, and the identification of surface waters problems.[247] The initial permit-processing fee does not cover the cost of on-going compliance monitoring, which is crucial to the permitting cycle. The implementation of a permit fee system that requires greater contribution from permit holders would increase the funds available to continue compliance monitoring and enforcement efforts. This would allow agencies such as DWR to conduct more inspections and thus improve overall compliance rates.

The N.C. General Assembly and DENR should establish a department-wide electronic system for sharing compliance and permitting information, both internally and with the public.

In order for DENR to successfully serve the State of North Carolina, the department must ensure not only that permits are reviewed in a timely manner, but also that permit holders properly comply with permit conditions. The creation of a department-wide, publicly accessible database serves the goal of improving compliance by: (1) providing each DENR division with access to all other divisions' compliance data, thus allowing each division and DENR as a whole to make more informed enforcement decisions; and (2) allowing an informed public to monitor DENR enforcement efforts and pressure permitted facilities to comply with environmental rules.

Internally, each DENR division uses its own electronic system to record and store permitting, compliance and enforcement data.[248] Not only do these individual databases present a challenge to interdepartmental communication, but they also pose problems at the divisional level. For example, staff from the water quality programs and the stormwater permitting program, when they operated as DWQ, have noted that their permit-tracking database, known as BIMS, is inefficient and does not satisfy the division's needs.[249]

DENR produced an Enforcement Assessment study in 2000 that addressed the department's data-sharing problems.[250] Without specifically mentioning a department-wide, publicly accessible database, the study suggested implementing a system to connect DENR divisions to each other and to the public.[251] Because the then-available technology was both prohibitively expensive and logistically infeasible, the recommendation was not implemented at the time of the study, and the problems persist.[252] Budgetary and technological limitations persist, but the inadequacy of the current system highlights the need to reconsider this recommendation and explore ways that it might finally be realized.

Department-wide communication currently takes place via an outdated memorandum system.[253] For example, if a DEMLR employee notices an issue with a riparian buffer while conducting an inspection of a permitted site, that employee must return to the office and personally contact DWR to apprise the division of the issue.[254] As divisions have limited time and staff to attend to their obligations, requiring interpersonal communication is, at best, inefficient. At worst, imposing this burden on an employee's time invites the risk that such communication between departments will not take place at all, leaving potential violations unaddressed. Under a unified database system, however, the DEMLR inspector in the aforementioned example can note the riparian buffer issue in a report and then upload the report to the shared database. The DWR employee charged with inspecting that site then has access to all previous inspections of the site, including the DEMLR's notes on the riparian buffer, and can address the issue accordingly.

The technology to merge existing divisional databases does not currently exist within DENR, thus the steering committee recommends that DENR create a new department-wide database to bring each division under the umbrella of a unified and streamlined system. Given the cost and logistical limitations of physical servers, the steering committee also suggests exploring cloud-based technology as a potential unification strategy. A unified database furthers the goal of improved compliance by keeping all DENR divisions abreast of all inspection results. Given that a single permitted facility is often regulated by multiple DENR divisions,[255] coordination of compliance data between divisions is crucial for efficient enforcement.

With regards to external communication, the public currently has access to permitting data but not compliance data.[256] Although state law guarantees public access to monitoring data, NOVs and penalty assessments, a member of the public seeking information on permit violations and responsive state actions must travel to pull hard copy files from either the DENR regional offices or the central office in Raleigh.[257] This process often requires that the member of the public contact multiple divisions and/or regional offices, as one division cannot necessarily answer questions regarding the actions of another division.[258] The burdensome nature of this task limits public awareness of and involvement in enforcement efforts, which in turn limits the level of accountability.[259] The creation of a unified database would drastically improve the ease of access to compliance and enforcement data and thus allow the public to fulfill its role as diligent watchdog. In addition, it would reduce the time and cost burden incurred by the agencies in responding to requests by the public. Finally, the General Assembly recently placed stricter tracking and reporting requirements on the DENR permitting process,[260] and a unified database would facilitate the implementation of this law.

The N.C. General Assembly and DENR should coordinate and streamline compliance monitoring and enforcement through the use of tablets, laptops, smartphones and similar technology in the field.

As discussed at length in this chapter, the data collected during inspections of permitted sites is essential to determine the effectiveness of the current state coastal stormwater program and other such regulatory efforts. Therefore, it would be beneficial to DENR and the State of North Carolina to increase both the quantity and accuracy of compliance data. This recommendation serves that goal by: (1) increasing the number of inspections a division can feasibly conduct; and (2) ensuring the accuracy of the information collected during those inspections.

Under the current system, inspectors for the water quality programs and stormwater permitting program use pen and paper to collect this data in the field, and then record the data electronically upon returning to the office.[261] The use of tablets in the field would: (1) reduce the time required to complete an inspection by eliminating the need for in-office data entry, (2) improve the accuracy of the data by reducing the number of necessary steps and opportunities for human error, and (3) improve customer service by providing faster turnaround times between inspections and notifications to permit holders and property owners.

The introduction of tablets and laptops into monitoring and enforcement efforts has yielded these results in other DENR divisions, such as the Division of Waste Management (DWM),[262] and in government agencies in other states, such as the Maryland Department of the Environment (MDE). One year ago, DWM inspectors began using a system of "home-based" tablets, which

transmits and stores collected data into a database shared by all DWM regional offices.[263] After only one year with the tablet system, DWM Deputy Director Linda Culpepper refers to the tablets as a "necessity."[264] She notes that the system has been largely free of technological problems[265] and praises the system's efficiency, as it has streamlined the data recording process and eliminated the need for digital cameras to take photographs during inspections.[266]

MDE inspectors have used laptops in the field since 1996.[267] They record their findings on a laptop on-site and then return to the office to sync the data to a department-wide database.[268] Like Culpepper, Jessie Salter, Environmental Program Director at MDE, underscores the "critical purpose" the technology serves in carrying out monitoring and compliance efforts.[269] In addition to the improved efficiency as noted by DWM in North Carolina, MDE has found its system's two-way data sharing beneficial as it allows inspectors not only to input and store reports, but also to download essential maps and forms while out of the office.[270] MDE's use of portable technology also highlights the ways in which this recommendation complements this committee's prior recommendation for a department-wide data sharing system. Inspectors can view previous inspection reports of similar sites, thus eliminating ambiguities and inconsistencies in the manner in which the forms are completed and thus improves the quality of the collected data set. Although DWM and MDE keep IT personnel on staff to address potential technological issues, Culpepper notes that DWM's technology has been largely issue-free following the initial transition phase, while Salter explains that MDE's IT department has actually made strides towards keeping departmental costs down.[271]

As these examples indicate, the use of tablets in the field decreases the time and resources required to conduct a single inspection, which allows departments to conduct more inspections and thus collect more compliance and enforcement data. Further, the use of tablets improves the accuracy of that collected data by simplifying the data entry process. In addition to the benefits seen at DWM and MDE, Amy Adams, former assistant regional office supervisor for the Washington Regional Office of DWR, anticipates that the use of tablets in the field will improve customer service.[272] Adams noted that the use of tablets will expedite communication between inspectors and the regulated community by allowing inspectors to quickly compile and send information related to site visits.[273] She further noted that the GPS tracking capabilities of tablets can be used to: (1) provide quality assurance by ensuring that inspectors end up at the proper locations and (2) improve emergency response time, which would allow the division to ascertain the whereabouts of its inspectors in the event of a spill or other emergency and then swiftly direct the nearest inspectors to the site of the emergency.[274]

The success in other governmental departments indicates that the use of portable technology in monitoring and enforcement efforts not only streamlines day-to-day operations, but also cuts down on costs. DWM received a grant from EPA to finance its switch to digital inspections.[275] According to DWM's cost savings analysis, the use of home-based tablets will net savings of $59,752.[276] In addition, Adams pointed out that the utilization of modern technology also will cut costs by reducing the number of employees required to carry out the division's duties.[277] In Maryland, the transition to digital data collection cost MDE between $56,000-$63,000 for the laptops plus the cost of software upgrades, but Salter concludes that the increased efficiency is worth the cost.[278]

DENR should grant each division, particularly DWR and DEMLR, the authority to develop expedited enforcement procedures for minor violations to streamline the enforcement process.

As this chapter has explained, the current compliance monitoring and enforcement efforts are cumbersome and ineffective for both DENR and the regulated community. The inefficient nature of the regulatory process drains DENR's manpower and financial resources. This leads to fewer inspections, which limits DENR's ability to gauge the successes and shortcomings of existing regulatory programs and, consequently, DENR's ability to achieve the goals of those programs. A more streamlined compliance monitoring and enforcement system would reduce the burden on DENR's resources, allowing for more inspections and improved compliance. This recommendation serves to streamline the enforcement system by encouraging flexibility at the regional level and by reducing the amount of resources spent on minor violations.

DCM's procedures illustrate the benefits of an expedited, streamlined process. DCM employs streamlined compliance monitoring and enforcement efforts that set it apart from other DENR divisions.[279] A comparison offers a stark contrast to the process currently used by the water quality programs of DWR and underscores the inefficiency of that process. While DCM operates on a smaller scale than the water quality programs, with fewer programs and less expansive sites to monitor, DCM's high rate of compliance makes the division's enforcement program worth exploring as a possible model by which to evaluate and restructure the enforcement efforts of DWR's water quality programs and other DENR divisions.

DCM places a strong emphasis on compliance monitoring and enforcement efforts and has seen high permit compliance rates as a result.[280] One of the ways DCM has successfully streamlined the process is by entrusting enforcement power to division directors and DCM staff.[281] Under DWR's enforcement scheme, only the DENR Secretary can assess civil penalties; under DCM's enforcement scheme, such tasks are delegated to DCM staff through the informal enforcement assessment process discussed in this chapter.[282] This expedited process allows DCM staff to swiftly and efficiently resolve minor violations by working directly with the permit holder to fix the violation and assess the fees. In contrast, the water quality programs require the oversight and approval of the DENR central office and therefore staff must expend time and resources to compile a full enforcement package for all violations, regardless of the violation's severity.[283] By following DCM's example and granting each division the authority to develop expedited enforcement procedures for minor violations, DENR can save time and money.

Endnotes – Chapter 3

[191] N.C. Dep't of Env't and Natural Res., Enforcement Assessment 2000, *available at* http://www.enr.state.nc.us/novs/enforce2.pdf.

[192] *See About DENR,* N.C. Dep't of Env't and Natural Res., http://portal.ncdenr.org/web/guest/about-denr (last visited Aug. 20, 2013).

[193] Press Release, N.C Dep't of Env't and Natural Res., DENR Secretary announces merging of state water programs to create efficiency, better customer service (Aug. 1, 2013), *available at* http://portal.ncdenr.org/c/journal/view_article_content?groupId=4711509&articleId=14525331.

[194] *Id.*

[195] *Id.*

[196] *Id.*

[197] *Stormwater Program*, U.S. Envtl. Protection Agency, Office of Wastewater Mgmt., http://cfpub.epa.gov/npdes/home.cfm?program_id=6 (last updated Feb. 16, 2012).

[198] *See id.*

[199] 33 U.S.C. § 1342 (2006 & Supp. 2012). North Carolina has been delegated the authority to administer the NPDES program on behalf of the Environmental Protection Agency (EPA). *See Authorization Status for EPA's Stormwater Construction and Industrial Programs*, U.S. Envtl. Protection Agency, Office of Wastewater Mgmt., http://cfpub.epa.gov/npdes/stormwater/authorizationstatus.cfm (last updated Apr. 16, 2012).

[200] *NPDES Permit Program Basics: Other Federal Laws*, U.S. Envtl. Protection Agency, Office of Wastewater Mgmt., http://cfpub.epa.gov/npdes/fedlaws.cfm?program_id=6 (last updated Dec. 5, 2012).

[201] *About DWR Water Quality Programs*, N.C. Dep't of Env't and Natural Res., Div. of Water Res., http://portal.ncdenr.org/web/wq/home/about (last visited August 20, 2013); *see also* N.C. Gen. Stat. § 143B-282 (2011) (creating the EMC and setting forth its powers and duties).

[202] Typically, field inspectors are able to perform approximately four field inspections on any given day. This number is subject to distances between sites and the significance of discovered violations.

[203] For example, in DENR's most recent compliance report from 2008, there were approximately 9,186 regulated entities in the water quality programs and approximately 48,309 regulated entities in the stormwater permitting program, based on the data provided. *See* N.C. Dep't of Env't and Natural Res., Environmental Regulatory Compliance Activity in Calendar Year 2008 (2009), *available at* http://portal.ncdenr.org/web/guest/enforcement/departmental-enforcement.

[204] N.C. Dep't of Env't and Natural Res., Enforcement Assessment 2000 6, *available at* http://www.enr.state.nc.us/novs/enforce2.pdf.

[205] *Id.*

[206] N.C. Dep't of Env't and Natural Res., Enforcement Penalty for Self Reported Violations 1–2 (2000), *available at* http://portal.ncdenr.org/web/guest/self-reported-penalty-policy. For example, an entity's economic gain from non-compliance could occur through: "(1) Delaying necessary pollution control expenditures; (2) avoiding necessary pollution control expenditures; and/or (3) obtaining an illegal competitive advantage." Notice of final action and response to comment, Calculation of the Economic Benefit of Noncompliance in EPA's Civil Penalty Enforcement Cases, 70 Fed. Reg. 50326, 50327 (Aug. 26, 2005).

[207] *See* N.C. Dep't of Env't and Natural Res., Enforcement Penalty for Self Reported Violations 1–2 (2000), *available at* http://portal.ncdenr.org/web/guest/self-reported-penalty-policy.

[208] N.C. Dep't of Env't and Natural Res., Report on Tiered Enforcement Policy Development 1 (2011), *available at* http://portal.ncdenr.org/c/document_library/get_file?uuid=6c8fe528-52d2-49cb-82b9-650e48a8043a&groupId=2444522.

[209] *Id.*

[210] *Id.* at 2, 11.

[211] *Id.* at 11.

[212] *Id.* at 2, 11.

[213] *Id.* at 12. Note: NODs do not always have to be issued before a NOV. *Id.* at 12.

[214] *Id.* at 2–3, 12.

[215] *Id.* at 12.

[216] *Id.* at 3, 12.

[217] 15A N.C. Admin. Code 7J.0409 (2012).

[218] Remarks at the meeting of the Inner Coast Steering Committee (June 19, 2012) (recording and meeting notes on file with author).

[219] *Id.* 7J.0409(e)–(g).

[220] N.C. Gen. Stat. § 113A-126(d)(4) (2011 & Supp. 2012).

[221] N.C. Const. art. IX, § 7; N.C. Gen. Stat. § 115C-457.3 (2011); *see also* N.C. Sch. Bd. Ass'n v. Moore, 359 N.C. 474, 510 (N.C. 2005) (holding that, inter alia, civil penalties assessed by DENR may not be used to fund supplemental environmental projects and all clear proceeds of penalties, forfeitures, and fines go to the school fund).

[222] *See* N.C. Gen. Stat. § 115C-457.2.

[223] Email from Scott Vinson, Environmental Engineer, NC DENR-DWR, to Ashley McAlarney, Research Law Fellow, N.C. Coastal Resources Law, Planning and Policy Center (Aug, 3 2012, 15:19 EST) (on file with the N.C. Coastal Resources Law, Planning and Policy Center).

[224] Some of the burden of permitting and enforcement is also carried by local governments. *See* Robert Patterson, *DWQ's Stormwater Programs: Overview and Recent Changes*, N.C. Dep't of Env't and Natural Res., Div. of Water Quality, Stormwater Permitting Unit 5 (Feb. 9, 2011), http://cnr.ncsu.edu/rrs/pdfs/Webinar_Stormwater_2011_Feb09.pdf.

[225] For a collection of all available DENR annual compliance activity reports, see *Enforcement*, N.C. Dep't of Env't and Natural Res., http://ncdenr.gov/web/guest/enforcement (last visited Aug. 21, 2013).

[226] *Id.*

[227] State Stormwater Management (15A NCAC 2H .1000): Project characteristics and compliance account for five (5) selected coastal counties in southeastern North Carolina, Danny Smith, N.C. Dep't of Env't and Natural Res., Div. of Water Quality 1 (2005) (unpublished report) (on file with DENR Wilmington Regional Office).The project types included in the study were detention ponds, low-density sites, curb outlets, and infiltration systems. *Id.*

[228] *Id.* at 14.

[229] Preliminary Report on Stormwater Permit Compliance Project, N.C. Dep't of Env't and Natural Res., Div. of Water Quality 2 (2007).

[230] *Id.* at 3.

[231] *Id.* at 2–3.

[232] *Id.* at 4.

[233] *Id.* at 5.

[234] *Id.* at 5-6. Note: the high-density permit currently has a duration of eight years, as of 2012.

[235] *Toolbox: By the Numbers*, N.C. Dep't of Env't and Natural Res., Div. of Water Quality, http://www.ncstormwater.org/pages/toolkitfreecontent.html (click on the link to "By the Numbers") (last visited Dec. 2, 2013)

[236] *Id.*

[237] *Stormwater FAQs: Why do we need to manage stormwater and polluted runoff?*, N.C. Dep't of Env't and Natural Res., Div. of Water Quality, http://portal.ncdenr.org/web/lr/faq-stormwater (last visited Dec. 2, 2013).

[238] *Coastal Stormwater Rules*, N.C. Conservation Network, http://www.ncconservationnetwork.org/issues/coastal_issues/issues/water_issues/polluted_runoff (last visited Aug. 21, 2013).

[239] *Swimming Advisories*, N.C. Dep't of Env't and Natural Res., Div. of Marine Fisheries, http://portal.ncdenr.org/web/mf/rwq-swim-advisories-current (select "Advisory Archive" tab; then set "Swimming Season" tab to 2011) (last visited Aug. 21, 2013).

[240] Conservation Council of N.C. Found., See No Evil: Why Our Environmental Laws Aren't Being Enforced 4 (2002), *available at* http://nclcvf.org/assets/SNEfinal.pdf.

[241] *See* N.C. Dep't of Env't and Natural Res., Enforcement Assessment 2000 6, *available at* http://www.enr.state.nc.us/novs/enforce2.pdf.

[242] State Stormwater Management (15A NCAC 2H .1000): Project characteristics and compliance account for five (5) selected coastal counties in southeastern North Carolina, Danny Smith, N.C. Dep't of Env't and Natural Res., Div. of Water Quality 1 (2005) (unpublished report) (on file with DENR Wilmington Regional Office).

[243] *Id.* at 14.

[244] *Id.*

[245] *See* N.C. Gen. Stat. § 143-215.1(d2) (2011); *See Stormwater Permit Fees*, N.C. Dep't of Env't and Natural Res., Div. of Water Res., http://portal.ncdenr.org/web/lr/spu-fees (scroll down to "Miscellaneous Activities") (last visited Dec. 2, 2013).

[246] The Water Quality Certification (WQC) program faces similar problems (see Appendix F for details). Over the years, the WQC permit has become a perpetual permit with on-going permit requirements, yet the State charges only a one-time permit application fee. The cost of the WQC permit does not cover the cost of on-going compliance monitoring, which is crucial to the permitting cycle. *See Permit Fees*, N.C. Dep't of Env't and Natural Res., Div. of Water Res., http://portal.ncdenr.org/web/wq/ws/su/fees (last visited Aug. 21, 2013).

[247] *See* 15A N.C. Admin. Code 02B.0233.

[248] Remarks at the meeting of the Inner Coast Steering Committee (June 19, 2012) (recording and meeting notes on file with author).

[249] Preliminary Report on Stormwater Permit Compliance Project, N.C. Dep't of Env't and Natural Res., Div. of Water Quality 5–6 (2007).

[250] *See* N.C. Dep't of Env't and Natural Res., Enforcement Assessment 2000 16–17, *available at* http://www.enr.state.nc.us/novs/enforce2.pdf.

[251] *Id.*

[252] Telephone interview with Amy Adams, Environmental Regional Supervisor, N.C. Division of Water Quality (June 7, 2013).

[253] Remarks at the meeting of the Inner Coast Steering Committee (June 19, 2012) (meeting notes on file with author).

[254] *See id.*

[255] N.C. Dep't of Env't and Natural Res., Enforcement Assessment 2000 21, *available at* http://www.enr.state.nc.us/novs/enforce2.pdf.

[256] Remarks at the meeting of the Inner Coast Steering Committee (May 16, 2013) (meeting notes on file with author).

[257] Conservation Council of N.C. Found., See No Evil: Why Our Environmental Laws Aren't Being Enforced 18 (2002), *available at* http://nclcvf.org/assets/SNEfinal.pdf.

[258] *Id.*

[259] *Id.*

[260] *See* N.C. Gen. Stat. § 143B-279.17.

[261] Telephone interview with Amy Adams, Environmental Regional Supervisor, N.C. Division of Water Quality (June 7, 2013).

[262] Other DENR departments, such as the Division of Air Quality and the Division of Coastal Management, have also incorporated the use of electronic devices into their on-site inspections. Telephone interview with Michael Abraczinskas, N.C. Division of Air Quality (November 2, 2012). For the purpose of brevity, only the efforts of the DWM will be explored in depth.

[263] Telephone interview with Linda Culpepper, Deputy Director, N.C. Division of Waste Management (January 10, 2013).

[264] *Id.*

[265] *Id.*

[266] Telephone interview with Linda Culpepper, Deputy Director, N.C. Division of Waste Management (May 23, 2013).

[267] Telephone interview with Jessie Salter, Environmental Program Director, Maryland Department of the Environment (November 13, 2012).

[268] *Id.*

[269] *Id.*

[270] *Id.*

[271] Telephone interview with Linda Culpepper, N.C. Division of Waste Management (January 10, 2013); Telephone Interview with Jessie Salter, Environmental Program Director, Maryland Department of the Environment (November 13, 2012).

[272] Amy Adams provided these comments prior to leaving her position as Environmental Regional Supervisor, N.C. Division of Water Quality, on Nov. 1, 2013.

[273] Telephone interview with Amy Adams, Environmental Regional Supervisor, N.C. Division of Water Quality (June 7, 2013).

[274] *Id.*

[275] Telephone interview with Linda Culpepper, N.C. Division of Waste Management (January 10, 2013).

[276] DWM estimated the capital cost of the switch at $12,320 (18 Samsung Galaxy tablets at $614.99 each, and $1,250 total for additional accessories such as chargers, cases, and screen protectors), plus a monthly wireless charge of $38.94, and the savings at $72,072 (18 out of 44 staff would utilize the tablets for a projected 7% increase in staff efficiency from not having to take field notes, type up an inspection report and enter the information into a database. 18 (number of staff) x$27.50 / hour (average hourly salary) x 2080 hours (average yearly hours) = $1,029,600 x 7% (increase in efficiency)).The savings ($72,072) minus the cost ($12,320) yields a net yearly benefit of $59,752**.** Telephone Interview with Linda Culpepper, N.C. Division of Waste Management (May 23, 2013).

[277] Telephone interview with Amy Adams, Environmental Regional Supervisor, N.C. Division of Water Quality (June 7, 2013).

[278] Telephone interview with Jessie Salter, Environmental Program Director, Maryland Department of the Environment (November 13, 2012).

[279] Remarks at the meeting of the Inner Coast Steering Committee (Jan. 30, 2013) (meeting notes on file with author).

[280] *Id.*

[281] *Id.*

[282] *See* 15A N.C. Admin. Code 7J.0409(f) (2012).

[283] Remarks at the meeting of the Inner Coast Steering Committee (May 16, 2013) (meeting notes on file with author).

Chapter 4: Sanitary Sewer Overflows

The effective management of wastewater and its infrastructure are critical to the protection of North Carolina's coastal surface water resources and public health. One aspect of wastewater management that has significant implications for the future of the inner coast region is the prevention of sanitary sewer overflows (SSOs). For this reason, the steering committee selected this as an emerging issue.

Although the function of a sanitary sewer system (SSS)[284] is to collect and contain all raw sewage and transport it to a treatment facility, the reality is that overflows can and do occur when, for any of a number of reasons, the system is unable to contain and transport the waste material flowing through it. When these unintentional discharges occur, untreated or partially treated wastewater is released into the surrounding environment. These discharges may result in wastewater flowing onto public and private streets, into houses, apartments, businesses, public buildings and parks and entering public waters.

SSOs may allow wastewater to flow onto public areas, such as streets.[285]

Unexpected or unusual storm events may tax even well-designed SSSs, but if overflows occur frequently, then the system is likely to be in need of repair or replacement. Due to aging and outdated wastewater infrastructure, many inner coast communities in North Carolina are experiencing an increasing number of SSOs. But many inner coast communities lack the tax base and other financial resources necessary to make SSS repairs or upgrades and the ability to provide the necessary financing for such projects. This chapter will examine this emerging issue, explain the current federal and state legal and regulatory regimes in place to address them, provide an overview of the policy challenges, and make recommendations on the steps that the State, DENR and local governments can take to reduce the frequency of SSOs and plan for the future.

It will cost money to adequately address the SSO problem. Finding the financial resources is admittedly a challenge for many smaller inner coast communities. However, there are ways in which communities may be able to find the necessary funds. To assist such communities and their leaders, Appendix H provides detailed information on how units of local government can fund water and wastewater infrastructure projects.

Scope of the Issue

Typical causes of SSOs include line breaks, line blockages due to grease and other materials, system overload due to inflow of stormwater, inadequate design, and inadequate operation and maintenance. No SSS is completely immune to SSOs, and any SSO is a concern. But when they occur frequently or discharge significant volumes of untreated or partially treated wastewater, they raise especially serious public health and environmental concerns.

Causes of Sanitary Sewer Overflows

According to the EPA, there are a variety of causes for a SSO. Outside infiltration of the system is one cause. This may happen when an overabundance of rainfall or snowmelt infiltrates through the ground and into collection systems that are leaking or not designed to hold the additional flow. Outside infiltration of the system also can occur when excess water inflows through roof drains that are connected to sewers, broken pipes, and improperly connected sewer lines. A second cause of SSOs is undersized systems, such as sewers and pumps that are too small to carry sewage from expanding subdivisions or commercial areas. Pipe failures are a third cause, which can be attributed to blocked, broken or cracked pipes; tree roots that grow into the sewer; sections of pipe that settle or shift so that pipe joints no longer match and builds up sediment; or other material that can cause pipes to break or collapse. A fourth cause is equipment failure, which can include pump failures and power failures. In addition, there may be other problems associated with deteriorating collection systems or with sewer service connections, which can lead to discharges to houses and other buildings.[286] Storm events such as hurricanes and nor'easters are of special concern in the inner coast. Heavy rainfall and flooding can quickly overload collection systems, resulting in substantial SSOs. Release volumes can range from a few gallons to millions of gallons. These releases are generally into surface waters and if on land also can infiltrate the groundwater system.

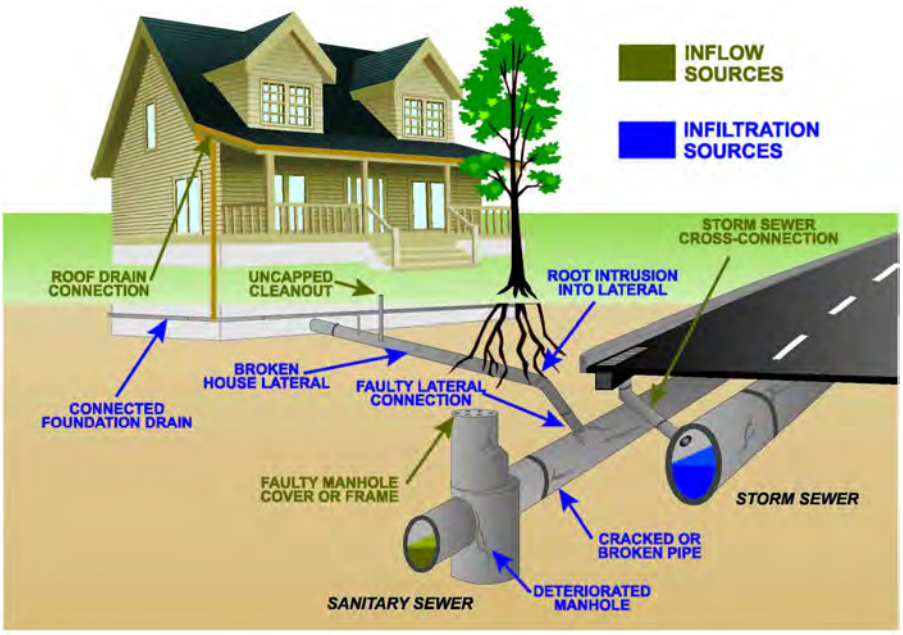


Figure 7: Potential Causes of Sanitary Sewer Overflows[287]

Impacts to Public Health, the Environment and the Coastal Economy

SSOs caused by inadequately managed and failing systems can present serious environmental and public health issues and adversely impact overall water quality, damage private property, and result in losses to the local economy. Overflows may contain raw sewage, which can carry bacteria, viruses and parasites. This could lead to contamination of public waters, triggering a public health concern. The diseases that can result from exposure to these contaminants vary from mild gastroenteritis to cholera and hepatitis.[288] Exposure can occur through drinking water, direct contact in public areas such as streets and recreational waters, consumption of shellfish harvested from contaminated waters, inhalation, and skin absorption.[289]

SSOs also have adverse environmental and economic consequences. SSOs may pollute oceans, estuaries or freshwater areas affecting water quality. If those public waters can no longer be used for commerce (such as fishing) or recreation (such as swimming and boating), then shellfishermen, fishermen and other water-dependent business owners may suffer financial harm.

SSOs can make public waters unusable for commerce and recreation.[290]

Challenges in Coastal North Carolina

According to DWR, there were more than 15,000 reported SSO incidences throughout the state from January 1, 2007 to January 1, 2012, with approximately 1,081 of those incidences reported to the DENR Washington Regional Office and approximately 536 incidences reported to the DENR Wilmington Regional Office.[291] However, as noted by the N.C. Rural Economic Development Center (Rural Center) in the Water 2030 Initiative, most of these SSOs can be traced back to the aging and failing water and sewer systems in the inner coast region.[292] Most of North Carolina's water systems are 40 years old or older, with many of them 60 to 70 years old.[293] The average age of wastewater treatment plants in the state is approximately 40 years old, though many of them have undergone renovations to comply with current state and federal regulations.[294]

In its 2013 North Carolina report card, the North Carolina section of the American Society of Civil Engineers gave North Carolina's wastewater infrastructure a statewide grade of "C". According to the report "North Carolina has documented a need of over $4 billion of additional wastewater infrastructure investment needs through the year 2030. These funds are needed to replace aging

facilities, comply with mandated CWA regulations, and provide as well as keep pace with economic development."[295]

Where sewer lines are the original installations, replacing them is an expensive and time-consuming task.[296] However, the replacement of these installations can be beneficial for economic development. Having adequate wastewater capacity can be part of a business's decision of where to locate. If a local government faces challenges in financing repair or replacement of sewer lines, then it also may face challenges with expanding or building new lines to accommodate residential development and attract businesses. These problems and needs are especially acute in a number of inner coast communities. Many of these communities have aging and failing systems. For example, in the Town of Belhaven, while it has sewer lines varying in age, the oldest lines are 100 years old.[297] In the Town of Columbia, the oldest sewer lines are 85 to 90 years old.[298]

All but one of North Carolina's 20 coastal counties are classified as rural.[299] By definition, rural counties have lower, and less dense, populations. This means fewer water and sewer customers and fewer businesses and industries among which to spread the cost of replacing or upgrading wastewater infrastructure. Furthermore, according to the 2010 U.S. Census, 11 of the 20 coastal counties are among the poorest counties in North Carolina, with a poverty level of 17.9% or higher.[300] Five of the 20 coastal counties have a poverty rate between 15.9% and 17.8%.[301] The median household incomes for 14 of these 16 counties are approximately $834 to $16,965 below North Carolina's overall median household income of $46,291.[302] The exceptions are Carteret and New Hanover Counties, which have median household incomes of approximately $47,403 and $48,893, respectively. The factors directly impact a community's bond rating and its ability to qualify for a private loan. Therefore, these communities tend to rely on grants to finance infrastructure improvements; but, obtaining grants may be difficult for some local governments because they cannot provide the necessary matching funds.[303] For example, raising water and sewer fees is one way to raise the matching funds, but frequently there is public resistance to any increase in fees, and local governments may find it challenging to gain the necessary political support to take such action.[304] Furthermore, even if a local government is able to secure grant funds, the grant may not cover the total cost of the project. Therefore, the local government would need to obtain additional funding from other sources.

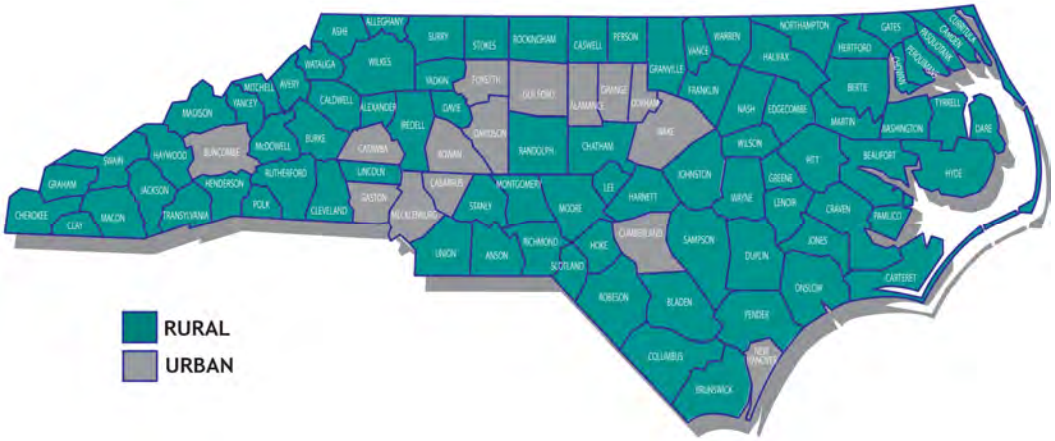


Figure 8: Urban and rural classifications of N.C. counties by the Rural Center.[305]

Government Initiatives

There have been multiple government-led initiatives from the federal level to state and local levels to address challenges presented by SSOs. For example, there have been attempts at the national level to create consistency in the manner in which federal permits are considered for wastewater discharges and for the enforcement of laws prohibiting unpermitted discharges. One such effort was the creation of the Sanitary Sewer Overflow Federal Advisory Subcommittee in 1994, which remained active until 1999. This subcommittee, which was a part of a larger federal advisory committee on urban wet weather flows, included representatives from states, municipalities, health agencies and environmental groups. The subcommittee's purpose was to examine the need for national consistency in permitting and enforcement and to provide input on a potential SSO regulation.[306] The subcommittee report expressed support for capacity, management, operation and maintenance (CMOM) programs for municipal collection systems; a prohibition on SSOs, which included a recommended framework for raising a defense for unavoidable discharges; and requirements for reporting, public notification and record-keeping requirements for municipal sanitary sewer collection systems and SSOs.[307] However, the subcommittee's recommendations were not incorporated into any existing or new federal regulations.[308]

In 2004, EPA reported to Congress on the impacts and controls of sewer overflows.[309] In its report, EPA provided recommendations on how to reduce the environmental and public health impacts of SSOs. Some of the recommendations issued by EPA addressed maintenance and improvement of the integrity of the nation's wastewater infrastructure, improved monitoring and reporting to provide better data to decision-makers, and continued cooperation between federal and state agencies and local governments, non-governmental organizations and citizens.[310]

One possible reason the federal government and the state may be slow in fully addressing the problem of SSOs is that, due to unreported or under-reported incidences of SSOs, existing data does not reflect the true scale of the problem.[311] The EPA conducted surveys in 1981 and 1994, but more recent national-level data is needed.[312] Under-reporting also may be an issue at the state level, but that may be a function of reporting requirements. For example, North Carolina requires the reporting of any spills reaching surface waters, regardless of the volume of the spill.[313] Otherwise, any spill of more than 1,000 gallons should be reported.[314] This threshold for reporting does leave room for unreported spills.

Legal and Regulatory Framework

Wastewater collection systems convey wastewater to a treatment plant, which carries out the process of disinfection and destruction of pathogenic and other microorganisms, and then generally discharges the treated water into some public body of water. For the protection of public health, public water supplies, and the environment, it is essential that: (a) the collection systems function properly and efficiently; and (b) any system discharges satisfy established water quality standards. In North Carolina, the regulatory responsibility for ensuring that this happens lies with both the EPA and DENR. EPA's role is setting water quality standards for discharges and for issuing NPDES permits, which authorizes a system operator to discharge the material in a collection system into public waters. DENR's role is two-fold. First, standards are established for the operation and maintenance of the working parts of the collection and treatment system itself. Second, because EPA has delegated to North Carolina the authority to issue NPDES permits, DENR

also has the responsibility to make sure that any discharges from the collection system meet federal water quality standards.

Federal Framework

The CWA prohibits any discharge of any pollutant from a point source into waters of the United States, unless authorized by permit.[315] At the federal level, the responsibility for implementation of the CWA's mandate falls to the EPA.[316] Exercising that authority, EPA has implemented pollution control programs, e.g., wastewater standards for industry and water quality standards for all contaminants in surface waters. A violation of those standards, or the discharge of any pollutant from a collection system without a permit, constitutes a violation of the CWA for which administrative, civil and criminal penalties may apply. The process established by EPA for the issuance of the necessary permit is the NPDES program. Therefore, to avoid any potential criminal liability an operator of a system must have a NPDES permit authorizing any discharge flowing into public surface waters from the collection system and must adhere to the conditions established by the permit.

North Carolina Framework

In 1975, EPA delegated NPDES permitting authority to the State of North Carolina.[317] The program operates as the NPDES Permitting and Compliance Program. The EMC issues and renews permits under this program, and both the EMC and the DENR develop and implement rules for wastewater systems.[318] DWR is responsible for permit reviews and compliance monitoring and enforcement. The NPDES Permitting and Compliance Program includes standards for the operation and maintenance of any wastewater collection system and wastewater treatment facilities. Viewed broadly, this program provides the authorization for the installation, operation and maintenance of a collection system and its moving parts; the CWA and the NPDES program regulate discharges that come out of the collection system's pipes.

In order to operate, a wastewater collection system owner must obtain either a general permit or individual permit from the EMC,[319] unless the system is deemed permitted under commission rules.[320] DWR reviews general permit applications for certain categories of statewide activities, such as domestic discharges from single-family residences. Individual permits are issued on a case-by-case basis for activities that do not fall under a general permit category. There are two categories of individual permits – major permits and minor permits. Commercial and industrial discharges are classified as "major" based on factors such as flow, waste characteristics, and impacts to water quality and public health.[321] An example of a major permit project is one in which the discharge from the system treating domestic waste has a design flow greater than one million GPD.[322] An example of an entity requiring a minor permit might be a seafood processing facility.[323]

Under the authority of section 143-215.1 of the General Statutes, DWR also administers state-level permit programs for wastewater collection systems, which include a system-wide collection system program and a sewer extension program. The system-wide collection system permit serves as an extension to the proper operation and maintenance clause included in the NPDES permit.[324] When an applicant seeks a permit for a new facility, the process is to apply for both the NPDES permit and system-wide collection system permit at the same time.[325] The issuance and renewal of these permits are linked together. According to DWR, the rationale for keeping the system-wide collection permit separate from the NPDES permit was due to a growing number of aging

collection systems in which operators had not invested the needed resources to keep the systems running properly and efficiently.[326] This, in turn, led to an increased number of SSOs.[327] The system-wide collection system permit provides for performance standards, minimum design and construction requirements, formal capital improvements planning, operation and maintenance requirements, and minimum reporting requirements.[328]

McKean-Maffit (Southside) Wastewater Treatment Plant in Wilmington[329]

Collection systems with an average daily flow of less than 200,000 GPD are deemed permitted by regulation and do not need to go through the general permit or individual permit process, if they meet the conditions set forth in title 15A, rule 2T.0403 of the North Carolina Administrative Code. Collection systems that exceed 200,000 GPD must go through the full permit process described above.[330] For sewer extension projects, expedited "fast track" permitting is available in some instances, if the project meets minimum design criteria and is certified by a professional engineer.[331] Expedited permitting means that the project is not subject to a full technical review.[332] Projects that meet the conditions set forth in title 15A, rule 2T.0303 are deemed permitted by regulation. Projects that are not deemed permitted or do not qualify for expedited permitting must receive an individual permit.[333]

Both state and federal law require that permits be renewed every five years.[334,335,336] However, if the permittee submits a timely renewal application, the facility may continue to operate under its existing permit until a new one is issued, even after the permit's expiration date.[337] Facility operators also are required to submit self-monitoring reports.[338] DWR regional offices periodically inspect systems and facilities to ensure they are in compliance with the conditions of their permits.[339]

Local government also may play a role in the regulation of wastewater collection systems. Subsection 143-215.1(f) of the General Statutes authorizes the delegation of the permitting of sewer systems to local entities through the creation of local permit programs. When such

authority has been delegated, the local permits issued are in lieu of permits issued by DWR, except for projects involving an Environmental Assessment.[340] The delegation allows the local authority to issue permits for construction, modification and operation of public and private sewer systems.[341]

Compliance Monitoring and Enforcement of SSOs

Beginning in the 1990s, regulators and the public focused increased attention on SSOs and collection system performance and became more aware of the public health and environmental impacts of SSOs. It was during this time period that DWR collected data and drafted policies that resulted in the institution of the current collection system permit program.

While DWR's permitting and inspection processes have solidified and strengthened over the years, the agency has identified SSO enforcement as an area that needs improvement. Beginning in 2007, DWR sought to fulfill its goal of having a strong enforcement program and developed a SSO Compliance and Enforcement Operating Guidance. This guidance was officially implemented in March 2009.[342] The goal of the guidance is consistency in SSO compliance and enforcement evaluation, implemented at the DENR Regional Office level. According to DWR, this policy guidance is based on the standardized compliance and enforcement guidelines of the NPDES and non-discharge programs.[343]

Although SSO enforcement in North Carolina is largely achieved through self-reporting of violations, there are instances when unreported spills are brought to DWR's attention through citizen complaint or agency inspection. If the agency determines that the permittee knowingly failed to report a SSO, then enforcement is authorized under section 143.215.6A of the General Statutes. DWR believes that a standardized approach to compliance is key to the integrity of the enforcement program, including cases when permittees do not properly report spills.[344]

All violations are judged on their own merits, given the variable and sometimes uncontrollable (e.g., major storm event, vandalism) nature of SSOs. Under the SSO Compliance and Enforcement Operating Guidance, regional staff evaluates the SSO and then uses its best professional judgment to determine if: (1) no further action will be taken; (2) a NOV should be issued; or (3) a NOV with notice of intent to enforce should be issued.[345] If a penalty is to be issued, the EMC assesses an amount according to a set of eight statutory factors.[346] Each case is considered for all eight factors, and penalties can be based on any combination of them.[347] These eight penalty assessment factors are: (1) degree and extent of harm to the natural resources of the State, to public health, or to private property; (2) duration and gravity; (3) effect on water quantity and quality; (4) cost to rectify the damage; (5) amount of money saved by noncompliance; (6) whether the SSO was willful or intentional; (7) prior record of the violator; and (8) enforcement costs.[348]

Local programs related to collections systems also include enforcement provisions.[349] For example, local programs must include enforcement procedures and penalties compatible with permits issued by DWR.[350] In addition, a professional engineer must be either on staff of the local sewer system or retained as consultant to answer questions during the review stage of the project, and each project permitted by the local program must be inspected for compliance at least once during construction.[351] While SSOs over 1,000 gallons still must be reported to DWR, provisions contained in local sewer system programs can provide strategies and procedures to prevent SSO occurrences in areas within the program's jurisdiction.

Certified operators play a crucial role in ensuring that collection systems run properly and addressing SSO occurrences as they arise. In North Carolina, owners of "classified water pollution control systems," which include wastewater collection systems, must designate one Operator in Responsible Charge (ORC) and one back-up ORC.[352] The responsibilities of ORCs include visiting collection systems as often as needed to ensure proper operation. More specific to collection systems, ORCs are required to visit these systems within 24 hours of knowledge of a bypass, spill or overflow.[353] ORCs are also responsible for all monitoring and reporting and must notify collection system owners of overflows and any need for system repairs and modifications.[354]

However, ORCs are only required by rule for collection systems that are classified by the EMC as a "water pollution control collection system." According to EMC rules, collection systems that exceed 200,000 GPD receive this classification because these systems must have a permit to operate, but systems deemed permitted by regulation[355] are not subject to classification unless the EMC determines the system is not being operated and maintained in a responsible manner.[356] In addition, the system-wide collection system program allows for permitting by regulation. The permitting by regulation rule requires, among other things, an operation and maintenance plan and inspections every six months for high-priority sewers, but designation of an ORC is not included as a condition. Given that not all collection systems are classified,[357] and there are currently 55 known deemed permitted systems[358] under the DENR Washington Regional Office's jurisdiction, this leaves a high number of systems that may not have either an ORC or back-up ORC. Still, that does not necessarily mean all of those systems go without proper operation and maintenance.

Non-Regulatory Programs and Initiatives

In addition to the EMC's and DENR's regulatory roles regarding wastewater infrastructure (which includes SSOs), there are other state-level entities with considerable influence over wastewater infrastructure policy and financing in North Carolina. This section describes previous, current and new entities that have influenced wastewater infrastructure financing and policy, or will have influence on wastewater infrastructure financing and policy in the future. In 2005, the General Assembly created the State Water Infrastructure Commission (SWIC), which operated within the Office of the Governor. The SWIC was abolished in 2013 when the General Assembly repealed the statute that created it and established a new State Water Infrastructure Authority (SWIA) and Division of Water Infrastructure within DENR.[359] The SWIC's purpose was "to identify the State's water infrastructure needs, develop a plan to meet those needs, and monitor the implementation of the plan."[360] Among the SWIC's duties were to assess the State's role in the development and funding of wastewater, drinking water and stormwater infrastructure; analyze the adequacy of projected funding to meet projected needs; and recommend funding priorities.[361] During its tenure, the SWIC focused on "enhancing cooperation, communication, and collaboration among funding entities."[362]

Although SWIA and DWI were only recently established, their intended functions are notable. During the 2013-2014 General Session of the General Assembly, the legislature transferred all powers and obligations related to the implementation and administration of water infrastructure loans and grants from DWR, DWQ (both divisions since merged as DWR) and the N.C. Department of Commerce to a single, new DENR division – the Division of Water Infrastructure (DWI).[363] The primary function of DWI is to administer grants and loans awarded by SWIA to units of local government for infrastructure projects.[364] In addition to awarding grants and loans for

infrastructure projects, the nine-member SWIA also will develop a master plan to meet North Carolina's water infrastructure needs and make recommendations on the State's role in the funding and development of wastewater, drinking water and stormwater infrastructure.[365] In addition to creating SWIA and DWI, the General Assembly tasked the Legislative Research Commission (LRC) to assess how the State could distribute its funding for water, wastewater and economic development projects more efficiently.[366] The LRC is to report its findings and recommendations to the 2014 Regular Session of the 2013 General Assembly "upon its convening."[367]

Also in 2013, the General Assembly established the Rural Economic Development Division[368] (REDD) and Rural Infrastructure Authority (RIA) in the Appropriations Act of 2013, both within the N.C. Department of Commerce. RIA and REDD were established after the General Assembly eliminated State funding to the Rural Center following a damaging financial report released by the State Auditor.[369] RIA and REDD will work together to provide funding assistance primarily to the economically distressed areas of North Carolina.[370] RIA will set policies and priorities for funding and award grants and loans, while REDD will administer grants and loans awarded by RIA.[371] The Appropriations Act of 2013 provides approximately $11 million in funding for 2013-2014 and approximately $15 million for 2014-2015.[372] Funding programs to be offered by RIA and REDD will be similar to those previously offered by the Rural Center, including funding for construction of critical water and wastewater infrastructure facilities.[373]

Although state-level funding ended for the group in 2013 and its future is uncertain, the Rural Center in the past played a significant role in policy development regarding water and wastewater infrastructure, which includes SSOs.[374] In order to implement its mission and serve North Carolina's 85 rural counties, the Rural Center operated numerous business and community programs throughout its history, and water and wastewater infrastructure was one such program. One of the organization's goals was to provide North Carolina's rural counties with information, technical assistance and financial assistance. One of the ways in which the Rural Center implemented its mission was through an infrastructure grants program, which included funding for clean water construction projects and clean water planning grants.

In 2006, the Rural Center released a set of reports as part of its Water 2030 Initiative. The initiative was a multi-year study that produced extensive information on North Carolina's public infrastructure and water supply. It identified $16.63 billion in improvements needed for water, sewer and stormwater systems across the state to keep pace with a growing population, repair and replace old lines and equipment, and meet new environmental regulations.[375] DENR, through its water and sewer needs surveys, concurred with the $16 billion need. Water 2030 was a follow-up to previous work by the Rural Center and other groups in the late 1990s as part of the North Carolina Water and Sewer Initiative.[376] The Rural Center, as part of this initiative, assessed the state's capital needs regarding water, sewer and stormwater infrastructure and presented the following findings: (1) financing water and sewer projects is becoming increasingly difficult; (2) North Carolina's water, sewer and stormwater capital needs are mounting; and (3) population growth will place major demands on the state's water resources.[377]

To address these issues, the initiative made several recommendations, including passage of another bond bill to fund construction and repair of water, sewer and stormwater facilities in urgent need; creation of a permanent funding source for water, sewer and stormwater improvements; and implementation of a means to ensure that rate structures are developed in a

sound manner that is fair to both utility customers and utility operators.[378] One of the successes of the initiative was that the needs data generated by the project encouraged the General Assembly to create the Clean Water Partners Infrastructure Program, which appropriated $150 million over a two-year period to help economically distressed rural communities meet critical water and sewer needs.[379]

Policy Challenge: Aging Infrastructure

To effectively address the issue of SSOs, numerous policy challenges must be considered. Perhaps the most significant challenge is replacing aging wastewater infrastructure, which can be an expensive and time-consuming venture, particularly for small communities. While these small communities understand that aging infrastructure can impede growth, major issues include limited local funding to pay for system expansions and upgrades and limited financing options. In many of North Carolina's coastal communities, water and sewer systems are 50 to 80 years old,[380] with some of the coast's first recorded public water systems installed in Wilmington in the early 1900s.[381] While wastewater treatment plants have benefited from upgrades required by federal and state regulations, other infrastructure, such as sewer lines, has not benefited from upgrades in many areas, particularly in rural communities. While EPA remains a major federal funding source for water and sewer infrastructure through revolving loan funds, the level of financial support has decreased significantly since the 1970s. Other federal agencies that provide funding include the U.S. Department of Agriculture (USDA) and U.S. Department of Commerce's Economic Development Administration (EDA).[382] In the 1970s, Congress authorized EPA to play a major national role in financing sewer infrastructure. Since that time, however, the level and type of funding provided by EPA has changed significantly. In the 1970s and early 1980s, EPA awarded grants up to 75 percent of the total cost of a project.[383] In 1985, the cap was lowered to 55 percent, and grants were eliminated by 1990.[384] Presently, EPA construction funds are allocated to the State through grants, which the State distributes to local governments in revolving loan programs.[385] Funding from the USDA and EDA has exhibited a similar downward trend.

These trends at the federal level have turned the State into a critical source of grant funding for wastewater infrastructure projects. Between 1995 and 2005, the years of study for the Water 2030 Initiative, the Rural Center noted that nearly 80 percent of grant funds came from the State and that these grant funds were critical to low-wealth communities that wanted to make infrastructure improvements. During the same time-period, the 1998 Clean Water Bond referendum was passed, which approved $800 million in bonds for water and sewer projects. State Clean Water Bond Grant funding accounted for 49 percent of the total of state and federal water and sewer grants between 1995 and 2005 and financed 1,103 improvement projects in 97 counties.[386] The allotted funds granted by the bond referendum were completely allocated by 2005.

According to the General Assembly's Program Evaluation Division, more than $2.5 billion was spent in North Carolina between 1998 and 2007 to fund water and wastewater infrastructure projects, including repairs to existing systems, construction of new systems, and extension of lines to accommodate economic development.[387] While this amount may seem very high, it pales in comparison to the $16.63 billion capital improvement needs identified by the Rural Center.[388] One recommendation from the Rural Center's Water 2030 Initiative was a new $1 billion state bond referendum to continue to meet North Carolina's needs for water and sewer system improvement. However, this new bond referendum was not passed by voters.

Policy Challenge: Financing Repairs and Improvements

One particular challenge in finding low-cost funding is choosing an option that fairly distributes costs among water and sewer customers. According to the EPA's "Financing Capital Improvement for SSO Abatement" fact sheet, there are several categories of funding options available to the collection system owner and operator (also the NPDES permit holder): bonds, loans, grants and other capital funding options.[389] However, many sewer system owners or operators usually obtain funding through revenue bonds or state revolving loan funds. Appendix H contains a detailed summary of funding options available for collection system repairs and upgrades.

Asset Management and Capital Improvements Planning

Aging infrastructure and funding are not the only policy challenges. Other challenges are in the planning arena, which includes asset management and capital improvements planning. Long-term strategic planning for managing a utility's or local government's wastewater infrastructure is key for optimum function of these systems and for planning ahead to finance repairs and upgrades, so that at least some funding is in place when projects are finally needed. Given the downward trend of government-based grants and loans for infrastructure improvements, and the difficulties smaller local governments can have securing commercial loans at reasonable interest rates, local governments and utilities can take the lead by planning ahead for the future. This will enable them to anticipate future demand for services, estimate time frames when repairs and upgrades likely will be needed (for both newer and older systems), and develop strategies for how to finance them.

Moreover, lack of a robust capital improvements plan (CIP) or asset management plan can hinder attempts to receive grants and loans and impact the local government's ability to attract businesses. For example, if a town does not have adequate sewer capacity, it is limited in its ability to attract new industry or to expand the town's existing industry.[390] There also can be regulatory challenges. State and federal laws and regulations exist to protect the public health and the environment, but some of these regulations were passed as unfunded mandates, i.e., new requirements that must be met without a corresponding increase in public funding to support the necessary improvements in order to comply with those regulations.[391] It is a challenge for local governments, particularly in small and low-wealth communities, to follow regulations while also keeping water and sewer rates affordable to their users. This section will present an overview of the benefits of asset management and capital improvements planning and show how at least one town along North Carolina's inner coast is using planning to its advantage.

Asset Management

Asset management is defined as "maintaining a desired level of service for what you want your assets to provide at the lowest life-cycle cost".[392] For wastewater infrastructure, an "asset" is a "component of a facility with an independent physical and functional identity and age (e.g., pump, motor, sedimentation tank, main)."[393] For a utility or local government, managing these assets can ensure the components of the water or wastewater system under their control continue to operate correctly and efficiently. The ultimate goal of asset management is to minimize the total costs of acquiring, operating, maintaining and renewing assets, while still delivering the service needed by customers and required by regulators. Noted benefits of asset management include prolonged lives of current assets through a repair/replacement/rehabilitation schedule, setting of

rates based on sound operational and financial planning, budget activities that focus on needs critical to optimal system performance, improved crisis response, and improved safety and security of assets.[394] In order to realize the benefits of asset management, a written asset management plan is needed, along with programming to implement the plan.

EPA has identified five core steps for developing an effective asset management plan: (1) assessing the current state of assets; (2) understanding the system's required "sustainable" level of service, which includes assessing quality, quantity, reliability and environmental standards in order to set short-term and long-term system performance goals; (3) identifying assets critical to the sustained performance of the system; (4) assessing minimum life-cycle costs to determine the lowest cost options for providing the highest level of service and to optimize operation and maintenance; and (5) developing a long-term funding strategy.[395]

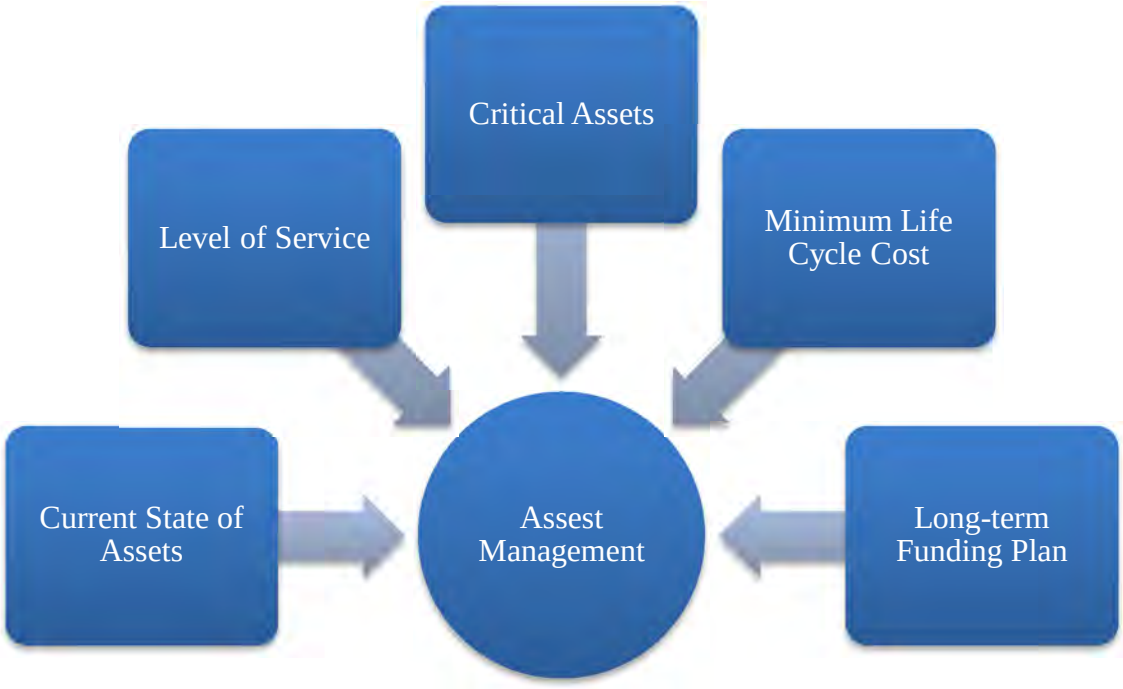


Figure 9: Core Steps for Developing an Effective Asset Management Plan[396]

Support from elected officials and input utility staff, local government staff, or both must be included as part of the planning process in order to facilitate implementation of the plan. In addition, there should be performance measures in place to track progress, and flexibility in the asset management plan itself to adapt to changing circumstances.[397]

Capital Improvements Planning

The budgeting process undertaken by local governments is not a one-size-fits-all process. Local governments actively plan and develop their budgets and CIPs. In North Carolina, the budget planning process for local governments generally begins in October for a new fiscal year that begins on July 1 of the following year.[398] The first phase of the process is revenue and expenditure forecasting, which determines how much money is available for the next fiscal year. In order to conduct this forecasting, property tax values, personal property taxes and motor vehicle taxes are collected and combined to yield a total amount for the year. After the revenue and expenditure-forecasting phase, local governments attempt to predict the needs of the county as a whole or the municipality. Individual departments are solicited for their thoughts, concerns and projected budgets. By February, local governments receive this information and work with the county or city manager to relay the projects from the departments and highlight the yearly trends identified by the city or county government's budget director. Budget directors consider the last three years when assessing a comfortable budget allocation for specific departments. After this information is compiled, the budget director relays it to the county or city manager for distribution to the various departments for discussion. Comprehensive annotation and analysis is included in the budget report that is submitted to the county or city manager. The county or city manager makes adjustments, if necessary, and then submits the budget for the approval of the county commissioners prior to the start of the new fiscal year. From start to finish, the process can be characterized as forecasting revenues and expenditures, determining department-specific targets, sharing the budget with the county or city manager, reconciling any issues with departments, and presenting the budget to the county or city commission.[399]

Developing a comprehensive CIP is among the most important responsibilities for local governments.[400] A fundamental aspect in developing a comprehensive CIP involves assessing and forecasting the financial ability of the local government. County and city managers make a determination as to which resources are available to finance both capital needs and future annual budget requirements. One mechanism through which CIPs may be funded is through bonds.[401] The Local Government Bond Act,[402] passed by the General Assembly in 1971, authorizes general obligation bonds that can be secured by taxing power for a variety of purposes, such as capital needs.[403] There are a number of statutes that address CIPs.[404] Local governments work within the confines of these statutes to determine a proper course to proceed. For example, Catawba County includes a CIP in its annual expenditure plans. The county has allotted an eight-year CIP.[405] Generally, local governments follow CIP plans as they are written, though deviations may be made as fiscal climate and capital needs change during the life of the CIP – revenues may dry up, other expenditures may come up unexpectedly, and sometimes what was initially identified as a need for a local government may no longer need to be addressed. CIPs for most local governments follow a five- to 10-year planning model.[406]

DWR's system-wide wastewater collection system permit program does contain a requirement for capital improvements planning. Included in its general permit conditions is a requirement that applicants adopt and implement a CIP.[407] According to DWR, the CIP should cover a three- to five-year period and address both short-term needs and long-term goals.[408] Forecasting future needs and cost analysis are among DWR's key recommended components for a CIP.[409] It should be noted, however, that the CIP permit condition applies only to permitted systems and not deemed permitted systems.[410]

The Town of Columbia exemplifies how capital improvements planning can work in practice. The town currently has a CIP for water and sewer.[411] The town adopted this plan in 2004 and is using the schedule included in the plan for its current phase of improvements to the town's water and sewer system.[412] The current phase includes replacing sections of sewer lines that are particularly susceptible to inflow and infiltration from storm events and increasing the capacity of the town's wastewater treatment plant.[413] Funds for these projects came from USDA and the American Recovery and Reinvestment Act.[414] The reason for expanding the wastewater treatment plant, which is approximately 13 years old, is to increase flow to accommodate economic development.[415] Columbia town manager Rhett White credited his predecessor's forward thinking in creating a reserve fund for repairs and future construction and expansions.[416] Mr. White believes that having a CIP puts the town in a good position to apply for funding when it becomes available.[417]

Considering the downward trend in grants and loans from the federal government and the State, having a long-term strategy in place can facilitate not only development of funding proposals, but also may increase the chance of being awarded those funds. Mr. White noted that even if a water or sewer system is new, funds should be set aside for repairs or partial replacement from the outset, even if they will not be needed for several years.[418] The issue then becomes how to raise those funds for inclusion in the system's operation and maintenance budget. Although raising water and sewer rates is rarely a popular option with customers, raising them incrementally (e.g., 10-15% per year over a period of several years) is one solution. Such a method would add funding for both operation and maintenance and for cost sharing necessary to obtain grant funds without needing to raise rates by a significant percentage all at once.

Recommendations

DENR and the EMC should incorporate into existing rules the requirement that municipal wastewater collection systems with 100,000 GPD or higher have a certified operator as an Operator in Responsible Charge (ORC).

There are benefits to having a designated ORC of a collection system, regardless of its size. First, designated operators must be certified by the Water Pollution Control System Operators Certification Commission. The purpose of this commission is to provide training and certification to water pollution control system operators, in order to protect the public's investment in these facilities. Therefore, having an assigned ORC means this individual will have adequate education and training to operate and maintain the collection system. Through certification of operators by the commission, collection system owners can be assured their investment, as well as the public health and the environment, are better protected by having an ORC that has expertise with the type and size of the particular collection system. The ORC can ensure effective and efficient system operation through the development and implementation of a maintenance plan, notification to the system owner of the need for system repairs or modifications necessary to ensure compliance with state and federal rules, certification of the validity of monitoring and reporting performed on the system and notification to the system owner (and also DWR, if required) of SSOs or other violations of permit conditions.[419] However, EMC rules currently do not require an ORC for deemed permitted collection systems or systems that are not classified. To ensure that educated and trained persons are designated to operate collection systems, DENR and the EMC should work together to amend existing rules to require that all collection systems have an ORC on staff.

DENR and the EMC should revise Title 15A Rule 02T.0403 of the N.C. Administrative Code to require that a minimum of 10% of a deemed permitted collection system's lines be cleaned on an annual basis.

As mentioned earlier in this chapter, the ASCE stated in its 2013 Report Card that pipes represent the largest capital need for wastewater infrastructure across the nation, comprising three quarters of total needs. The society noted that repairing and expanding pipes would address SSOs, as well as other pipe-related issues. In North Carolina, pipe blockages due to oil, grease, or other material such as twigs and leaves are among the common causes of SSOs on the coast. Regular cleaning of pipes is critical to ensure wastewater can flow through the pipes properly. One condition for a general permit for a system-wide collection system requires cleaning a minimum of 10% of a system's lines each year.[420]

However, systems that are deemed permitted by regulation are not held to this requirement, and line cleaning is not included at all as a condition. As stated earlier in the chapter, there are 52 permitted collection systems within the DENR Washington Regional Office's jurisdiction and 55 known deemed permitted systems. However, the actual number of deemed permitted systems remains unknown. It is likely there are deemed permitted systems that have not been inspected or have not reported a SSO and, therefore, would not have been assigned a "deemed permitted number." Given the higher number of deemed permitted systems versus permitted systems in the Washington region of the coast alone, and given that pipe blockage remains a common cause of SSOs in coastal North Carolina, it makes sense to require deemed permitted systems to clean at least 10% of their lines each year to reduce the potential for SSOs. This requirement would put deemed permitted systems more on par with permitted systems, at least with respect to system

maintenance. Therefore, the steering committee recommends that Condition 8 of the Operation and Maintenance Section of the Wastewater Collection System permit, or similar condition, be incorporated into Title 15A Rule 02T.0403.

The N.C. General Assembly should put in place a dedicated fund for water and wastewater infrastructure maintenance and repairs.

In 2013, there was a considerable change in how wastewater infrastructure grants and loans will be administered in North Carolina. To recap the earlier discussion, a new SWIA was established to award infrastructure grants and loans, and the administration of infrastructure grants and loans programs from the DWR and the former DWQ was transferred to the newly created DWI. Also in 2013, State funding was eliminated for the Rural Center and a new RIA and REDD were established within the N.C. Department of Commerce. Given the reductions in federal funding for infrastructure grants and loans, state-level grants and loans programs are critical to addressing the continuing issue of aging wastewater (and water) systems and the continuing need to expand systems to meet development needs.

As noted in Appendix H (wastewater infrastructure funding options), bonds and commercial loans have their limitations, especially if the local government is rural, low-wealth, or both. While government-based grants and loans programs are not a panacea for rural areas and are not a substitute for comprehensive capital improvements planning or structuring water and sewer rates so the collection system can help "pay for itself," they do offer options that are typically lower in interest rates or do not require repayment. For a rural, low-wealth community with fewer water and sewer customers, grants and loans are important avenues to fund infrastructure improvements and expansions.

As mentioned in the wastewater infrastructure funding options section in Appendix H, the General Assembly approved a referendum in 1998 for $800 million in bonds for water and sewer projects. These bonds provided a much-needed funding pool for North Carolina's water and sewer infrastructure and provided financial assistance to many low-wealth communities to make repairs or upgrade their infrastructure. Given the continued needs of local governments in coastal North Carolina (and throughout the state) to finance water and wastewater infrastructure repairs and upgrades, a dedicated fund in the State budget to supplement current grants and loans programs administered by the state and federal government would provide additional support to local governments that need financial assistance.

The State should establish a working group of experts to discuss and develop recommendations to address the issues associated with SSOs, as well as broader water and wastewater infrastructure issues, in North Carolina's rural counties and municipalities.

Addressing the issues associated with wastewater (and water) infrastructure is a challenging task, as this steering committee discovered when researching SSOs. There are other wastewater infrastructure issues not discussed in this chapter, due to time and space constraints, which nevertheless need robust research and analysis. Given the breadth and scope of wastewater infrastructure as an issue for the entire state, but particularly for rural areas, the steering committee recommends the establishment of a statewide working group to: identify the causes for wastewater infrastructure issues specific to rural communities; discuss avenues for remediation and prevention; share information; and develop long-term strategies to assist rural areas with

planning and financing collection system repairs and upgrades, as well as prepare for future expansions. This working group would not have regulatory authority, but instead would act in an educational and advisory capacity. The working group should have the ability to provide technical and outreach assistance to supplement the work of the SWIA and DWI and RIA and REDD. Part of the outreach efforts of the working group would be to host open meetings, workshops, and other educational forums in the rural communities, so those local government officials and staff would not need to travel to attend these sessions. As an alternative, these forums could be web-based or have a web component to allow participants to join remotely. The working group would include a diverse range of wastewater infrastructure experts (including experts on financing infrastructure repairs and upgrades), economists, state agency staff, local government representatives, and members of community organizations to encourage discussion of all perspectives.

Local governments should focus on capital improvements planning and asset management planning, to aid in budgeting for improvements that will avoid and minimize the effects of wastewater collection system failures.

The benefits to communities of capital improvements planning and asset management planning have been discussed in this chapter. Municipalities such as Columbia have noted the benefits of planning ahead, including adjusting water and sewer rates incrementally, to ensure funds are available for repairs and upgrades as these needs arise. CIPs can be tailored to meet a collection system's specific needs and tailored to fit revenue, budgetary limitations, and other considerations of the collection system owner. In some instances, the State requires capital improvements planning for system-wide collection systems. The list of general permit conditions for system-wide wastewater collection systems includes the requirement that the permit holder adopt and implement a CIP that designates funding for "reinvestment into the wastewater collection system infrastructure."[421] However, deemed permit collection systems are not required to have a CIP; they are only required to have an operation and maintenance plan.[422] Moreover, as noted earlier in this chapter, there are at least 55 deemed permitted systems within the Washington Regional Office's jurisdiction alone. The number of deemed permitted systems may be higher because there likely are deemed permitted systems that have neither been inspected by DWR nor reported a SSO and, therefore, would not have been assigned a deemed permitted number by the Division. Additional research is needed to determine how many of these deemed permitted systems have a CIP and how many do not. The system owners that do not have a CIP should be encouraged to develop one. The working group recommended earlier could conduct the research to determine which deemed permitted systems have a CIP for their systems and which ones do not. However, the reality is that some of these deemed permitted systems could be located in towns that have little financial resources or expertise in developing such a plan. Part of the educational emphasis and strategic planning focus of this working group could be dedicated to capital improvements planning and assisting collection system owners in developing and adopting a plan. Other groups that have experience working with rural counties and municipalities, such as the UNC School of Government, DENR, and perhaps also the Rural Center (should it survive without State funding) could assist in this effort. The newly established RIA and SWIA also should be invited to participate in this effort.

Endnotes – Chapter 4

[284] Sewers are referred to by the type of wastewater each transports to a treatment facility or other point of discharge. For instance, storm sewers convey stormwater, and industrial sewers convey industrial waste. Sanitary sewers convey both domestic and industrial wastewater. *See* U.S. Envtl. Protection Agency, Report to Congress on the Impacts and Controls of Combined Sewer Overflows and Sanitary Sewer Overflows (2004), *available at* http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm.

[285] *Eliminating Sanitary Sewer Overflows in New England*, U.S. Envtl. Protection Agency, http://www.epa.gov/region1/sso/ (last visited Oct. 21, 2013).

[286] *See id.*

[287] *Available at* http://www.bryantx.gov/departments/default.asp?name=inflow_infiltration (last visited Oct. 21, 2013).

[288] *Sanitary Sewer Overflows and Peak Flows Frequently Asked Questions,* U.S. Envtl. Protection Agency, http://cfpub.epa.gov/npdes/faqs.cfm?program_id=4 (last updated Jan. 24, 2013).

[289] *See id*.

[290] *Effort to end sewage overflows brings higher bills in 2011*, Central District News, http://www.centraldistrictnews.com/2010/07/effort-to-end-sewage-overflows-means-higher-bills-in-2011/ (last visited Oct. 21, 2013).

[291] *See* SSO Incident List Statewide January 1, 2007-January 1, 2012, N.C. Div. of Water Resources (on file with the N.C. Coastal Resources Law, Planning and Policy Center and also available from the N.C. Division of Water Resources). Note: Although this chapter focuses on the "inner coast" region, the approximate number of incidences reported to the Wilmington Regional Office are included to illustrate the issue from a regional perspective and illustrate the difference in severity of the issue among the different parts of the coast.

[292] The problem of aging and failing water and sewer infrastructure is not limited to the inner coast or North Carolina. It is a problem of national scope. In its 2013 Report Card for America's Infrastructure, the American Society of Civil Engineers (ASCE) gave the country's wastewater infrastructure a "D" grade. From a nationwide perspective, the ASCE stated:

> Capital investment needs for the nation's wastewater and stormwater systems are estimated to total $298 billion over the next twenty years. Pipes represent the largest capital need, comprising three quarters of total needs. Fixing and expanding the pipes will address sanitary sewer overflows, combined sewer overflows, and other pipe-related issues. In recent years, capital needs for the treatment plants comprise about 15%-20% of total needs, but will likely increase due to new regulatory requirements. Stormwater needs, while growing, are still small compared with sanitary pipes and treatment plants. Since 2007, the federal government has required cities to invest more than $15 billion in new pipes, plants, and equipment to eliminate combined sewer overflows.[292]

The North Carolina section of the ASCE expressed similar concerns over the state's wastewater infrastructure needs.

[293] N.C. Rural Econ. Dev't Ctr., Clean Water: Our Livelihood, Our Life 14 (1998), *available at* http://www.ncruralcenter.org/images/PDFs/Water2030/cleanwaterreport99.pdf.

[294] *See id*. at 18.

[295] Am. Soc'y of Civil Eng'rs, N.C. Section, 2013 Report Card for North Carolina's Infrastructure (2013), *available at* http://www.infrastructurereportcard.org/wp-content/uploads/2013/03/2013-Report-Card-for-North-Carolina-Infrastructure-Lo-Res.pdf.

[296] *See id.*

[297] Telephone Interview by Lisa Schiavinato with Steve Novils, Finance Officer, Town of Belhaven (March 18, 2013).

[298] Telephone Interview by Lisa Schiavinato with Rhett White, Town Manager, Town of Columbia (March 19, 2013).

[299] *See Rural/Urban Counties in North Carolina*, N.C. Rural Econ Dev't Center, http://www.ncruralcenter.org/index.php?option=com_content&view=article&id=75&Itemid=126 (last visited Aug. 20, 2013). New Hanover County is the only coastal county classified by the Rural Center as urban.

[300] Based on county-level data sets from the U.S. Department of Agriculture, Pasquotank, Perquimans, Chowan, Hertford, Bertie, Washington, Tyrrell, Hyde, Beaufort, Pamlico and Brunswick Counties have a poverty rate of 17.9% or higher. *See* County-Level Data Sets, Economic Research Service, U.S. Dep't of Agriculture, http://www.ers.usda.gov/data-products/county-level-data-sets/poverty.aspx#.UhNvC7wmylU (last visited Aug. 20, 2013).

[301] Based on county-level data sets from the U.S. Department of Agriculture, Gates, Carteret, Onslow, Pender, and New Hanover Counties have a poverty rate between 15.9% and 17.8%. *See* County-Level Data Sets, Economic Research Service, U.S. Dep't of Agriculture, http://www.ers.usda.gov/data-products/county-level-data-sets/poverty.aspx#.UhNvC7wmylU (last visited Aug. 20, 2013).

[302] *See State and County Quick Facts*, U.S. Census Bureau, http://quickfacts.census.gov/qfd/states/37000.html (last visited Aug. 20, 2013). To view the median household incomes and other data for each county, select from the drop-down menu.

[303] For example, the Rural Center requires matching funds for proposals for the organization's Economic Infrastructure Grants, Clean Water Planning Grants, and Clean Water Construction Grants programs. *See Infrastructure grants programs*, N.C. Rural Econ. Dev't Ctr., http://www.ncruralcenter.org/index.php?option=com_content&view=article&id=107&Itemid=143 (last visited Aug. 10, 2013).

[304] However, the situation can be more complex than that. For instance, if a local government is low-population, low-wealth or both, it is sometimes an issue of whether the water and sewer customers would be able to afford to pay higher fees.

[305] *Available at* www.ncruralcenter.org/images/images/RuralUrbanjpg060310.jpg (last visited Oct. 21, 2013).

[306] *See Sanitary Sewer Overflow Federal Advisory Subcommittee*, U.S. Envtl. Protection Agency, http://cfpub.epa.gov/npdes/sso/faca.cfm (last updated Jan. 28, 2011).

[307] *Id.*

[308] Although no new regulations were promulgated, the federal Clean Water Act prohibition against unpermitted discharges is applicable to SSOs and, therefore, an SSO may violate Section 402 of the Act as a discharge of a pollutant. *See* 33 U.S.C. § 1342.

[309] *See* U.S. Envtl. Protection Agency, Report to Congress on the Impacts and Controls of Combined Sewer Overflows and Sanitary Sewer Overflows (2004), *available at* http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm.

[310] *Id.*

[311] *Sanitary Sewer Overflows and Peak Flows Frequently Asked Questions,* U.S. Envtl. Protection Agency, http://cfpub.epa.gov/npdes/faqs.cfm?program_id=4 (last updated Jan. 24, 2013).

[312] *See id.*

[313] *See Sanitary Sewer Overflow (SSO) Reporting Requirements to the Division of Water Quality*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/swp/ps/cs/ssoreport (last visited Aug. 10, 2013).

[314] *See id*. In addition, section 143-215.1C of the North Carolina General Statutes provides public reporting requirements for discharges of 1,000 gallons or more of untreated wastewater to surface waters. N.C. Gen. Stat. § 143-215.1C.

[315] *See id.*; *see also* 33 U.S.C. § 1311(a).

[316] 33 U.S.C. § 1342.

[317] *NPDES History*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/swp/ps/npdes/history (last visited. Aug. 19, 2013).

[318] *See* N.C. Gen. Stat. §§130A-335 and 143-215.1.

[319] Rules contained in Title 15A, Chapters 2 and 8, of the North Carolina Administrative Code implement section 143-215.1 of the General Statutes regarding wastewater management and water pollution control systems. *See* 15A N.C. Admin. Code 2B.0101–.0609 (Surface Water and Wetland Standards); *id.* 2H.0101–.1305 (Procedures for Permit Approvals); *id.* 2T.0101–.1608 (Waste Not Discharged to Surface Waters); *id.* 8G.0101–.1001 (Operation and Classification of Water Pollution Control Systems).

[320] *See id.* 2T.0101–.0120.

[321] *NPDES Permitting Processes*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/swp/ps/npdes/permitprocess (last visited Aug. 10, 2013).

[322] *See id.*

[323] *NPDES Individual / General Permits*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/swp/ps/npdes/permitapps (last visited Aug. 19, 2013).

[324] *Collection System Frequently Asked Questions*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/swp/ps/cs/faq (last visited Aug. 10, 2013).

[325] *See id*.

[326] *See id*.

[327] *See id.*

[328] N.C. Gen. Stat. § 143-215.9B.

[329] *Available at* http://www.cfpua.org/index.aspx?NID=295 (last visited Oct. 21, 2013).

[330] *See* 15A N.C. Admin. Code 2T.0403; *see also System-Wide Wastewater Collection System Permitting*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/swp/ps/cs/apps (last visited Aug. 10, 2013).

[331] *See* 15A N.C. Admin. Code 2T.0302(5); *see also Sewer Extension Permitting*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/swp/ps/cs/ext (last visited Aug. 10, 2013).

[332] *See* 15A N.C. Admin. Code 2T.0302(5); *see also Sewer Extension Permitting*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/swp/ps/cs/ext (last visited Aug. 10, 2013).

[333] *See, e.g.*, 15A N.C. Admin. Code 2T.0113(a), (e).

[334] 40 C.F.R. § 122.46(a).

[335] *See* N.C. Gen. Stat. § 143-215.1(d2).

[336] *See* 15A N.C. Admin. Code 2T.0108(e), .0111(e).

[337] *NPDES Permitting Process: Renewing an NPDES Permit*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/swp/ps/npdes/permitprocess#Renewing_NPDES (last visited Aug. 12, 2013).

[338] *See* 15A N.C. Admin. Code 2B.0505, .0506.

[339] *NPDES Program FAQs*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/swp/ps/npdes/faqs#CP1 (last visited Aug. 12, 2013).

[340] 15A N.C. Admin. Code 2T.0306(a). DWR retains jurisdiction over projects that require an Environmental Assessment. *See id.*

[341] N.C. Gen. Stat. § 143.215.1(f).

[342] Memorandum from N.C. Div. of Water Quality (now the Division of Water Resources) Central Office to Regional Office Supervisors (Apr. 7, 2009) (on file with the N.C. Coastal Resources Law, Planning and Policy Center) (offering guidance on SSO compliance and enforcement operations).

[343] *See id.*

[344] *See id.*

[345] *See id.*

[346] N.C. Gen. Stat. § 143B-282.1(b).

[347] *See id.*

[348] *See id.*

[349] *See* 15A N.C. Admin. Code 2T.0306.

[350] *See id.* 2T.0306(b)(3), (d)(2).

[351] *Id.* 2T.0306(b)(6), (7).

[352] *See* 15A N.C. Admin. Code 8G.0201(1), (2).

[353] *Id.* 8G.0204(2)(d).

[354] *Id.* 8G.0204(4), (6).

[355] As mentioned earlier, if a system has an approved daily flow of less than 200,000 GPD and meets certain conditions, then it is deemed permitted and does not need a General Permit or Individual Permit.

[356] *See id.* 8G.0301, .0303; *see also* Email from Allen Clark, N.C. Div. of Water Resources, to Lisa Schiavinato, Co-Director, N.C. Coastal Resources Law, Planning and Policy Center (July 12, 2013, 1:17 PM EDT) (on file with the N.C. Coastal Resources Law, Planning and Policy Center).

[357] Currently, there are 52 permitted collection facilities in the Washington region of the coast. *See id*.

[358] *See id.* Mr. Clark notes the reason there is an unknown number of deemed permitted systems in the Washington region is that there are likely deemed permitted systems that have not been inspected by DWR or have not reported a SSO and, therefore, would not have been assigned a "deemed permitted number" by the Division. Mr. Clark also noted that in his time at the Washington Regional Office of DWR, he has yet to come across a deemed permitted collection system that was classified by the EMC because of irresponsible operation and maintenance. *See id.*

[359] 2013-360 N.C. Sess. Laws 217-218.

[360] N.C. Gen. Stat. § 159G-65(a).

[361] *Id.* § 159G-66.

[362] *Id.*

[363] 2013-360 N.C. Sess. Laws 216-217.

[364] *See id.*

[365] 2013-360 N.C. Sess. Laws 217-218.

[366] 2013-360 N.C. Sess. Laws 237-238.

[367] *Id.*

[368] *See* 2013-360 N.C. Sess. Laws 234-236. *See also* 2013-363 N.C. Sess. Laws 18-19.

[369] Office of the State Auditor, North Carolina Rural Economic Development Center, Inc. Financial Audit State Grant Management and Sub-Recipient Monitoring (2013), *available at* http://www.ncauditor.net/EPSWeb/Reports/FiscalControl/FCA-2013-7901.pdf.

[370] Funding priority is to be given to Tier 1 and Tier 2 counties. *See* 2013-363 N.C. Sess. Laws 18-19. For more information on county tier designations, *see* 2013 County Tier Designations, N.C. Dep't. of Commerce, http://www.nccommerce.com/research-publications/incentive-reports/county-tier-designations (last visited Aug. 20, 2013).

[371] 2013-363 N.C. Sess. Laws 18-19.

[372] N.C. General Assembly, The Joint Conference Committee Report on the Continuation, Expansion, and Capital Budgets H15 (2013), *available at* http://ncleg.net/sessions/2013/budget/2013/SB402_Committee_Report_2013-07-21.pdf.

[373] 2013-360 N.C. Sess. Laws 234-235.

[374] While the future of the Rural Center is uncertain, the organization's new leadership hopes the center will continue in some form. *See* J. Andrew Curliss, *Rural Center Plan Would Halt Grant Making, Survive in Diminished Form*, The News & Observer, Aug. 28, 2013, at http://www.newsobserver.com/2013/08/28/3141601/rural-centers-future-pay-for-ex.html.

[375] *See* N.C. Rural Econ. Dev't Ctr., Water 2030 Report 3: Water, Sewer, and Stormwater Capital Needs 1 (2006), *available at* http://www.ncruralcenter.org/images/PDFs/Water2030/capitalneeds.pdf. Note: In its 2013 Report Card for America's Infrastructure, the American Society of Civil Engineers reported a $6.6 billion need in North Carolina for wastewater infrastructure alone within the next 20 years. *See North Carolina Key Facts*, Am. Soc'y of Civil Eng'rs (2013), http://www.infrastructurereportcard.org/north_carolina/north-carolina-overview/.

[376] *See* N.C. Rural Econ. Dev't Ctr., Clean Water: Our Livelihood, Our Life 4 (1998), *available at* http://www.ncruralcenter.org/images/PDFs/Water2030/cleanwaterreport99.pdf.

[377] *See id.* at 4–7.

[378] *See id.* at 26–29.

[379] *See Rural Policy*, N.C. Rural Econ. Dev't Ctr., http://www.ncruralcenter.org/index.php?option=com_content&view=article&id=61&Itemid=112 (last visited Dec. 16, 2013).

[380] See N.C. Rural Econ. Dev't Ctr., Clean Water: Our Livelihood, Our Life 14 (1998), *available at* http://www.ncruralcenter.org/images/PDFs/Water2030/cleanwaterreport99.pdf.

[381] *See* Email from Phil Prete, City of Wilmington, N.C., to Lisa Schiavinato, Co-Director, N.C. Coastal Resources Law, Planning and Policy Center (Dec. 13, 2012, 3:23 PM EST).

[382] Note that in order to receive funds from the EDA, the local government must make a business case for the rehabilitation of aging water and wastewater infrastructure. The Appalachian Regional Commission is another federal funding source, but since this report focuses on the communities of North Carolina's inner coast, the ARC is not discussed.

[383] N.C. Rural Econ. Dev't Ctr., Water 2030 Report 2: Trends in Water and Sewer Financing 4 (2006), *available at* http://www.ncruralcenter.org/images/PDFs/Water2030/fundingtrends.pdf.

[384] *See id.*

[385] *See id.*

[386] *See id*. at 7.

[387] N.C. Gen. Assemb. Program Evaluation Div., Rep. No. 2008-12-07, North Carolina's Water and Wastewater Infrastructure Funding Lacks Strategic Focus and Coordination 3 (2009), *available at* http://www.ncleg.net/PED/Reports/documents/WWI/WWI_Report.pdf. This funding was provided by various entities at the federal, regional and state levels.

[388] *See* N.C. Rural Econ. Dev't Ctr., Water 2030 Report 3: Water, Sewer, and Stormwater Capital Needs 1 (2006), *available at* http://www.ncruralcenter.org/images/PDFs/Water2030/capitalneeds.pdf.

[389] U.S. Envtl. Protection Agency, Financing Capital Improvements for SSO Abatements 1, *available at* http://www.epa.gov/npdes/pubs/sso_casestudy_finance.pdf (last visited Aug. 11, 2013).

[390] A specific, though dated, example is of the Town of Leland in Brunswick County, which was in competition for Otsuka Chemical in the late 1990s. Otsuka Chemical was an overseas chemical manufacturing company that was interested in locating an office in the town's industrial park. When the company discovered that the town did not have adequate sewer capacity, it decided to locate its new office in Virginia. The town lost a $22 million investment, which would have generated approximately 60 skilled jobs. *See* N.C. Rural Econ. Dev't Ctr., Clean Water: Our Livelihood, Our Life 19 (1998), *available at* http://www.ncruralcenter.org/images/PDFs/Water2030/cleanwaterreport99.pdf.

[391] *See id.* at 20–21.

[392] *Water: Sustainable Infrastructure: Asset Management*, U.S. Envtl. Protection Agency, http://water.epa.gov/infrastructure/sustain/asset_management.cfm (last updated Sept. 14, 2012). According to EPA, "lowest life-cycle cost" means the best appropriate cost for rehabilitating, repairing or replacing an asset. *Id.*

[393] *Id.*

[394] *See* Office of Water, U.S. Envtl. Protection Agency, Asset Management: A Best Practices Guide 1 (2008), *available at* http://water.epa.gov/type/watersheds/wastewater/upload/guide_smallsystems_assetmanagement_bestpractices.pdf.

[395] *See id*. at 2–4.

[396] *See id.*

[397] For more details on the benefits of asset management and guidance on how to develop an asset management plan, see *See* Office of Water, U.S. Envtl. Protection Agency, Asset Management: A Best Practices Guide 1 (2008), *available at* http://water.epa.gov/type/watersheds/wastewater/upload/guide_smallsystems_assetmanagement_bestpractices.pdf.

[398] The budget of a unit of local government covers a fiscal year beginning July 1 and ending on June 30. *See* N.C. Gen. Stat. § 159-8.

[399] Telephone interview by Center Research Law Fellow Safa Sajadi with Barron Monroe, Catawba County Budget Analyst II (Mar. 29, 2013).

[400] *See* David M. Lawrence and A. John Vogt, *Article 17: Capital Planning, Budgeting and Debt Financing*, *in* County and Municipal Government in North Carolina 9 (2007), *available at* http://www.sogpubs.unc.edu/cmg/cmg17.pdf.

[401] *See id.* at 2.

[402] N.C. Gen. Stat. §§ 159-43 to -79.

[403] *See* David M. Lawrence and A. John Vogt, *Article 17: Capital Planning, Budgeting and Debt Financing*, *in* County and Municipal Government in North Carolina 1-2 (2007), *available at* http://www.sogpubs.unc.edu/cmg/cmg17.pdf.

[404] *See* N.C. Gen. Stat. § 143C-8-1 through § 143C-8-12 and N.C. Gen. Stat. § 159-55.

[405] Telephone interview by Center Research Law Fellow Safa Sajadi with Barron Monroe, Catawba County Budget Analyst II (Mar. 29, 2013).

[406] *See id*. at 6.

[407] *See System-Wide Wastewater Collection System Permitting*, N.C. Div. of Water Quality, http://portal.ncdenr.org/c/document_library/get_file?uuid=d8c60681-a2be-444d-a00f-dd63694274a6&groupId=38364 (last visited June 17, 2013). *See also* 15A N.C. Admin. Code 2T.0111.

[408] *See id.*

[409] *See id.*

[410] *See id.*; *see also* 15A N.C. Admin. Code 2T.0403 (listing requirements for deemed permitted systems).

[411] Telephone interview by Lisa Schiavinato with Rhett White, Town Manager, Town of Columbia (March 19, 2013).

[412] *See id.*

[413] *See id.*

[414] *See id.*

[415] *See id.*

[416] *See id.*

[417] *See id.*

[418] *See id.*

[419] *See* 15A N.C. Admin. Code 8G.0204.

[420] *See Wastewater Collection System Permit (Draft)*, N.C. Div. of Water Resources, http://portal.ncdenr.org/c/document_library/get_file?uuid=d8c60681-a2be-444d-a00f-dd63694274a6&groupId=38364 (last visited Aug. 21, 2013). Condition 8 in the Operation and Maintenance section of the permit states:

> The Permittee shall assess cleaning needs, and develop and implement a program for appropriately cleaning, whether by hydraulic or mechanical methods, all sewer lines. At least 10 percent of the wastewater collection system, selected at the discretion of the ORC, shall be cleaned each year. Preventative cleaning is not required for sewer lines less than five years old unless inspection otherwise reveals the need for cleaning or cleaning is required by a sewer line extension permit.

[421] *Systemwide Wastewater Collection System Permitting*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/swp/ps/cs/apps (last visited Aug. 10, 2013).

[422] *See* 15A N.C. Admin. Code 2T.0403.

Appendix A

Comparative Programs: Texas, Florida and Las Vegas

Texas

In 2008, the total amount of groundwater usage for the state of Texas measured 9.7 million acre-feet.[423] As the second largest state in the United States, with large prairielands and rainfall ranging from 8 to 54 inches a year, the state's unique geological and industrial characteristics have governed its approach to groundwater management.[424] In Texas, water rights differ between surface and groundwater. While surface water is publicly owned and governed by the state, groundwater follows the "rule of capture," a judicially created principle that the Texas legislature has left mostly intact for a century.[425] The "rule of capture" allows private land owners to pump as much groundwater as they wish, for almost any reason.[426] These groundwater rights are subject to a few limitations. The surface owner may not: (1) maliciously take the water for the sole purpose of injuring his neighbor; (2) wantonly and willfully waste the water; (3) pump the water in a negligent manner that proximately causes land subsidence; or (4) drill slanted wells that cross property boundaries.[427] Industries closely affecting groundwater within the state include agriculture and mining operations, specifically oil and gas. In fact, 80% of pumped groundwater is used for irrigation.[428] With potentially numerous interactions between private groups and groundwater, two equally important concerns for the State are overuse and contamination. Strict licensing regulations for well drilling and pump installers alleviate some contamination concerns, while the state's layered water regulation system addresses other concerns.

In an effort to create a statewide, comprehensive groundwater management plan, the Texas legislature created the Texas Groundwater Protection Committee (TGPC) in 1989.[429] TGPC includes nine state agencies that effect groundwater regulation and the Texas Alliance of Groundwater Districts (TAGDs).[430] That same year, the TGPC collaborated to produce the Texas Groundwater Protection Strategy – a set of guidelines for groundwater contamination prevention, conservation, and coordination among the different committee agencies. Since 1989, the Protection Strategy has been revised only once, which was in 2003.[431] The state's groundwater regulation system functions on a pyramid-style, hierarchical system. The tiers include the state-created Texas Water Development Board (TWDB), regional water planning districts, and finally, at the most local level, groundwater conservation districts (GCDs). Based on a "bottom-up" approach, GCDs represent the foundation of the pyramid and are the state-preferred method of groundwater regulation.[432] A GCD regulates production and spacing of water wells. These districts are also required to produce and execute a management plan for efficient use of their groundwater resources.[433] Once created, a district has three years in which to submit a management plan. Afterwards, districts are required to review and resubmit their resource plans with a uniform checklist to TWDB at least once every five years for approval. There are four ways to become a GCD: (1) by legislative act; (2) through a landowner petition to the Texas Commission on Environmental Quality (TCEQ); (3) through a landowner petition to join an existing GCD; and (4) as a TCEQ initiative in a Priority Groundwater Management Area (GMA).

Regional Water Planning Districts comprise the middle tier of the hierarchy.[434] Each district is responsible for determining its region's water supply and demand, quality and contamination, as well as any other significant social or economic factors that affect water for that region.[435] Regional Water Planning Districts under TWDB develop future plans for a 30–50 year period.[436] These plans

are then incorporated into the all-inclusive state water plan, which is updated every five years. In 2001, the TWDB created an additional middle tier called groundwater management areas (GMAs).[437] Sixteen areas were created to include all major and minor aquifers of the state with boundary lines determined by groundwater reservoirs. Today, these management plans require joint planning between local GCDs to determine the amount of groundwater available within these areas. Districts within a management area are expected to meet at least annually to decide on desired conditions at some future date. These desired conditions become guidelines for the amount of managed available groundwater, which is approved by the TWDB and the Texas Division of Water Quality. Then, groundwater withdrawal permits are issued up to the managed available groundwater to achieve the future desired conditions. In addition to GMAs, there is a category of Priority GMAs.[438] These priority areas function specifically to address areas with defined shortages of surface or groundwater, land subsidence caused by over-pumping, or groundwater contamination, otherwise known as "critical groundwater problems."[439] These areas are heavily studied and designated by the TWDB, TEWQ, or Texas Parks and Wildlife Department (TPWD). Even though all land is within a region or management area, not every area is included within a GCD. This gap raises concern over adequate representation for those that lie outside a GCD but within a GMA. Generally, these groups receive no representation. Some GCDs have allowed nonvoting representation, but for the most part, they do not even receive representation on GMA issues since GMAs manage joint planning between GCDs.

At the state level, Chapter 36 of the Texas Water Code mandates ground and surface water planning for the State by the TWDB. The TWDB is responsible for creating a state water plan as well as overseeing water planning at the regional and local level. It provides educational and technical assistance to other tiers as well as water–planning data.

Florida

Florida residents are both fortunate and unfortunate to be close to the ocean from any point in the state. While residents benefit in many ways by being close to the beach, the state's groundwater supply is unfortunately continuously threatened by contamination and over-pumping. Most of the state's groundwater is located in north and central Florida, with the bottom third of the state having limited resources for potable water. All aquifers are highly vulnerable to pollution, drought and over-withdrawals. Most wells located near the shore are vulnerable to saltwater intrusion. Irrigation accounts for almost half of the aquifer use, with public safety as the second biggest user.

Florida has three main aquifer systems that supply potable water. The first is the Biscayne aquifer, which is located in the southeastern tip of the state and is the most heavily pumped in the state.[440] More than five million residents rely on this aquifer,[441] and it is particularly susceptible to contamination because it is so close to the surface.[442] The second is the Floridian aquifer, which supplies 60% of the state's groundwater and is part of the largest aquifer system in the southeastern region of the United States, which covers parts of Alabama, Georgia and South Carolina.[443] Finally, the third aquifer is the Sand-and-Gravel aquifer, which is located in the western portion of the Florida Panhandle.[444] Unfortunately, this aquifer has been a victim of over-pumping, contamination by industrial waste and saltwater intrusion.[445] There are several other intermediate aquifers that collectively supply 10% of the state's groundwater to rural areas.

Florida has a three-tiered system that includes management at the state, regional and local levels. The middle-tier regional districts hold the most responsibility for groundwater management in the

state and significantly affect the responsibilities of the other two layers. At the state level, the Florida Department of Environmental Protection (FDEP) has created two separate programs to protect the state's groundwater. The Ground Water Management Program is in charge of monitoring, assessment, groundwater-surface water interaction, and general protection of the state's groundwater as a resource.[446] The Aquifer Protection Program is a supportive program responsible for implementing regulations that affect groundwater.[447] These regulations mostly focus on contamination prevention. FDEP has also created an efficient monitoring and data collection network for the state based on a three-tiered system.[448] Tier 1 addresses statewide and regional monitoring; Tier 2 focuses on basin-specific inquiries; and Tier 3 addresses site-specific questions.[449] Together, these layers provide a comprehensive multi-resource for the state's regulation and protection programs.

At the regional level, the Water Management Districts (WMDs) are in charge of regulating water withdrawal permits, and conducting evaluation programs of the area's available resources.[450] There are five regional WMDs in Florida.[451] Each WMD is charged with evaluating the groundwater supply/demand ratio of its district. If the WMD determines that supply will outstrip demand areas within the district, then the district must create a regional water supply plan for those areas for the next 20-year period; the regional water supply plans are reassessed every five years.[452] Also, all local governments that fall into the area of concern under the regional water plan must create their own 10-year plans.[453] Information included in water supply plans are identification of water resources and water supply development options for these areas of concern, which may include desalination, aquifer storage and recovery facilities (ASR), and water conservation.[454] Regional WMDs also develop drought plans and flood protection programs. Finally, WMDs also administer the stormwater management program.[455]

The Southwest Florida WMD has taken the most initiative to find alternative sources of water, mostly due to the very limited supply of groundwater through intermediate aquifers. The two most notable initiatives are the Tampa Bay Seawater desalination plant and the C.W. Bill Young Reservoir. The Tampa Bay plant is the largest in North America and provides 25 MGD of drinking water.[456] In total, it supplies 10% of the region's water[457] and its reservoir holds 15.5 billion gallons of water.[458] Most heavily utilized during times of drought, the reservoir stores runoff during the rainy season. The reservoir cost $146 million, of which $57 million came from federal funds.[459] However, in 2009, flaws in the design were discovered, with Tampa Bay Water predicting a five-year repair period and an estimated cost of $125 million.[460]

City of Las Vegas

The City of Las Vegas was not always as dry as it is today. In 1855, for example, the Las Vegas Springs produced the most water in the entire valley.[461] Nevertheless, the amount of groundwater originally present under the city was not enough to appease the growing population. Throughout the 19th and early 20th centuries, the original Las Vegas Springs located slightly west of the city today easily supplied water to its 1,000 settlers.[462] By 1950 the population had increased to 41,000, the city had experienced several periods of drought, and most wells were uncapped to allow water to flow freely.[463] By pumping 35,000 acre-feet per year, the city had exceeded the area's natural recharge.[464] Las Vegas's water dilemma continued to grow for the next two decades, losing two to four feet per year in water levels.[465] In 1971, Las Vegas began to draw Colorado River water from Lake Mead.[466] Based on the "Law of the River," Las Vegas has a set allocation of 300,000 acre-feet per year, which has remained the allotment today even though the city's metro population has quadrupled in the last 30 years.[467]

Today, the Southern Nevada Water Authority (SNWA) governs water use for the Las Vegas Area. The SNWA is a collection of seven government entities, including the Big Bend Water District; the Cities of Boulder City, Henderson, Las Vegas and North Las Vegas; the Clark County Water Reclamation District; and the Las Vegas Valley Water District.[468] The SNWA is a wholesale water provider responsible for water treatment and long-term water resource management for Southern Nevada. Faced with a set, limited supply and an increasing demand for water, Las Vegas is a prime example of how local government and large businesses can mutually benefit from conservation techniques, preserving water resources for the city and cutting costs for businesses. *The Big Thirst*, written by Charles Fishman, provides two positive examples of these conservation techniques. In his first example, the SNWA attempted to decrease lawn watering through a "cash for grass" program. The SNWA decided to pay homeowners and businesses, mostly golf courses, $1.50 for every square foot of grass removed from their property. With increasing water rates based on volume, lawn watering became a very expensive luxury. By incentivizing residents to remove 140 million square feet of grass and thereby decrease their water usage, the city saved 7.7 billion gallons of water a year, or eight percent of the city's Lake Mead allocation.[469]

In Fishman's second example, SNWA General Manager Patricia Mulroy went head to head against one of the biggest casino owners on the strip, who wanted to develop a new casino that would feature nightly battle scenes on pirate ships in a lagoon.[470] Mulroy had just ascended to her position of general manager and was in the midst of implementing new conservation policies. After a two-hour conversation, the developer agreed to use treated wastewater for his shows and saved costs by creating a water treatment plant in the basement of his hotel.

Today, there are only three ways any company can use water gratuitously. Developers must have rights or permits that predate the modern era, use treated wastewater, or offset their water features through larger water conservation elsewhere so that the total amount of water used by the establishment is considerably less.[471]

Other components of the SNWA's conservation initiative include free indoor water audits, specific guidelines regulating efficient landscape irrigation, seasonal watering restrictions, and rebates for installing water-efficient devices or technologies. The Water Efficient Technologies (WET) program is primarily for large-scale water-saving technologies, such as commercial or multifamily property owners.[472] In order to enroll in the WET program, the service account must be in good standing prior to project implementation and the project must be within the scope of the current business process, conserve at least 250,000 gallons per year, and be sustained over at least a 10-year period.[473] One of the largest conservation techniques implemented by SNWA is the amount of recycled water use. More than 90% of water used indoors is recycled back to fountains, golf courses or returned to Lake Mead.[474]

The SNWA may be facing new problems from the extended drought periods that have lowered total capacity of Lake Mead. In January 2010, the reservoir was at 39% capacity.[475] The maximum depth of Lake Mead is 489 feet, but Intake 1, which is one of two pipes that transport water to Las Vegas, is only safe from the surface at 125 feet or more.[476] In order to combat the imminent possibility of perilously low water levels, the SNWA is currently seeking additional water supplies through a 300-foot underground groundwater pipeline from northeast counties.[477] The SNWA has also revised its water resource plan to account for these drought conditions, making it the eighth revision in 13 years.[478]

Endnotes – Appendix A

[423] *Groundwater Conservation District Facts,* Tex. Water Dev't Bd., http://www.twdb.state.tx.us/groundwater/conservation_districts/facts.asp (last visited Aug. 26, 2013). Acre-feet measures 1 acre in land, 1 foot deep.

[424] *U.S. Census Bureau Announces 2010 Census Population Counts,* U.S. Census Bureau (Dec. 21, 2010), http://www.census.gov/2010census/news/releases/operations/cb10-cn93.html.

[425] *See* Sipriano v. Great Spring Waters of America, Inc., 1 S.W.3d 75, 75–78 (Tex. 1999).

[426] *Water in Texas– Who Owns It?,* Tex. Groundwater Prot. Comm., http://www.tgpc.state.tx.us/subcommittees/POE/faqs/waterownership_FAQ.pdf (last visited Aug. 26, 2013).

[427] *See Sipriano*, 1 S.W.3d at 76, 78; Hastings Oil Co. V. Texas Co., 234 S.W.2d 389, 396 (Tex. 1950). There is a current debate within the state between individuals wanting to retain groundwater rights against increasing governmental regulation in groundwater use.

[428] Tex. Groundwater Prot. Comm., Activities and Recommendations of the Texas Groundwater Protection Committee: A Report to the 82nd Legislature 17 (2011), *available at* http://www.tceq.state.tx.us/assets/public/comm_exec/pubs/sfr/047_10.pdf.

[429] The main goal of TGPC is to protect, conserve and remediate groundwater for the state. For additional information on TGPC, see Tex. Groundwater Prot. Comm., http://www.tgpc.state.tx.us/ (last visited Aug. 26, 2013).

[430] TAGD provides day-to-day communication and information between the groundwater conservation districts. Voting membership is limited to GCDs and functions only for educational and scientific purposes.

[431] For the most recent Groundwater Protection Strategy, see Tex. Groundwater Prot. Comm., Texas Groundwater Protection Strategy (2003), *available at* http://www.tceq.state.tx.us/assets/public/comm_exec/pubs/as/188.pdf.

[432] There are currently 96 approved groundwater conservation districts with 127 counties wholly or partially within a GCD.

[433] Districts are required to review and resubmit their resource plans to TWDB at least once every five years.

[434] There are currently 16 regional water planning districts. The creation of these regional development plans cost $20,187,598 for the entire state.

[435] In 1998, 270 required interest groups comprised the initial members of regional water planning committees. Today, there are many public forums to voice concerns, and it is not mandatory to participate in the planning process of the region; however, there are many incentives to different organizations in identifying and offering solutions for future water needs. Also, participants are eligible to receive low-interest TWDB loans for financing water supply projects.

[436] The current 5-year planning period runs from 2011-2016. These plans range from specific strategies for the next 30 years to identifying areas of concern with no feasible solutions.

[437] *What is a Groundwater Management Area?,* Tex. Groundwater Prot. Comm,, http://www.twdb.state.tx.us/gwrd/gma/pdf/TCEQ%20GMA%20summary.pdf (last visited Aug. 26, 2013).

[438] *See generally What is a Priority Groundwater Management Area (PGMA)?,* Tex. Comm'n on Envtl. Quality, http://www.tceq.texas.gov/assets/public/permitting/watersupply/groundwater/maps/pgma_text.pdf (last visited Aug. 26, 2013).

[439] There are currently eight designated areas. Since the inception of PGMAs, 18 full studies and five follow-up studies have been conducted, and 10 of the 18 studied areas have improved and are no longer within the critical range. *Id.*

[440] *Groundwater Modeling*, S. Fla. Water Mgmt. Dist., http://www.sfwmd.gov/portal/page/portal/xweb%20-%20release%203%20water%20supply/ground%20water%20modeling (last visited Aug. 26, 2013).

[441] *Id.*

[442] *Biscayne Aquifer*, Miami-Dade Cnty., Water & Sewer, http://www.miamidade.gov/water/biscayne-aquifer.asp (last updated Mar. 26, 2012).

[443] *Groundwater Modeling*, S. Fla. Water Mgmt. Dist., http://www.sfwmd.gov/portal/page/portal/xweb%20-%20release%203%20water%20supply/ground%20water%20modeling (last visited Aug. 26, 2013).

[444] *Sand and Gravel Aquifer*, U.S. Geological Survey, http://pubs.usgs.gov/ha/ha730/ch_g/G-text3.html (last visited Aug. 26, 2013).

[445] *See generally* Patricia L. Ryan et al., Nw. Fla. Water Mgmt. Dist., NWFWMD Water Supply Assessment, Region I: Escambia County (1998), *available at* http://www.nwfwmd.state.fl.us/rmd/wsa/region_i.pdf.

[446] *Ground Water Program,* Fla. Dep't of Envtl. Prot., http://www.dep.state.fl.us/water/groundwater/index.htm (last updated July 28, 2013).

[447] *Id.*

[448] *See Watershed Monitoring*, Fla. Dep't of Envtl. Prot., http://www.dep.state.fl.us/water/monitoring/ (last updated Mar. 22, 2013).

[449] *Id.*

[450] *See Florida's Water Permitting Portal*, Fla. Dep't of Envtl. Prot., http://flwaterpermits.com/ (last visited Aug. 26, 2013).

[451] *Id.*; *Water Management Districts,* Fla. Dep't of Envtl. Prot., http://www.dep.state.fl.us/secretary/watman/ (last updated Aug. 1, 2013).

[452] *See* James P. Heaney et al., Water Conservation Evaluations Within the Context of Regional Water Supply Planning in Florida 1 (2010), *available at* http://www.conservefloridawater.org/publications/waterconservationevaluationsregionalwatersupplyplannng.pdf

[453] *Id.*

[454] *Regional Water Supply Planning*, Fla. Dep't of Envtl. Prot., http://www.dep.state.fl.us/water/waterpolicy/rwsp.htm (last updated May 17, 2013).

[455] *Water Management Districts*, Fla. Dep't of Envtl. Prot., http://www.dep.state.fl.us/secretary/watman/ (last updated Aug. 1, 2013).

[456] *Tampa Bay Seawater Desalination Plant, Florida, United States of America,* water-technology.net, http://www.water-technology.net/projects/tampa/ (last visited Aug. 26, 2013).

[457] *Id.*

[458] *Reservoir Renovation Project,* Tampa Bay Water, http://www.tampabaywater.org/facilities/reservoir/index.aspx (last visited Aug. 26, 2013).

[459] Tom Swihart, Florida's Water: A Fragile Resource in a Vulnerable State (2011).

[460] Craig Pittman, *Proposals for Tampa Bay Water Reservoir Repair As High As $170 Million*, Tampa Bay Times (4/18/11, 11:59 AM), http://www.tampabay.com/news/localgovernment/proposals-for-tampa-bay-water-reservoir-repair-as-high-as-170-million/1164501.

[461] *History of Groundwater in the Las Vegas Valley*, Las Vegas Valley Groundwater Mgmt. Program, http://www.lasvegasgmp.com/html/about_history.html (last visited Aug. 26, 2013).

[462] *Id*.

[463] *Id.*

[464] *Id.*

[465] *Id.*

[466] Lake Mead is the largest reservoir in the United States. It supplies water to Nevada, California, and Arizona. The "Law of the River" refers to the series of compacts, court decisions, federal laws, etc., that manage the distribution of water from the Colorado River. The Boulder Canyon Act of 1928 established water allocation for Nevada. For more information regarding the "Law of the River," see *The Law of the River*, U.S. Dep't of the Interior, Bureau of Reclamation, http://www.usbr.gov/lc/region/g1000/lawofrvr.html (last updated Mar. 2008).

[467] Jenny Farman et al., *The Flow of Change: State Boundaries and Water Management in Las Vegas*, Stanford Univ. Bill Lane Center for the American West (Oct. 5, 2011), http://west.stanford.edu/students/soco/flow-change-state-boundaries-and-water-management-las-vegas; *Population Trends,* Las Vegas Convention and Visitors Auth., http://www.lvcva.com/getfile/Population.pdf?Fileid=241 (last visited Aug. 26, 2013).

[468] S. Nev. Water Auth., Water Resource Plan 2009, at v, *available at* http://www.snwa.com/assets/pdf/wr_plan_exec_summary.pdf.

[469] Charles Fishman, The Big Thirst: The Secret Life and Turbulent Future of Water 70 (2011).

[470] *Id.* At 62.

[471] *Id* at 62–63.

[472] *Water Efficient Technologies*, S. Nev. Water Auth., http://www.snwa.com/biz/rebates_wet.html (last visited Aug. 26, 2013).

[473] *WET Program Conditions*, S. Nev. Water Auth., http://www.snwa.com/biz/rebates_wet_conditions.html (last visited Aug. 26, 2013).

[474] Charles Fishman, The Big Thirst: The Secret Life and Turbulent Future of Water (2011).

[475] For information on the elevation levels (feet) of Lake Mead at Hoover Dam by month from 1935 to the present, see *Lake Mead at Hoover Dam, Elevation (Feet)*, U.S. Dep't of the Interior, Bureau of Reclamation, http://www.usbr.gov/lc/region/g4000/hourly/mead-elv.html (last updated Aug. 1, 2013).

[476] Charles Fishman, The Big Thirst: The Secret Life and Turbulent Future of Water (2011).

[477] *See Groundwater Development Project*, S. Nev. Water Auth., http://www.snwa.com/ws/future_gdp.html (last visited Aug. 26, 2013).

[478] S. Nev. Water Auth., Water Resource Plan 2009, at v–vi, *available at* http://www.snwa.com/assets/pdf/wr_plan_exec_summary.pdf.

Appendix B

Gray Water Programs and Benefits

Residential gray water reuse systems are used across the world as a means to conserve potable water and save money on monthly water bills; this financial incentive to utilize gray water is significant, particularly during periods of drought when water rationing, irrigation restrictions, and increasing-block (water conservation) pricing policies and fines for excessive use come into effect.[479] Gray water systems also enable municipalities to stretch resource supplies further. While such setups can be beneficial, implementing gray water systems presents unique challenges because individuals are placed in charge of a resource that can be wasted or mismanaged. Gray water is not to be confused with black water, which is wastewater from the toilet; typically, gray water use programs do not permit the reuse of wastewater from the kitchen sink or dishwasher.[480] Because of these impurities, gray water is reserved for non-contact uses and such systems are subject to permitting and other regulations. Choosing which sources of gray water will be acceptable for reuse is just one consideration North Carolina will face when establishing such a program. There is no shortage of examples from other communities to guide a future gray water reuse program in North Carolina.

Using gray water has numerous advantages for individuals and municipalities. On the most basic level, raising awareness of gray water use and why it is necessary may motivate consumers to be more responsible with their water use. Encouraging water conservation is especially important in North Carolina given its history of droughts. Additionally, "[r]eusing gray water has been shown to increase the efficient use of water in the home and minimizes reliance on municipal water, conserving potable water."[481] Reduced reliance on municipal water will not only put less of a demand on local water resources, but it will also help families and businesses lower their water bills. Significant savings are possible because a sizeable portion of wastewater from households can be reused as gray water. Avoiding contact with people is paramount, but gray water can be useful for firebreaks as well as irrigating lawns, trees, and crops. Gray water can also be used for toilet flushing, a source which alone may account for anywhere between 27 and 50 percent of indoor water use."[482]

Using gray water can also provide significant savings to municipalities due to the reduction of the quantity of water that requires processing. With a large portion of indoor water being reused, septic systems have reduced wastewater flows. This can help improve the effectiveness of septic treatment and may also extend the life of a septic system due to the reduction in system stress.[483] In addition, a lower demand from users can produce a more efficient supply system and a reduction in the amount of electricity needed to power treatment facilities.[484] The savings in energy costs are higher in areas where treated water has to be pumped long distances,[485] meaning that rural and underdeveloped areas on the coast may stand to benefit more than other communities. Lessening the strain on infrastructure may also help communities delay building larger pipes or treatment facilities.

States in the southeast and southwest – particularly those affected by droughts – offer a myriad of approaches for encouraging and regulating gray water reuse. Analyzing their regulations and experiences will help North Carolina make the most of this conservation strategy. For large-scale gray water reuse, New Mexico requires a formal permit process, in which an applicant must show that "the proposed liquid waste system will, by itself or in combination with other liquid waste

systems, neither cause a hazard to public health nor degrade any body of water."[486] New Mexico offers a more streamlined process for smaller scale use, allowing up to 250 gallons of gray water to be used daily without a permit.[487]

Arizona has been a leader in gray water reuse, thanks to a three-tiered regulation system organized by usage. The first tier is for systems using less than 400 GPD; a formal permit is not needed, but households are required to adhere to 13 BMPs designed to protect water quality and public health.[488] The BMPs include protocol for how to handle a backup; restrictions on where gray water can be used; and specifications for which purposes gray water can be used. The second tier – which requires a permit – is for systems that process more than 400 GPD, are multi-family, commercial or institutional systems, or don't meet the 13 requirements of the first tier.[489] The highest tier is for systems processing more than 3,000 GPD, and such systems are regulated individually.[490] This system entails stricter requirements as the size of a system increases, making it easy for homeowners to set up a system while also protecting the community from the potential hazards of mismanaging a larger system.

California also has a system in which households are exempt from normal permit requirements if BMPs are followed.[491] However, the exclusion is limited to households with reuse systems limited to a single fixture. Among the conditions that must be followed are: prohibition of ponding, a requirement that all gray water is contained on the site in an irrigation or disposal field, and a specification that the system does not interfere with other building utilities components.[492] Systems allowing small-scale users to avoid inconvenient permitting processes create a low barrier to entry and encourage participation. California's rules also provide system performance goals rather than specific mandated designs, opening the door for a wider base of users.[493]

Simply permitting gray water reuse is unlikely to trigger a massive reduction in water demand. It is best viewed as a component in a comprehensive water management strategy rather than a silver bullet. Public outreach will be critical. There are a number of major obstacles to getting the public to embrace reuse as a viable option. First, surveys in municipalities where gray water reuse is permitted indicate lack of knowledge with respect to setting up and using gray water systems. The second obstacle has to do with inadequate information and assistance in using the systems.[494] Inadequate incentives and inconvenient permitting processes and legal concerns can also have a discouraging effect, so public education, incentives, and a streamlined permitting process are crucial if the benefits of gray water reuse are to be fully realized.[495]

Endnotes – Appendix B

[479] Bahman Sheikh, White Paper on Graywater 7 (2010), *available at* http://www.watereuse.org/files/s/docs/Graywater_White_Paper.pdf.

[480] *Id*. At 1.

[481] *See* Chung M. Khong, San Jose State Univ., Perception and Use of Graywater in Berkeley, California 5 (2009), *available at* http://scholarworks.sjsu.edu/cgi/viewcontent.cgi?Article=4689&context=etd_theses. *See also Indoor Water Use in the United States*, U.S. Envtl. Protection Agency, http://www.epa.gov/watersense/pubs/indoor.html (last visited Sept. 9, 2013).

[482] *Id.*

[483] Art Ludwig, *Grey Water*, Oasis Design, http://www.oasisdesign.net/greywater/ (last visited Aug. 26, 2013).

[484] *Id.*

[485] Lucy Allen et al., Pac. Inst., Overview of Greywater Reuse: The Potential of Greywater Systems to Aid Sustainable Water Management 27 (2010), *available at* http://www.pacinst.org/wp-content/uploads/2013/02/greywater_overview3.pdf.

[486] N.M. Code R. § 20.7.3.404(A) (lexisnexis 2013).

[487] Bahman Sheikh, White Paper on Graywater 20 (2010), *available at* http://www.watereuse.org/files/s/docs/Graywater_White_Paper.pdf.

[488] *Id.* At 15; *Permits: Reclaimed Water*, Ariz. Dep't of Envtl. Quality, Water Quality Div., http://azdeq.gov/environ/water/permits/reclaimed.html#1 (last visited Aug. 26, 2013).

[489] Art Ludwig, Builder's Greywater Guide 24 (15th ed. 2007), *available at* http://www.oasisdesign.net/greywater/law/improve/improvementstogwlaws.pdf.

[490] *Id.*

[491] Cal. Plumbing Code § 1601 (2010), *available at* http://www.iapmo.org/2010%20California%20Plumbing%20Code/Chapter%2016A.pdf; Bahman Sheikh, White Paper on Graywater 17 (2010), *available at* http://www.watereuse.org/files/s/docs/Graywater_White_Paper.pdf.

[492] Cal. Plumbing Code § 1601 (2010), *available at* http://www.iapmo.org/2010%20California%20Plumbing%20Code/Chapter%2016A.pdf; Bahman Sheikh, White Paper on Graywater 17 (2010), *available at* http://www.watereuse.org/files/s/docs/Graywater_White_Paper.pdf.

[493] Art Ludwig, Builder's Greywater Guide 24 (15th ed. 2007), *available at* http://www.oasisdesign.net/greywater/law/improve/improvementstogwlaws.pdf.

[494] Bahman Sheikh, White Paper on Graywater 12 (2010), *available at* http://www.watereuse.org/files/s/docs/Graywater_White_Paper.pdf.

[495] *Id.*

Appendix C

North Carolina Session Law 2011-374
This bill was signed into law June 27, 2011.[496]

SESSION LAW 2011-374
HOUSE BILL 609

AN ACT TO PROMOTE THE DEVELOPMENT OF WATER SUPPLY RESERVOIRS AND OTHER WATER SUPPLY RESOURCES, TO PROVIDE THAT FUNDS FROM THE CLEAN WATER MANAGEMENT TRUST FUND MAY BE USED TO PRESERVE LANDS FOR THE DEVELOPMENT OF WATER SUPPLY RESERVOIRS, AND TO IMPROVE THE EFFICIENCY OF USE OF NORTH CAROLINA'S WATER RESOURCES.

Whereas, S.L. 2007-518 directed the Environmental Review Commission to study the allocation of surface water resources and their availability and maintenance in the State; and

Whereas, pursuant to this directive, the Environmental Review Commission commissioned a study and report on water allocation issues and policy options; and

Whereas, the resulting water allocation report included a recommendation that the State create an expedited regulatory process for the construction of new water supply reservoirs; and

Whereas, the resulting water allocation report found that certain areas of the State, including the Piedmont, are expected to experience significant population growth over the next 30 years and do not have adequate water supplies to support the expected growth; Now, therefore,

The General Assembly of North Carolina enacts:

PART I. PROMOTE THE DEVELOPMENT OF WATER SUPPLY RESERVOIRS AND OTHER WATER SUPPLY RESOURCES

SECTION 1.1. G.S. 143-355(b) is amended by adding two new subdivisions to read:

"(b) Functions to Be Performed. – The Department shall:

…

(16) Cooperate with units of local government in the identification of water supply needs and appropriate water supply sources and water storage projects to meet those needs. By agreement with a unit of local government, the Department may do any of the following:

a. Assist in the assessment of alternatives for meeting water supply needs; the conduct of engineering studies, hydraulic computations, and hydrographic surveys; and the development of a plan of study for purposes of obtaining necessary permits.

b. For budget and planning purposes, develop estimates of the costs of the proposed new water supply project.

c. Apply for State and federal permits for the development of regional water supplies.

(17) Be the principal State agency to cooperate with other State agencies, the United States Army Corps of Engineers, and all other federal agencies or

instrumentalities in the planning and development of water supply sources and water storage projects for the State."

SECTION 1.2. Article 38 of Chapter 143 of the General Statutes is amended by adding two new sections to read:

"**§ 143-355.7. Water supply development; State-local cooperation.**

(a) At the request of one or more units of local government, the Department may assist the local government in identifying the preferred water supply alternative that alone or in combination with other water sources will provide for the long-term water supply needs documented in the local water supply plan and meet all of the following criteria:

(1) Are economically and practically feasible.

(2) Make maximum, practical beneficial use of reclaimed wastewater and stormwater.

(3) Comply with water quality classifications and standards.

(4) Avoid or mitigate impacts to threatened or endangered species to the extent such species are protected by State or federal law.

(5) Maintain downstream flows necessary to protect downstream users.

(6) Do not have significant adverse impacts on other water withdrawals or wastewater discharges.

(7) Avoid or mitigate water quality impacts consistent with the requirements of rules adopted by the Environmental Management Commission to implement 33 U.S.C. § 1341.

(b) During the alternatives analysis, the Department shall request relevant information regarding the potential alternatives, including the establishment or expansion of the water supply reservoir or other water supply resources, from other State agencies with jurisdiction over any natural resources that will be impacted under the alternatives identified by the Department. Unless the local government agrees to an extension of time, the Department shall determine the preferred alternative within two years of the execution of a contract with the requesting local government for the costs of the analysis. The determination of the preferred alternative shall be binding on all State agencies unless the Department determines from its further evaluation during its review of any State or federal permit applications for the project that another preferred alternative should be selected in light of additional information brought forward during the permit reviews.

(c) If the Department provides an analysis of practicable alternatives for meeting a water supply need under this section, the analysis shall be accepted by the Department and the Department of Administration for purposes of satisfying the requirements of the North Carolina Environmental Policy Act and any State permit or authorization that requires identification and assessment of alternatives, including, but not limited to, a request for an interbasin transfer pursuant to G.S. 143-215.22L.

(d) The Department may provide technical assistance to a unit of local government in obtaining federal permits for the preferred water supply alternative identified pursuant to subsection (a) of this section. For purposes of providing technical assistance and conducting studies in support of a proposed water supply project under this section, the Department may enter into an agreement with one or more units of local government to conduct studies or modeling. The agreement shall specify the allocation of costs for any studies or modeling prepared by the Department in support of the project.

(e) When the Department has identified the most practicable alternative, a regional water supply system may request that the Department become a co-applicant for all required federal approvals for the alternative identified by the Department. The Department may become a co-applicant when all of the following conditions are met:

(1) The regional water supply system has acquired or will acquire the property necessary for construction of the water supply reservoir or other water supply resource.

(2) The local water supply plan shows that the regional water supply system has implemented appropriate conservation measures similar in effect to the measures in comparably sized North Carolina regional water supply systems.

(3) The regional water supply system has developed and is implementing measures to replace existing leaking infrastructure that is similar in effect to the measures being implemented by comparably sized North Carolina regional water systems.

(4) The regional water supply system has entered into a contractual agreement to pay the expenses incurred by the Department as a co-applicant for the project approval.

(f) Nothing in this section shall be construed to limit the authority of the Department to require environmental permits or to apply and enforce environmental standards pursuant to State law.

"**§ 143-355.8. Regional water supply planning organizations.**

(a) One or more water systems may establish a water supply planning organization to plan for and coordinate water resource supply and demand on a regional basis. A water supply planning organization may include representatives of local government water systems, water authorities, nongovernmental water systems, and registered water withdrawers.

(b) A regional water supply planning organization may do any of the following:

(1) Identify sources of raw water supply for regional systems.

(2) Identify areas suitable for the development of new regional water sources.

(3) Identify opportunities for purchase and sale of water between water systems to meet regional water supply needs.

(4) Prepare joint water supply plans.

(5) Enter into agreements with the Department for technical assistance in identifying practical alternatives to meet regional water supply needs pursuant to G.S. 143-355.7 or to provide studies in support of a proposed regional water supply project.

(6) Support cooperative arrangements between water systems for purchase and sale of water by providing technical assistance and voluntary mediation of disputes concerning water supply.

(c) Nothing in this section shall be construed to alter the requirements for obtaining a certificate for an interbasin transfer."

PART II. PROVIDE THAT FUNDS FROM THE CLEAN WATER MANAGEMENT TRUST FUND MAY BE USED TO PRESERVE LANDS FOR THE DEVELOPMENT OF WATER SUPPLY RESERVOIRS

SECTION 2.1. G.S. 113A-251 reads as rewritten:

"**§ 113A-251. Purpose.**

The General Assembly recognizes that a critical need exists in this State to clean up pollution in the State's surface waters and to ~~protect~~ protect, preserve, and conserve those waters that are not yet polluted. The task of cleaning up polluted waters and protecting and enhancing the State's water resources is multifaceted and requires different approaches, including innovative pilot projects, that take into account the problems, the type of pollution, the geographical area, and the recognition that the hydrological and ecological values of each resource sought to be upgraded, conserved, and protected are unique.

It is the intent of the General Assembly that moneys from the Fund created under this Article shall be used to help finance projects that specifically address water pollution problems and focus on upgrading surface waters, eliminating pollution, and ~~protecting~~ protecting, preserving, and conserving unpolluted surface waters, including enhancement or development of ~~urban~~ drinking water supplies. It is the further intent of the General Assembly that moneys from the Fund also be used to build a network of riparian buffers and greenways for environmental, educational, and recreational benefits. It is lastly the intent of the General Assembly that moneys from the Fund also be used to preserve lands that could be used for water supply reservoirs. While the purpose of this Article is to focus on the cleanup and prevention of pollution of the State's surface ~~waters~~ waters, ~~and~~the establishment of a network of riparian buffers and greenways, and the preservation of property for establishing clean water supplies, the General Assembly believes that the results of these efforts will also be beneficial to wildlife and marine fisheries habitats."

SECTION 2.2. G.S. 113A-253 reads as rewritten:

"**§ 113A-253. Clean Water Management Trust Fund.**

(a) Fund Established. – The Clean Water Management Trust Fund is established as a special revenue fund. The Fund receives revenue from the following sources and may receive revenue from other sources:

(1) Annual appropriations under G.S. 143-15.3B.

(2) Scenic River special registration plates under G.S. 20-81.12.

(b) Fund Earnings, Assets, and Balances. – The State Treasurer shall hold the Fund separate and apart from all other moneys, funds, and accounts. Investment earnings credited to the assets of the Fund shall become part of the Fund. Any balance remaining in the Fund at the end of any fiscal year shall be carried forward in the Fund for the next succeeding fiscal year. Payments from the Fund shall be made on the warrant of the Chair of the Board of Trustees.

(c) Fund Purposes. – Moneys from the Fund are appropriated annually to finance projects to clean up or prevent surface water pollution and for land preservation in accordance with this Article. Revenue in the Fund may be used for any of the following purposes:

(1) To acquire land for riparian buffers for the purposes of providing environmental protection for surface waters and urban drinking water supplies and establishing a network of riparian greenways for environmental, educational, and recreational uses and to retire debt incurred for this purpose under Article 9 of Chapter 142 of the General Statutes.

(2) To acquire conservation easements or other interests in real property for the purpose of protecting and conserving surface waters and enhancing ~~urban~~ drinking water ~~supplies~~ supplies, including the development of water supply reservoirs, and to retire debt incurred for this purpose under Article 9 of Chapter 142 of the General Statutes.

(3) To coordinate with other public programs involved with lands adjoining water bodies to gain the most public benefit while protecting and improving water quality and to retire debt incurred for this purpose under Article 9 of Chapter 142 of the General Statutes.

(4) To restore previously degraded lands to reestablish their ability to protect water quality and to retire debt incurred for this purpose under Article 9 of Chapter 142 of the General Statutes.

(5) To repair failing wastewater collection systems and wastewater treatment works if the repair is a reasonable remedy for resolving an existing waste treatment problem and the repair is not for the purpose of expanding the system to accommodate future anticipated growth of a community.

(6) To repair and eliminate failing septic tank systems, to eliminate illegal drainage connections, and to expand a wastewater collection system or wastewater treatment works if the expansion eliminates failing septic tank systems or illegal drainage connections.

(7) To finance stormwater quality projects.

(8) To facilitate planning that targets reductions in surface water pollution.

(8a) To finance innovative efforts, including pilot projects, to improve stormwater management, to reduce pollutants entering the State's waterways, to improve water quality, and to research alternative solutions to the State's water quality problems.

(9) To fund operating expenses of the Board of Trustees and its staff.

(d) Limit on Operating and Administrative Expenses. – No more than two percent (2%) of the annual balance of the Fund on 1 July or a total sum of one million two hundred fifty thousand dollars ($1,250,000), whichever is greater, may be used each fiscal year for administrative and operating expenses of the Board of Trustees and its staff."

SECTION 2.3. G.S. 113A-253.1 reads as rewritten:

"**§ 113A-253.1. The Clean Water Management Trust Fund; appropriation.**

(a) The General Assembly finds that, due to the critical need in this State to clean up pollution in the State's surface ~~waters and~~waters, to protect and conserve those waters that are not yet polluted, and to preserve lands that may be used for water supply reservoirs, it is imperative that the State provide a minimum of one hundred million dollars ($100,000,000) each calendar year to the Clean Water Management Trust Fund; therefore, there is annually appropriated from the General Fund to the Clean Water Management Trust Fund the sum of one hundred million dollars ($100,000,000).

(b) The funds in the Clean Water Management Trust Fund shall be used only in accordance with this Article."

SECTION 2.4. G.S. 113A-256 reads as rewritten:

"**§ 113A-256. Clean Water Management Trust Fund Board of Trustees: powers and duties.**

(a) Allocate Grant Funds. – The Trustees shall allocate moneys from the Fund as grants. A grant may be awarded only for a project or activity that satisfies the criteria and furthers the purposes of this Article.

(b) Develop Grant Criteria. – The Trustees shall develop criteria for awarding grants under this Article. The criteria developed shall include consideration of the following:

(1) The significant enhancement and conservation of water quality in the State.

(2) The objectives of the basinwide management plans for the State's river basins and watersheds.

(3) The promotion of regional integrated ecological networks insofar as they affect water quality.

(4) The specific areas targeted as being environmentally sensitive.

(5) The geographic distribution of funds as appropriate.

(6) The preservation of water resources with significant recreational or economic value and uses.

(7) The development of a network of riparian buffer-greenways bordering and connecting the State's waterways that will serve environmental, educational, and recreational uses.

(8) Water supply availability and the public's need for resources adequate to meet demand for essential water uses. Criteria developed pursuant to this

subdivision may include consideration of the likelihood of a proposed water supply project ultimately being permitted and built.

(c) Develop Additional Guidelines. – The Trustees may develop guidelines in addition to the grant criteria consistent with and as necessary to implement this Article.

(d) Acquisition of Land. – The Trustees may acquire land by purchase, negotiation, gift, or devise. Any acquisition of land by the Trustees must be reviewed and approved by the Council of State and the deed for the land subject to approval of the Attorney General before the acquisition can become effective. In determining whether to acquire land as permitted by this Article, the Trustees shall consider whether the acquisition furthers the purposes of this Article and may also consider recommendations from the Council. Nothing in this section shall allow the Trustees to acquire land under the right of eminent domain.

(e) Exchange of Land. – The Trustees may exchange any land they acquire in carrying out the powers conferred on the Trustees by this Article.

(f) Land Management. – The Trustees may designate managers or managing agencies of the lands acquired under this Article.

(g) Tax Credit Certification. – The Trustees shall develop guidelines to determine whether land donated for a tax credit under G.S. 105-130.34 or G.S. 105-151.12 are suitable for one of the purposes under this Article and may be certified for a tax credit.

(h) Rule-making Authority. – The Trustees may adopt rules to implement this Article. Chapter 150B of the General Statutes applies to the adoption of rules by the Trustees.

(i) Repealed by Session Laws 1999-237, s. 15.11, effective July 1, 1999.

(j) Debt. – Of the funds credited annually to the Fund, the Trustees may authorize expenditure of a portion to reimburse the General Fund for debt service on special indebtedness to be issued or incurred under Article 9 of Chapter 142 of the General Statutes for the purposes provided in G.S. 113A-253(c)(1) through (4). In order to authorize expenditure of funds for debt service reimbursement, the Trustees must identify to the State Treasurer and the Department of Administration the specific capital projects for which they would like special indebtedness to be issued or incurred and the annual amount they intend to make available, and request the State Treasurer to issue or incur the indebtedness. After special indebtedness has been issued or incurred for a capital project requested by the Trustees, the Trustees must direct the State Treasurer to credit to the General Fund each year the actual aggregate principal and interest payments to be made in that year on the special indebtedness, as identified by the State Treasurer."

PART III. IMPROVE THE EFFICIENCY OF USE OF NORTH CAROLINA'S WATER RESOURCES

SECTION 3.1. G.S. 143-355(l) reads as rewritten:

"(l) Local Water Supply Plans. – Each unit of local government that provides public water service or that plans to provide public water service and each large community water system shall, either individually or together with other units of local government and large community water systems, prepare a local water supply plan and submit it to the Department for approval. The Department shall provide technical assistance with the preparation of plans to units of local government and large community water systems upon request and to the extent that the Department has resources available to provide assistance. At a minimum, each unit of local government and large community water system shall include in local water supply plans all information that is readily available to it. Plans shall include present and projected population, industrial development, and water use within the service area; present and future water supplies; an estimate of the technical assistance that may be needed at the local level to address projected water needs; current and future water conservation and water reuse~~programs;~~ programs, including a plan for the reduction of long-term per capita demand for potable water; a description

of how the local government or large community water system will respond to drought and other water shortage emergencies and continue to meet essential public water supply needs during the emergency; and any other related information as the Department may require in the preparation of a State water supply plan. A unit of local government or large community water system shall submit a revised plan that specifies how the water system intends to address foreseeable future water needs when eighty percent (80%) of the water system's available water supply based on calendar year average daily demand has been allocated to current or prospective water users or the seasonal demand exceeds ninety percent (90%). Local plans shall be revised to reflect changes in relevant data and projections at least once each five years unless the Department requests more frequent revisions. The revised plan shall include the current and anticipated reliance by the local government unit or large community water system on surface water transfers as defined by G.S. 143-215.22G. Local plans and revised plans shall be submitted to the Department once they have been approved by each unit of local government and large community water system that participated in the preparation of the plan."

SECTION 3.2. G.S. 143-355.4(b) reads as rewritten:

"(b) To be eligible for State water infrastructure funds from the Drinking Water State Revolving Fund or the Drinking Water Reserve or any other grant or loan of funds allocated by the General Assembly whether the allocation of funds is to a State agency or to a nonprofit organization for the purpose of extending waterlines or expanding water treatment capacity, a local government or large community water system must demonstrate that the system:

…

(7) Has implemented a consumer education program that emphasizes the importance of water ~~conservation.~~conservation and that includes information on measures that residential customers may implement to reduce water consumption."

SECTION 3.3. G.S. 159-52(a) reads as rewritten:

"(a) In determining whether a proposed bond issue shall be approved, the Commission may consider:

…

(13) If the proposed bond issue is for a water system as described in G.S. 159-48(b)(21), whether a unit has prepared a local water supply plan in compliance with G.S. 143-355."

SECTION 3.4. The Department of Environment and Natural Resources shall provide statewide outreach and technical assistance as needed regarding water efficiency, which shall include the development of best management practices for community water efficiency and conservation. These best management practices shall address at least all of the following practices:

(1) Integrating water efficiency and conservation into water supply plans.
(2) Conducting regular water audits to identify revenue and nonrevenue water and water losses.
(3) Adopting water loss abatement programs.
(4) Metering and submetering of existing multiunit residential, commercial, and industrial complexes.
(5) Retrofitting fixtures, equipment, and irrigation systems to make them more water efficient.
(6) Landscaping in a manner that conserves water use and is regionally appropriate.
(7) Employing water reuse practices that include harvesting rainwater and using grey water.

(8) Pricing water to achieve comprehensive conservation and adopting full-cost accounting in line with the recommendation approved by the State Water Infrastructure Commission in November 2010.

SECTION 3.5. Nothing in Sections 3.1 through 3.4 of this act shall be construed to authorize the adoption of rules to implement those sections. Nothing in Sections 3.1 through 3.4 of this act shall be construed or implemented in a way so as to negatively impact economic development.

SECTION 4. Sections 3.1 through 3.5 of this act become effective October 1, 2011. All other sections of this act are effective when this act becomes law.

In the General Assembly read three times and ratified this the 17th day of June, 2011.

Endnotes – Appendix C

[496] For the legislative history of this bill, see *House Bill 609 Information/History (2011-2012 Session)*, N.C. Gen. Assemb., http://www.ncga.state.nc.us/gascripts/billlookup/billlookup.pl?Session=2011&billid=H609 (last visited Aug. 27, 2013).

Appendix D

Estuarine Shoreline Types

In 2006, DCM published the North Carolina Estuarine Biological and Physical Processes Work Group[497] report outlining recommendations for shoreline stabilization techniques appropriate for the various types of estuarine shoreline. The Work Group identified 11 types of shoreline commonly found in our estuaries. The most effective and suitable form of shoreline stabilization may vary based on the shoreline type. The following list is adapted from the Work Group's report and also is available to the public in a DCM brochure:[498]

- **Swamp Forest**: poorly drained forested wetlands that are periodically or regularly flooded by normal water conditions. These may occur directly on the shoreline or be fronted by marsh and are expansive enough that wave energy is dissipated before reaching any sediment bank.

- **Marsh**: low-lying vegetated meadows subject to regular or irregular flooding in normal conditions. Vegetation is specialized and adapted to water salinity and frequency of inundation. Marshes may be eroded by wave action and built up by sediment deposition.

- **Marsh with oysters**: Marsh shoreline with adjacent oyster reefs.

- **Marsh with mudflats**: Marsh shoreline with adjacent mudflats, which are exposed at low tide.

Note: Low sediment banks are banks less than five feet in vertical height comprised of unconsolidated sediment atop a clay bed.

- **Low sediment bank with marsh**: Low sediment bank fronted by narrow fringing marsh.

- **Low sediment bank with swamp forest**: Low sediment bank fronted by a narrow band of swamp forest.

- **Low sediment bank with sand**: Low sediment bank fronted by a broad, shallow beach or sandy bottom.

- **Low sediment bank with woody debris**: Low sediment bank fronted by naturally occurring drowned trees, stumps, logs and brush.

- **Low sediment bank with oysters-SAV**: Low sediment bank with oyster reefs or submerged aquatic vegetation bed.

- **High sediment bank**: Shoreline over five feet of vertical height with clay or consolidated sediments at base and unconsolidated sands or clay-sands above and usually fronted by sand beach.

- **Overwash Barrier/Inlet area**: Areas with active overwash or inlet influence.

Endnotes – Appendix D

[497] This workgroup was organized by the North Carolina Coastal Resources Commission's Estuarine Shoreline Stabilization Subcommittee and was comprised of experts in estuarine shore processes. Using best professional judgment and review of the scholarly literature, the workgroup made recommendations on the best shoreline stabilization for the various shoreline types in NC. The full report can be accessed at: http://dcm2.enr.state.nc.us/estuarineshoreline/EWG%20Final%20Report%20082106.pdf.

[498] DCM booklet: *Estuarine Shoreline Stabilization – Property Owners Guide to Determining the Most Appropriate Stabilization Method*. See also: NOAA booklet: *Weighing Your Options.*

Appendix E

Summary of Stabilization Method Rankings

	Swamp Forest	Marsh	Marsh with Oysters	Marsh with Mudflats	Low Sediment Bank with Marsh	Low Sed. Bank with Swamp Forest
Land Planning	1	1	1	1	1	1
Vegetation Control	2	2	2	2	2	2
Beach Fill	3	3	NR	NR	NR	NR
Sills	4	4	3	3	3	3
Groins	5	5	4	4	4	4
Breakwaters	6	6	NR	NR	4	4
Sloped Structures	4-toe only NR-other	4-toe only NR-other	3-toe only NR-other	3-toe only NR-other	3-toe only 4-other	3-toe only 4-other
Vertical Structures	NR	NR	NR	NR	4	4

NR = Not Recommended

	Swamp Forest	Marsh	Marsh with Oysters	Marsh with Mudflats	Low Sediment Bank with Marsh	Low Sed. Bank with Swamp Forest
Land Planning	1	1	1	1	1	1
Vegetation Control	2	2	2	2	2	2
Beach Fill	3	3	NR	NR	NR	NR
Sills	4	4	3	3	3	3
Groins	5	5	4	4	4	4
Breakwaters	6	6	NR	NR	4	4
Sloped Structures	4-toe only NR-other	4-toe only NR-other	3-toe only NR-other	3-toe only NR-other	3-toe only 4-other	3-toe only 4-other
Vertical Structures	NR	NR	NR	NR	4	4

NR = Not Recommended

Appendix F

NPDES Stormwater Program

The NPDES Stormwater Program is a product of the CWA. The CWA's goal is to control water pollution by regulating point sources (e.g., pipes, ditches) that discharge pollutants into navigable waters. The CWA makes it unlawful to discharge any pollutant from a point source into navigable waters unless a permit is obtained.[499] The NPDES program regulates stormwater discharges directly into surface waters from three potential sources: municipal separate storm sewer systems (MS4s), construction activities, and industrial activities.[500] While the EPA retains ultimate authority over the NPDES program, North Carolina was delegated the authority to administer NPDES permitting.[501]

The NPDES program requires permits for: (1) industrial activities in 10 enumerated categories,[502] (2) construction activities that disturb one acre or more of land, and (3) municipalities and other public entities that own or operate a municipal separate storm sewer system (MS4).[503] Depending on the particular project, activities may be authorized under a General Permit or may require an Individual Permit. Permits are valid for five years, and facilities do not have to pay a permit renewal fee since the cost of renewal is included in a facility's annual fee.[504] Permit conditions typically require that the facilities monitor their discharges and provide periodic reports to DWR.[505]

State Stormwater Program

The state stormwater program is comprised of multiple state-mandated "post-construction" stormwater management control programs.[506] The programs apply to most development activities within the coastal counties and include coastal stormwater, nutrient sensitive waters, high quality/outstanding resource waters programs, and CWA Section 401 water quality certifications.

In 2008, the rules regulating stormwater in the coastal counties were revised to strengthen existing protections.[507] A state stormwater permit is currently required for: (1) any activity that requires a CAMA Major Permit or an Erosion and Sedimentation Control (E&SC) plan and meets any of the remaining criteria of location in one of the coastal counties, (2) drainage to Outstanding Resource Waters (ORW), or (3) location and drainage within a one-mile radius of High Quality Waters (HQW).[508] All non-residential activities in the 20 coastal counties that add more than 10,000 square feet of built-upon area and all residential activities that require a CAMA Major Permit or E&SC plan are subject to the coastal stormwater restrictions.[509] Some activities may be authorized under a general permit, [510] while others require individual permits. All initial permits require a fee, and depending on the type of project or permit, some permits also require a renewal fee.[511]

To limit the volume of polluted stormwater leaving a site,[512] stormwater permits typically require the use of Best Management Practices (BMPs) through the minimization of the built-upon area, on-site storage of stormwater, and treatment or elimination of stormwater. BMPs include both structural devices designed to capture, treat and eliminate stormwater runoff (e.g., permeable pavements, bio-retention and infiltration basins[513]), and non-structural administrative commitments (e.g., vehicle spill control and housekeeping practices).

Nutrient Management Strategies

In the 1990s, the increasing number of fish kills and algae blooms in the Neuse and Pamlico estuaries led the EMC to classify the Neuse and Tar-Pamlico basins as Nutrient Sensitive Waters (NSW) and set a goal to reduce the amount of nutrient loads to these basins. To achieve and maintain this reduction in nutrients and to provide control for peak stormwater flows, basin-wide stormwater requirements were promulgated. Municipalities and counties administer these requirements.

The Neuse Nutrient Management System requires preservation of riparian buffer areas to preserve their nutrient processing functions, as well as implementation of stormwater BMPs specifically designed to reduce the input of nitrogen into surface waters.[514] In addition to nitrogen stormwater BMPs, the Tar-Pamlico strategy also requires BMPs to reduce phosphorus.[515] These local programs mandate public education, maintenance of BMPs, and enforcement and compliance of rules, but communities typically do not have the resources for maintenance and enforcement.

Another component of the nutrient reduction strategy is the protection of existing riparian buffers within these basins. The Protection and Maintenance of Existing Riparian Buffers was first established in 1997 in the Neuse Basin and in 2000 in the Tar-Pamlico Basin. In 2011, the buffer rules applicable to single-family residences on existing lots in eight coastal counties were revised to allow construction of homes within the buffer, as long as a structure is at least 30 feet landward of the normal water level or normal high water level.[516] Prior to this change, any residential structure was required to be at least 50 feet landward of the normal water level, normal high water level, or the landward limit of the coastal marsh, whichever was more restrictive.

Clean Water Act Section 401

The management of stormwater is also addressed through 401 water quality certifications.[517] Section 401 of the CWA provides that states are required to issue water quality certification on projects that require any federal permit or license and that may result in a discharge into navigable waters or that has the potential to affect surface water and wetland standards developed by the State.[518] Water quality certifications are issued by DWR to verify that the permitted activity will not cause a degradation or "loss of use" of those surface waters or wetlands for their classification. DWR cannot issue a permit for an activity that would result in a loss of existing and anticipated uses. The 401 water quality certification program's requirements mirror the state's stormwater program.

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[499] 33 U.S.C. §§ 1251–1387 (2006 & Supp. 2012); *see also Summary of the Clean Water Act*, U.S. Envtl. Protection Agency, http://www.epa.gov/regulations/laws/cwa.html (last updated July 26, 2013).

[500] *Stormwater Program*, U.S. Envtl. Protection Agency, http://cfpub.epa.gov/npdes/home.cfm?program_id=6 (last updated Feb. 16, 2012).

[501] *See Authorization Status for EPA's Stormwater Construction and Industrial Programs*, U.S. Envtl. Protection Agency, Office of Wastewater Mgmt., http://cfpub.epa.gov/npdes/stormwater/authorizationstatus.cfm (last updated Apr. 16, 2012).

[502] Included are activities such as mineral industry, landfills, hazardous waste, steam electric plants, transportation, construction, treatment works, and light industry. For a complete list, see *Who is subject to the NPDES Storm Water Program?*, N.C. Dep't of Env't and Natural Res., http://portal.ncdenr.org/c/document_library/get_file?uuid=4043e042-5662-4ede-a1bf-6533a150a100&groupId=38364 (last updated Dec. 30, 2008).

[503] *See Permit* Directory, N.C. Dep't of Env't and Natural Res., http://portal.ncdenr.org/web/deao/permit-directory/#N (last vitied Aug. 23, 2013). *See* also 15A N.C. Admin. Code 2H.0126 (2012) (adopting EPA's NPDES Regulations found at Part 122 of Title 40 of the Code of Federal Regulations). An MS4 is a conveyance or system of conveyances that is: (1) owned by a state, city, town, village or other public entity that discharges to waters of the United States; (2) designed or used to collect or convey stormwater (including storm drains, pipes, ditches, etc.); (3) not a combined sewer; and (4) not part of a Publicly Owned Treatment Works (sewage treatment plant). 40 CFR § 122.26(b)(8) (2012).

[504] *See Permit Directory: NPDES Stormwater Permit*, N.C. Dep't of Env't and Natural Res., http://portal.ncdenr.org/web/deao/permit-directory/#N (select "NPDES (National Pollution Discharge Elimination System) Stormwater Permit" link) (last visited Aug. 21, 2013); *Permit Fees*, N.C. Dep't of Env't and Natural Res., Div. of Water Res., http://portal.ncdenr.org/web/wq/ws/su/fees (last visited Aug. 21, 2013).

[505] Conservation Council of N.C. Found., See No Evil: Why Our Environmental Laws Aren't Being Enforced 24 (2002), *available at* http://nclcvf.org/assets/SNEfinal.pdf.

[506] 15A N.C. Admin. Code 2H.1001–1020 (2012).

[507] *See* 2008 N.C. Sess. Laws 211.

[508] 15A N.C. Admin. Code 2H.1003(b) (2012); *Permit Directory: State Stormwater Permit (Individual and General Permits)*, N.C. Dep't of Env't and Natural Res., http://ncdenr.gov/web/deao/permit-directory/#S (select "State Stormwater Permit (Individual and General Permits" link) (last visited Aug. 21, 2013).

[509] 2008 N.C. Sess. Laws 211 § 2.(b).

[510] For examples of General Permits, see *State Stormwater Forms & Documents*, N.C. Dep't of Env't and Natural Res., Div. of Water Res., http://portal.ncdenr.org/web/wq/ws/su/statesw/forms_docs (select "General Permits" tab) (last visited Aug. 21, 2013).

[511] *Permit Fees*, N.C. Dep't of Env't and Natural Res., Div. of Water Res., http://portal.ncdenr.org/web/wq/ws/su/fees (last visited Aug. 21, 2013). All state stormwater permits have a $505 application fee, but low-density projects (with no engineered BMPs) do not expire while high-density projects (with engineered BMPs) are valid for up to eight years and subject to a renewal fee of $505. *Permit Directory: State Stormwater Permit (Individual and General Permits)*, N.C. Dep't of Env't and Natural Res., http://ncdenr.gov/web/deao/permit-directory/#S (select "State Stormwater Permit (Individual and General Permits" link) (last visited Aug. 21, 2013).

[512] Note that large or intense events can overwhelm BMPs, leading to untreated stormwater bypassing capture or treatment.

[513] N.C. Dep't of Env't and Natural Res., Div. of Water Quality, Stormwater Best Management Practices Manual 1-1 to 1-3 (2007), *available at* http://portal.ncdenr.org/c/document_library/get_file?uuid=269b96b4-f8e8-4b6c-b620-19d3b3e708e3&groupId=38364. Infiltration practices can address stormwater volume and quality by retention. However, shallow water tables across much of the inner coast limit the use of infiltration practices, causing a reliance on retention for treatment. Telephone Interview with Dr. Eban Bean, Assistant Professor, Department of Engineering, East Carolina University (May 13, 2013).

[514] *See* 15A N.C. Admin. Code 02B.0233.

[515] *See* 15A N.C. Admin. Code 02B.0259.

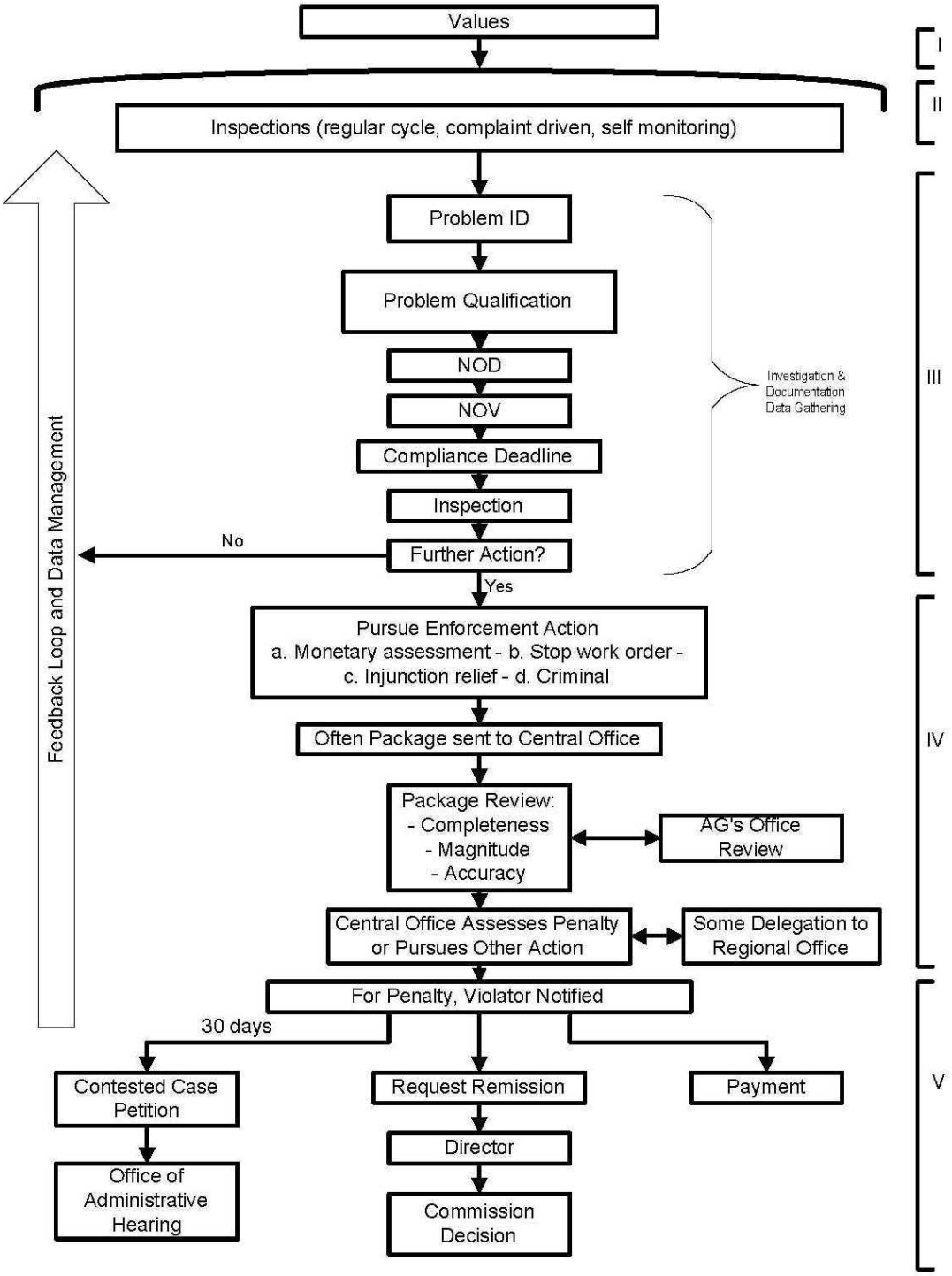
[516] 2011 N.C. Sess. Laws 394 § 17.(c).

[517] Outside of the coastal counties, the most common mechanism for stormwater protection is the 401 certification program.

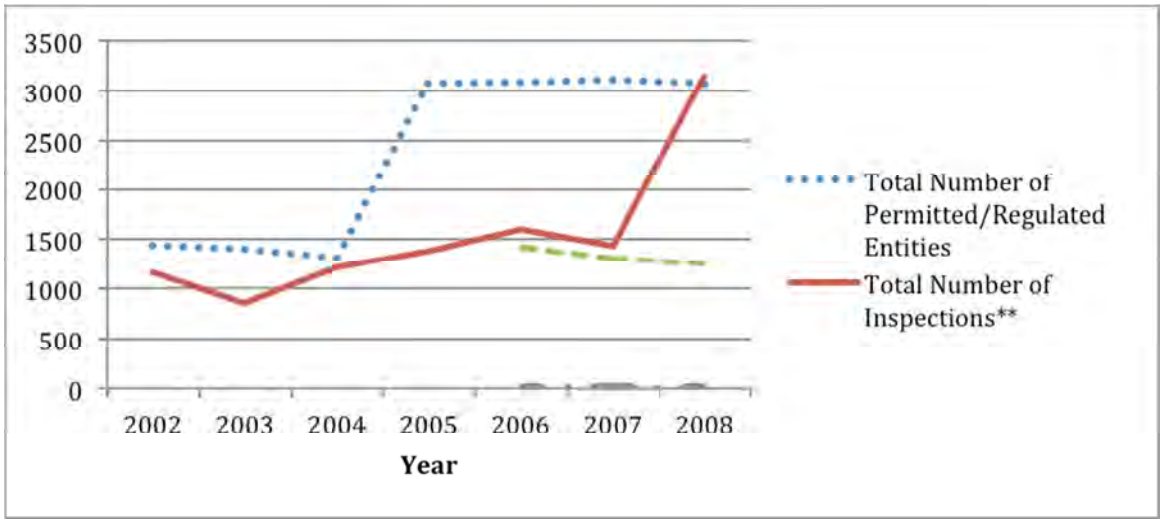
[518] *See* 33 U.S.C. § 1341 (2006); 40 C.F.R. §§ 131.1–131.22 (2012).

Appendix G

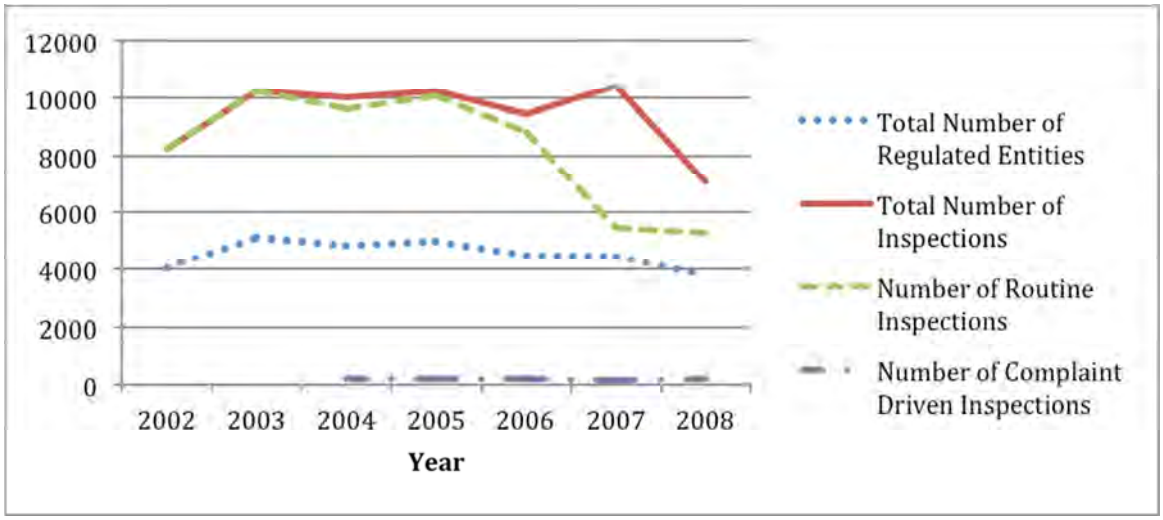
Generic DENR Enforcement Process[519]



DCM Inspections of Permitted and Regulated Entities[520]

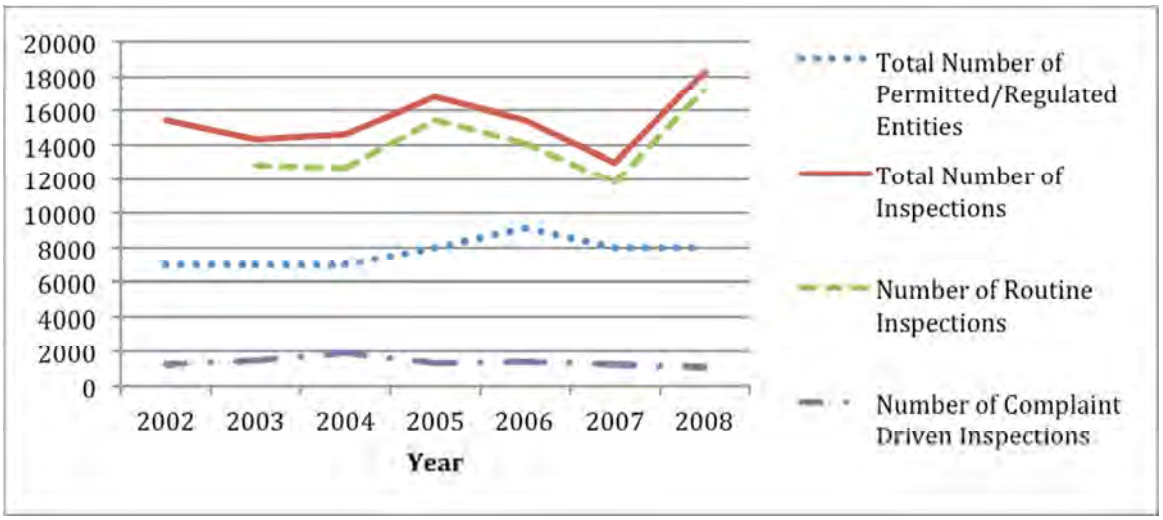


Inspections of Permitted and Regulated Entities - NPDES[521]

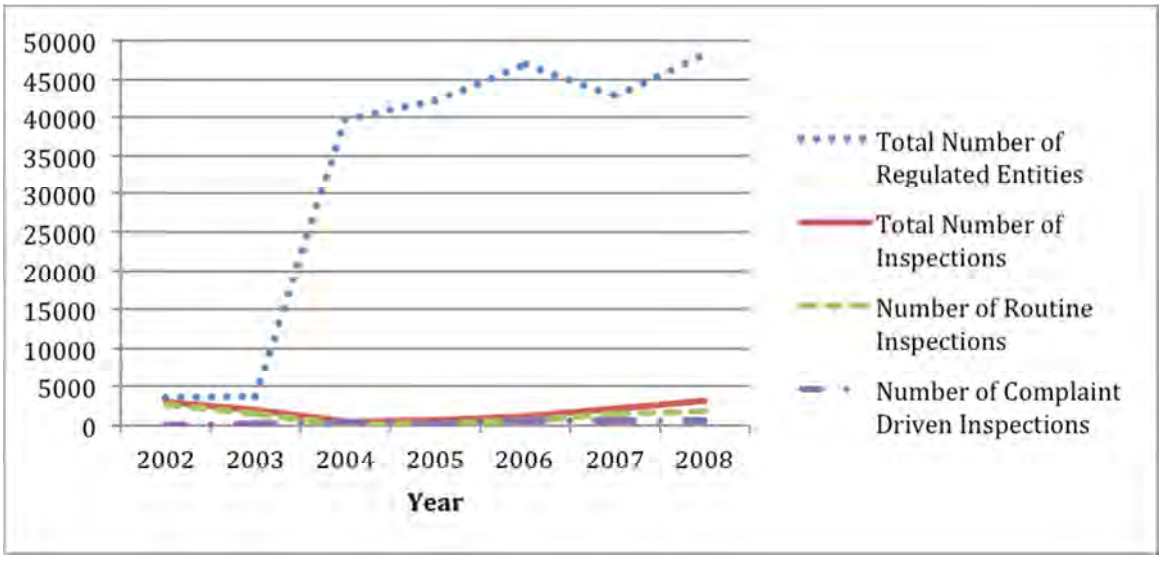


** This refers only to field inspections, not reviews of discharge reports.

Inspections of Permitted and Regulated Entities – Stormwater/Non-Point Source[522]



Inspections of Permitted and Regulated Entities – Erosion and Sediment Control



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[519] N.C. Dep't of Env't and Natural Res., Enforcement Assessment 2000 5, *available at* http://www.enr.state.nc.us/novs/enforce2.pdf.

[520] Data taken from DENR Compliance Reports 2002–2008. *See Departmental Enforcement*, N.C. Dep't of Env't and Natural Res., http://portal.ncdenr.org/web/guest/enforcement/departmental-enforcement (last visited Aug. 22, 2013) (select individual Compliance Report links).

[521] *Id.* These totals include NPDES permitting for municipal wastewater treatment plants, industrial wastewater treatment plants, package wastewater treatment plants, and single-family residences. In addition, the number of inspections for the year 2000 included both field inspection and review of Daily Monitoring Reports; the remaining data represents field inspections only.

[522] *Id.* These totals include entities regulated under the Nutrient Sensitive Waters buffer rules program, the State stormwater program, the CWA section 401 certification program, and activities that impact wetlands and streams.

Appendix H

Wastewater Infrastructure Funding Options

Collection system owners that prefer to conduct operation and maintenance activities without incurring debt have two options: (1) special reserve funds; and (2) a "pay as you go" approach. System owners can establish special reserve funds for repair and replacement of equipment.[523] For example, these funds could come from a portion of user fee revenues that are specifically set aside to address system problems resulting in a sewer overflow.[524] While having funds available for immediate use is a benefit, the funding level is limited and, therefore, usually is not used for major upgrades or equipment replacement. The "pay as you go" approach relies on annual taxes, water and sewer fees and other types of revenue (except loans).[525] These taxes and fees are usually collected in advance of project construction. While this option has the advantage of avoiding long-term debt for the community, it does require a large initial capital investment.[526]

Non-Debt Incurring Options

Bonds are promissory notes sold by utilities or local governments to raise funds for construction projects. Bonds tend to offer the greatest flexibility in financing collection system repairs and upgrades, with 20-year retirement schedules. The EPA fact sheet on SSO abatement financing provides a thorough overview of the different types of bonds that may be available to utilities and local governments in coastal North Carolina, such as general obligation bonds and revenue bonds.[527]

Low-interest loans are another option. Loans can be obtained from the State Revolving Fund (SRF) program, commercial lending institutions and the Rural Utilities Service. The SRF is a federally subsidized program that operates at the state level. According to the EPA, all 50 states and Puerto Rico have SRF programs. The major benefits to pursuing an SRF loan are no-interest and low-interest loans and skilled program staff that can assist applicants through the process. However, both loan amounts and the number of loans can be limited for two reasons: (1) they are not available for non-capital infiltration and inflow activities; and (2) loan applications tend to be reviewed on an annual or semi-annual basis, which requires advanced planning by the loan applicant.[528]

The last loan option is through a commercial lending institution. While commercial loans are widely available, they are not often used for capital improvement projects because utilities and local governments usually prefer to exhaust lower interest rate options before applying for a commercial loan. While the application process for a commercial loan may be faster than the other options discussed, with negotiable terms and rate and no set limits on the amount of the loan, there are limitations. The first, and most obvious, is that commercial loans typically come with interest rates higher than the other options, and they can be difficult to obtain without adequate collateral. For smaller utilities, municipalities and counties seeking to finance major capital improvements, both limitations present significant obstacles.[529]

The Local Government Commission (LGC), a division of the Department of State Treasurer, plays an additional critical role. Established by section 159-3 of the General Statutes, the LGC approves debt for all units of local government and assists them with fiscal management and debt

management.[530] This means that local governments must obtain LGC approval before borrowing money, including loans and bonds. During the approval process, the LGC takes into account whether the amount being borrowed is adequate and reasonable for the projects the local government unit is proposing, and whether the government unit can reasonably afford to repay the debt.[531] Once the LGC approves the local government unit's ability to borrow the money, it is then responsible for selling the debt or bonds on the unit's behalf.[532]

Federal Funding Options

This section will summarize federal funding options that are available for financing water and wastewater infrastructure. In the 1970s and 1980s, grant funding was more readily available for water and wastewater projects and other capital improvement projects. However, the more recent trend has been for the federal government to shift funds reserved for grants to the SRF and other local funding programs. Grants are a popular option, but they do have limitations. A major benefit is that grants do not need to be repaid, but most grant programs offer funding that is too low to fund an entire project or even a significant portion of it. In addition, grants usually have limitations on how the money may be spent, and are accompanied by increased administrative costs due to the lengthy and competitive application process. Grants also can be an unreliable source of funding due to their competitive nature. However, grants remain a viable funding source and are available through the USDA's Rural Utilities Loan Service (RUS) Grant Program, the Community Development Block Grant (CDBG) Program, EDA Grant Program and state grant programs.[533]

While the federal government first began providing financial assistance for wastewater facilities in the 1950s, it created a more robust grant program after the CWA was enacted. From the 1970s until the early 1980s, federal grants – primarily funded through EPA – provided up to 85 percent of the construction cost of wastewater treatment facilities. In the 1980s, support for these federal grant programs receded. As grant programs were reduced or eliminated, they were replaced by the SRF program, which requires a 20 percent state match. EPA is the primary funder of the SRF; in North Carolina, DENR is the state agency in charge of administering these funds. More details about this program are included in the next section on state funding entities. Although federal funding has been reduced, North Carolina has made efforts to fill this gap. Examples include the North Carolina Revolving Loan and Grant Program that was created by the General Assembly in 1987, the 1993 Clean Water Bond Bill, the 1998 Clean Water Bond Act, the creation of the Clean Water Management Trust Fund (CWMTF) in 1996 (infrastructure grant funds previously available through the CWMTF are now administered by DWI), and programming previously available from the Rural Center to assist low-wealth communities with water and sewer needs.

The RUS provides direct or guaranteed loans to communities with populations of 10,000 or fewer that are unable to obtain loans from commercial institutions at reasonable interest rates. This program is a particularly attractive option for North Carolina's numerous rural coastal communities. In addition to loan assistance, the RUS also provides grants, technical assistance and educational materials. The RUS has specific programs for both guaranteed and direct loans for water and waste disposal projects.[534] Funds are available to public bodies, non-profit institutions and Indian tribes, and applications are accepted on a continuing basis through the Rural Development's state and area offices. In North Carolina, the state office is located in Raleigh, and area offices serving the coastal counties are located in Bolivia, Kinston, Winton and Greenville.[535] While the RUS does offer lower interest rates than commercial loans or bonds with repayment between 20 and 40 years, loan applicants must first qualify for a lower rate. In the event the

applicant does not qualify for any of the lower rate categories, then the applicant could explore the SRF or other state loan programs that may offer an interest rate lower than the RUS.[536]

The EDA, a bureau of the U.S. Department of Commerce, also provides grants for water and wastewater infrastructure through its Public Works and Economic Adjustment programs. These types of grants are usually included as part of larger economic development projects, however, rather than being the focus of a project. The Public Works program funds projects with a focus on revitalization and expansion of physical infrastructure in communities in order to attract new businesses and diversify local economies, while the Economic Adjustment program focuses on funding strategies that will bring about change to an economy that is under threat from "serious structural damage" to the community's economic base.[537]

State Funding Options – Current and Historic

This section will summarize the state-level funding options for wastewater infrastructure improvements. North Carolina historically has had multiple funding entities administered the various loan and grant programs, including DENR, N.C. Department of Commerce and the CWMTF. Much of this changed in 2013, however, when the General Assembly consolidated wastewater infrastructure loan and grant administration into a single entity, DWI. These legislative changes to DENR transferred functions and duties previously within the Divisions of Water Resources and Water Quality and other state government entities to the newly established DWI and SWIA.[538] Since DWI and SWIA are still in their infancy, below is a short summary of state-level programming regarding wastewater infrastructure financing that has been transferred to DWI and SWIA.

Prior to the legislative changes that occurred in 2013, the Infrastructure Finance Section (IFS) and Public Water Supply Section (PWSS) of the DENR Division of Water Resources administered funding for water and wastewater infrastructure. However, each section had a different purpose. The IFS's purpose was to preserve, protect and enhance water resources, while the purpose of the PWSS was to provide safe drinking water through guidance and technical and financial assistance to local governments and certain non-profit water corporations. The IFS assisted local governments and tribes through low-interest loans and grants for wastewater treatment projects through the administration of three funding programs: the Clean Water SRF program,[539] the N.C. Clean Water Revolving Loan and Grant Program, and the State and Tribal Assistance Program. The types of projects funded under the IFS were publicly owned sewer collection, wastewater treatment and clean water green infrastructure.

The N.C. Department of Commerce has two relevant programs that previously funded infrastructure improvements, but their focus is on low-wealth communities: (1) the Division of Community Assistance (DCA); and (2) the Commerce Finance Center (CFC). The role of the DCA is to provide resources and services that will assist communities in planning for growth and economic development. The DCA provides assistance in a number of ways, including helping communities revitalize their downtown areas or upgrade their infrastructure and administering the "small cities" portion of the U.S. Department of Housing and Urban Development's CDBG program.[540] The CFC provides low-wealth and economically distressed communities with information on financing programs, such as tax credits and other incentives, available to companies considering locating or expanding in North Carolina. The CFC also administers the CDBG Program for Economic Development.[541] DWI now administers the infrastructure portion of CDBG funding for the State of North Carolina.[542]

Outside of DENR, funding was available through Rural Center programs until 2013. State funding has been eliminated for the organization, and the new RIA has been established to administer programs to assist rural communities. Nevertheless, for the sake of completeness, it is helpful to describe how Rural Center funding was used in the past to assist rural areas in addressing wastewater infrastructure challenges. The Rural Center had two competitive grant programs that focus on clean water: (1) a construction grants program and (2) a planning grants program. The construction grants program is a supplemental program designed to help rural communities construct water and sewer improvements.[543] This program was created in 2007 and received appropriations from the General Assembly in 2007 and 2008. Funding was available only for construction projects that would address a critical infrastructure issue, and documentation of the critical infrastructure issue was required. Local governments, as defined in subsection 159-7(15) of the General Statutes,[544] were eligible for grant funds. A one-to-one match also was required, meaning that the grant would fund only up to half the cost of the project, unless the applicant fell under an exception.[545] Eligible construction costs included water line and sewer line upgrades and extensions; construction, upgrade or expansion of a sewer facility; and construction of a wastewater land application system or a wetlands wastewater treatment system.[546] The planning grants program provided funding to assist communities in their planning for water and sewer improvements. Funds were used in planning activities that prepared the community or district for their construction activities. Similar eligibility rules applied, including the one-to-one financial match (with exceptions[547]) and documented need for the project.[548]

A success story for the financing of water and sewer infrastructure is the 1998 Clean Water Bonds. In 1998, a referendum was approved for $800 million in bonds for water and sewer projects. These bonds provided a much-needed funding pool for North Carolina's water and sewer infrastructure and provided financial assistance to many low-wealth communities to make repairs or upgrade their infrastructure. The Clean Water Bonds accounted for 30 percent of "all water and sewer investments in North Carolina by state and federal sources" until June 2005.[549] Of North Carolina's 100 counties, 97 of them received a bond-funded grant or loan for one or more projects. Also, rural areas benefitted from 75 percent of all projects financed by the bond initiative. Bond initiatives can promote economic development – for example, projects financed by the Clean Water Bonds helped create or retain approximately 42,000 jobs, most of them in economically distressed communities.[550]

Another state-level program that previously provided funding for wastewater infrastructure is the CWMTF. Established by the General Assembly in 1996, the CWMTF is a competitive grant program that issues funds to local governments, state agencies and conservation-based nonprofit organizations to help them "finance projects that specifically address water pollution problems and focus on upgrading surface waters, eliminating pollution and protecting, preserving and conserving unpolluted surface waters, including enhancement or development of drinking water supplies."[551] The grant application process takes place on an annual basis. Until 2013, the CWMTF provided funds for several categories of activities, including wastewater infrastructure and planning.[552] In addition, the CWMTF had a mini-grant program that operates on a continuing basis to help grant recipients prepare and plan for large projects.[553] Wastewater infrastructure-related grants are no longer administered by the CWMTF and are now administered by DWI.[554]

A final state-level entity that provides some level of financial assistance for wastewater infrastructure, even if only on a minor level, is the Golden Leaf Foundation. The foundation,

created by the General Assembly in 1999 to administer half of North Carolina's portion of the settlement agreement reached with cigarette manufacturers, provides economic impact assistance to economically impacted tobacco-dependent communities pursuant to the settlement agreement.[555] This impact assistance can include funding for water and wastewater infrastructure projects. The foundation does not have a funding program specifically for infrastructure, though this type of project is typically included as a component of the larger funding application submitted by the community.[556]

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[523] U.S. Envtl. Protection Agency, Financing Capital Improvements for SSO Abatements 3, *available at* http://www.epa.gov/npdes/pubs/sso_casestudy_finance.pdf (last visited Aug. 11, 2013).

[524] *See id.*

[525] *See id.*

[526] *See id.*

[527] *See id.* at 7–9.

[528] *See id.* at 11–13.

[529] *See id.* at 14.

[530] 20 N.C. Admin. Code 3.0101.

[531] *See generally id.* 3.0401–.0408 (rules regarding accounting and internal controls).

[532] *See generally id.* 3.0301–.0305 (rules regarding sale and delivery of bonds and notes).

[533] *See* U.S. Envtl. Protection Agency, Financing Capital Improvements for SSO Abatements 15-16, *available at* http://www.epa.gov/npdes/pubs/sso_casestudy_finance.pdf (last visited Aug. 11, 2013).

[534] *See Rural Development Loan Assistance*, U.S. Dep't of Agric., Rural Dev't, http://www.rurdev.usda.gov/RD_Loans.html (last updated July 5, 2013).

[535] *See USDA Rural Development Offices and contacts in North Carolina*, U.S. Dep't of Agric., Rural Dev't, http://www.rurdev.usda.gov/nc/whoweare.htm (last updated July 8, 2013).

[536] *See* U.S. Envtl. Protection Agency, Financing Capital Improvements for SSO Abatements 12-13, *available at* http://www.epa.gov/npdes/pubs/sso_casestudy_finance.pdf (last visited Aug. 11, 2013).

[537] *EDA Investment Programs*, U.S. Econ. Dev't Admin., http://www.eda.gov/programs.htm (last visited Aug. 12, 2013); *see also* U.S. Envtl. Protection Agency, Financing Capital Improvements for SSO Abatements 15-16, *available at* http://www.epa.gov/npdes/pubs/sso_casestudy_finance.pdf (last visited Aug. 11, 2013).

[538] 2013-360 N.C. Sess. Laws 217-218.

[539] Under the Clean Water SRF, Congress provides the states with grant funds to establish revolving loan programs to assist in the funding of wastewater treatment facilities and projects associated with estuary and nonpoint source programs. North Carolina is required to provide 20 percent matching funds. These funds are then made available to local governments at one-half of the market rate for a period of up to 20 years. The term of the loan is determined by the State Treasurer's Office. *See Clean Water State Revolving Fund (CWSRF)*, N.C. Div. of Water Resources, http://portal.ncdenr.org/web/wq/ifs/fap/cwsrf (last visited Aug. 12, 2013).

[540] *Community Development*, N.C. Dep't of Commerce, http://www.nccommerce.com/cd (last visited Aug. 12, 2013); *Community Development Block Grants*, N.C. Dep't of Commerce, http://www.nccommerce.com/communitydevelopment/investment-assistance (last visited Aug. 12, 2013).

[541] *Commerce Finance Center*, N.C. Dep't of Commerce, http://www.thrivenc.com/incentives/financial/commerce-finance-center (last visited Aug. 12, 2013); *Economic Development*, N.C. Dep't of Commerce, http://www.nccommerce.com/communitydevelopment/investment-assistance/grant-categories/economic-development (last visited Aug. 12, 2013).

[542] "*Community Development Block Grants*, N.C. Dep't of Env't and Nat. Res., Div. of Water Infrastructure, http://portal.ncdenr.org/web/wi/cdbg (last visited Jan. 10, 2014).

[543] *See Clean Water Partners Infrastructure Program Supplemental Construction Grants*, N.C. Rural Econ. Dev't Ctr., http://www.ncruralcenter.org/index.php?option=com_content&view=article&id=109:ws-construction-grants&catid=48&Itemid=231 (last visited Aug. 12, 2013).

[544] " 'Unit,' 'unit of local government,' or 'local government' is a municipal corporation that is not subject to the State Budget Act (Chapter 143C of the General Statutes) and that has the power to levy taxes, including a consolidated city-county, as defined by G.S. 160B-2(1), and all boards, agencies, commissions, authorities, and institutions thereof that are not municipal corporations." N.C. Gen. Stat. § 159-7(15).

[545] *See Clean Water Partners Infrastructure Program Supplemental Construction Grants*, N.C. Rural Econ. Dev't Ctr., http://www.ncruralcenter.org/index.php?option=com_content&view=article&id=109:ws-construction-grants&catid=48&Itemid=231 (last visited Aug. 12, 2013). Exceptions existed for (1) Tier 1 (most distressed) counties; (2) units of local government with a poverty rate that is 150 percent of the statewide rate; and (3) units with an ability-to-pay score less than half the county's score. *See id.*; *see also 2009/2010 Round 2 Rural Towns and Counties with Qualifying Indicators*, N.C. Rural Econ. Dev't Ctr., http://www.ncruralcenter.org/images/PDFs/Loansgrants/indicators%20for%20rd%205%20website%20version051010.pdf (May 6, 2010) (table showing qualifying exceptions for selected towns).

[546] *See Clean Water Partners Infrastructure Program Supplemental Construction Grants*, N.C. Rural Econ. Dev't Ctr., http://www.ncruralcenter.org/index.php?option=com_content&view=article&id=109:ws-construction-grants&catid=48&Itemid=231 (last visited Aug. 12, 2013).

[547] The exceptions are the same as those listed above, for the Construction Grants Program. *See Clean Water Partners Infrastructure Program Planning Grants*, N.C. Rural Econ. Dev't Ctr., http://www.ncruralcenter.org/index.php?option=com_content&view=article&id=111:ws-planning-grants&catid=48&Itemid=230 (last visited Aug. 12, 2013).

[548] *See id.*

[549] N.C. Rural Econ. Dev't Ctr., Water 2030 Report 1: Impact of 1998 Clean Water Bonds 1 (2004), *available at* http://www.ncruralcenter.org/images/PDFs/Water2030/impactofbonds.pdf.

[550] *See id*.

[551] N.C. Gen. Stat. § 113A-251; *see also About the Clean Water Management Trust Fund*, Clean Water Mgmt. Trust Fund, http://www.cwmtf.net/#about.html (last visited Aug. 12, 2013).

[552] *See* N.C. Gen. Stat. § 113A-253(c)(5), (8).

[553] *See For Applicants*, Clean Water Mgmt. Trust Fund, http://www.cwmtf.net/#appmain.htm (last visited Aug. 12, 2013).

[554] *See* 2013 N.C. Sess. Laws 360, 189-190 (codified as amended at N.C. Gen. Stat. § 113A-253.

[555] *See Charter*, Golden LEAF Found., http://www.goldenleaf.org/charter.html (last visited Aug. 12, 2013); *About Us*, Golden LEAF Found., http://www.goldenleaf.org/about.html (last visited Aug. 12, 2013).

[556] *See Initiatives: Community Assistance Initiative*, Golden LEAF Found., http://www.goldenleaf.org/initiatives.html#cai (last visited Aug. 12, 2013).

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