ACTION PLAN FOR NATURE-BASED STORMWATER STRATEGIES:

Promoting Natural Designs that Reduce Flooding and Improve Water Quality In North Carolina

MARCH 2021

The lovely aesthetics of River Bluffs in Castle Hayne, N.C. result from nature-based stormwater design being incorporated throughout the site. These stormwater measures help make it a walkable park-like neighborhood while preventing flooding and protecting water quality.

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Executive Summary

North Carolinians are increasingly affected by damage and disruptions from flooding. To solve this problem, state leadership, local governments, landowners and businesses are embracing innovative development and planning approaches that employ or replicate nature to soak up rainwater and reduce stormwater runoff.

Now, that support must be put into action across the state, from the coast to the mountains, and across landscapes, from farms to dense cities. The Action Plan for Nature-Based Stormwater Strategies was developed by the North Carolina Coastal Federation with input from four expert work groups focusing on opportunities for use of nature-based stormwater strategies in new development, stormwater retrofits, roadways and working lands. The Action Plan puts forward the following recommendations, and critical first steps that the state government, communities, businesses and nonprofits can take to make North Carolina more resilient and improve water quality.

Cross-Cutting Recommendations:

As the four work groups considered how to address these impediments at the state, local and project-specific level, four recommendations were identified and encouraged across those discussions.

1. State and local governments need to lead by example by promoting the use of nature-based stormwater strategies and implementing them widely where practicable.
2. Increase education, outreach and professional training for nature-based stormwater and watershed management strategies.
3. Create a Nature-Based Stormwater Steering Committee to ensure continued stakeholder engagement and leadership in support of long-term, meaningful progress.
4. Establish effective watershed management that focuses on protecting, restoring or mimicking natural water systems to reduce flooding and improve water quality.

Critical First Steps:

With this action plan in hand, over the next year the organizations and stakeholders engaged in this planning effort intend to focus on a number of initial steps that will be necessary to accomplish these outcomes.

1. Develop a comprehensive watershed management framework.
2. Conduct an economic study on costs and benefits of nature-based stormwater strategies in North Carolina.
3. Promote demonstration projects that exemplify the value of nature-based stormwater strategies with real world projects.
4. Provide accurate information on maintenance cost for nature-based stormwater strategies and amend the stormwater design manual to include this data.
5. Streamline modifications to existing post construction stormwater permits to encourage use of nature-based stormwater strategies.
6. Advance state and local policies promoting nature-based stormwater strategies.
7. Form the Action Plan Steering Committee to spearhead efforts to move forward with recommendations in this Action Plan.
8. Establish a work group to coordinate future planning for education and outreach.
9. Organize North Carolina Department of Transportation (NCDOT) work group to tackle NCDOT's priority actions, including updating its toolbox to more fully include nature-based stormwater strategies.
10. Educate the North Carolina Congressional delegation on opportunities to substantially increase the amount of financial resources for working lands and conservation coming from the federal Farm Bill and other federal programs.

Permeable paving grids were installed as part of a Town capital improvement project in Swansboro, N.C. The grids allow the newly constructed parking lot to infiltrate rain instead of generating stormwater runoff. © NORTH CAROLINA COASTAL FEDERATION

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Due to the COVID-19 pandemic, the work groups met for many hours virtually and provided written input and feedback over the course of 2020 to develop a strategic set of findings and recommendations for advancing nature-based stormwater strategies.

Recommendations contained in this Action Plan are made by the North Carolina Coastal Federation. Every effort has been made to reflect the philosophies, knowledge and expertise contributed by work group participants. Their guidance and insights shaped and directed the content of this Action Plan.

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Community members join together to build a rain garden in Swansboro, N.C. Rain gardens are shallow depressions that collect stormwater to reduce the volume of rain that contributes to localized flooding and surface water degradation. © NORTH CAROLINA COASTAL FEDERATION

Introduction

This is a watershed moment in North Carolina. North Carolinians, from the coast to the mountains, and across landscapes, from farms to dense cities, are increasingly affected by damages and disruptions from flooding. More rain means more water running off the land, carrying pollutants and debris into rivers and to the coast. Federal and state leadership, local governments and businesses are embracing innovative development and planning approaches that employ or replicate nature to soak up rainwater and reduce stormwater runoff. Now, that support must be put into action across the state.

North Carolina's leaders have already taken bold action to address flood risk, but there is still work to do. The N.C. General Assembly has appropriated more than $1.4 billion in recent years to state recovery from repeated hurricanes and extreme weather events.[1] Lawmakers have worked with the Governor's office to create the North Carolina Office of Recovery and Resiliency (NCORR), to administer disaster recovery throughout the state.

Building on these recovery efforts, Gov. Roy Cooper's Executive Order 80 in 2018 committed to improving statewide resilience to flooding and other climate hazards. Under this initiative, cabinet agencies developed a Climate Risk Assessment and Resilience Plan that evaluates the state's vulnerability to climate changes and discusses the best adaptation strategies.

The state has recognized that nature-based solutions are key to ensuring a more resilient future. North Carolina has set the stage to use nature-based stormwater strategies, especially to address localized flooding, by defining low-impact development[2] and runoff volume matching[3] as stormwater management options. Additionally, the North Carolina Climate Risk Assessment and Resilience Plan asserts that "the time to implement NBS (nature-based solutions) is *now* due to the time required to plan, implement and grow these solutions."[4] Nature-based stormwater strategies are not only an investment in cleaner water, reduced flood damages, and safer communities, but also in parks, preserving rural character, job creation, local businesses, and economic development.

The governor and lawmakers recognize the work to make the state more resilient is far from finished, and they need help from North Carolinians, statewide, to devise and carry out nature-based based solutions and adaptation measures. This process focused on nature-based stormwater strategies. Typically, these types of strategies work as part of the natural system to provide flood reduction and water quality benefits.

There are many terms to describe the concept of using natural features in design and planning across disciplines. Terms used in this plan include the following:

Nature-based solutions

Sustainable planning, design, environmental management and engineering practices that weave natural features or processes into the built environment to build more resilient communities.[5]

Low-impact development

Low-impact development (LID) also refers to systems and practices that use or mimic natural processes to retain and filter stormwater, but is specifically an approach to land development or redevelopment that works with nature to manage stormwater as close to its source as possible.[6]

Nature-based stormwater strategies

A subset of nature-based solutions, which are methods and practices that work with and enhance the natural capacity of landscapes to store, infiltrate convey and treat water.

In remarks made March 25, 2020, to stakeholders volunteering their time and expertise to this collaborative process, former North Carolina Department of Environmental Quality (DEQ) Secretary Michael S. Regan (nominated to be Administrator of the U.S. Environmental Protection Agency) charged work group members to devise recommendations that will help state leaders fashion policies and programs that will make our state less vulnerable to floods and improve water quality:

> *We have a responsibility to mitigate the damages caused by these storms and shifting weather patterns…and to make our communities more resilient.*
>
> *We have to rebuild stronger and smarter and ensure we can withstand the climate impacts of the future. What we know is that we have to act now. We cannot do the same old things and expect a different result. We have the opportunity to address flood risk and water quality and to make our communities safer.*
>
> *What you are doing today is critical to our state's success.*

For the nine months following the secretary's remarks, a diverse set of stakeholders with a wealth of experiences in land ownership and management, development, engineering, finance, government, farming, forestry, fishing as well as environmental management and restoration went to work. They concluded that:

> *The most cost-effective approaches to reduce flooding and protect water quality in North Carolina is to find practical and commonsense ways to protect, restore and mimic our state's natural watershed hydrology.*

This Plan recommends specific actions to maximize the benefits and cost-savings provided by nature-based stormwater strategies. The recommendations encourage collaborative, efficient approaches to design and siting for development, infrastructure and broader land use planning. To reduce flooding and improve water quality, the suggested actions promote a comprehensive strategy that works with nature to slow, reduce and treat stormwater runoff.

The Action Plan identifies guiding principles, recommendations and actions within a proposed framework of watershed management. A watershed is a drainage basin or an area of land that contributes water flow to the state's streams, creeks, rivers and coastal sounds and bays. A more holistic approach to planning that considers factors across a watershed will result in the cost-effective use of nature-based stormwater strategies to meet these challenges.

The four individual work groups examined opportunities to more effectively use these strategies to reduce flooding and water quality problems on four major types of major land uses in North Carolina:

- New development.
- Existing communities.
- Roadways and transportation infrastructure.
- Working lands such as agriculture and forestry.

As the work groups discussed or reviewed impediments to, and opportunities for, expanding the use of nature-

based stormwater strategies, they did not see a need to develop new regulatory standards to define nature-based stormwater requirements. Instead the work groups focused on ways to incorporate more practices and processes – both formal and informal – to advance the state's capacity to plan, design, construct and maintain stormwater practices that promote natural designs to reduce flooding and improve water quality.

Guiding Principles

Six distinct guiding principles emerged from all four work groups that framed their deliberations. The groups each agreed that:

- There are fewer flooding incidents and better water quality within watersheds where natural hydrology is protected, restored or simulated.
- Nature-based stormwater strategies are a cost-effective and sustainable way to reduce flooding and improve water quality when sited and designed correctly.
- Nature-based stormwater strategies provide social and economic benefits while reducing flooding and improving water quality.
- There is opportunity for the state and for communities to thoughtfully site and design nature-based stormwater strategies to address racial, income and other inequities.
- State and local government must lead by example in supporting nature-based stormwater strategies in ways that protect public health, safety and welfare.
- A comprehensive volume reduction-based watershed management strategy, implemented in a consistent and systematic way across North Carolina, would inform and support the cost-effective application of nature-based stormwater strategies at community and regional scales.

Cross-cutting Impediments

All four work groups identified numerous impediments that hinder the use of nature-based stormwater strategies. Some of these obstacles are unique to the land uses represented by each work group, while other constraints were universally identified. Specific impediments identified by the work groups are outlined in Appendix B. The key roadblocks are:

- **Lack of Awareness and Education:** Knowledge gaps and unfamiliarity with nature-based stormwater strategies among a wide diversity of important stakeholders impedes their use. These constituencies include landowners, developers, homeowners, regulators, lawmakers, agency staff, consultants, lenders, renters, farmers and foresters.
- **Inflexible Planning, Regulation and Policy:** Many state and local land use plans, regulations and policies were developed before the concept of nature-based stormwater strategies was conceived, and are not prepared in a way that facilitate or encourage the use of these measures. Additionally, some existing plans, rules and policies constrain the use of nature-based stormwater strategies by promoting site selections, designs, operations, and maintenance requirements that are counterproductive to the use of nature-based stormwater strategies.
- **Design Challenges:** Design planning frequently does not incorporate stormwater management early enough in the process to fully realize where and how nature-based stormwater strategies could be implemented. In many locations, limited space and soil types are frequently viewed as serious impediments due to lack of understanding by designers for how these nature-based strategies can be used in these types of locations. Lastly, understanding how to protect, restore or mimic natural rates and volumes of runoff is limited, and watershed plans that help to target management measures in a cost-effective manner have not been developed.
- **High Cost and/or Gaps in Funding:** Many stakeholders perceive that the cost of nature-based stormwater strategies is higher than conventional stormwater management measures, even when the opposite is often true, especially when considering the life cycle costs of such systems. A simple statewide cost comparison for design, construction and maintenance does not exist. There is limited funding allocated to operate and maintain all stormwater management systems, including those designed as nature-based strategies. Government programs to provide financial incentives and support for nature-based strategies are not adequately funded to meet demand.

- **Inadequate Operation and Maintenance:** Consistent guidance for operation and maintenance of all stormwater systems are lacking, including clarifying responsibility and assuring resources are available for long-term maintenance.
- **Lack of Monitoring and Evaluation:** There is no routine system in place to monitor and evaluate nature-based stormwater strategies. Monitoring for smaller devices and geographically dispersed systems require more oversight, which can be costly and time consuming.

Cross-cutting Recommendations

As the four work groups considered how to address these impediments at the state, local, and project-specific level, three recommendations were identified and encouraged across those discussions. These include:

1. **State and local governments need to lead by example by encouraging the use of nature-based stormwater strategies and implementing them widely.** The state and local governments need to consistently and systematically encourage the use of nature-based stormwater strategies when undertaking new government construction projects, making community infrastructure and housing investments, and by devising or amending state policies and procedures to facilitate increased use of these strategies. For example, use of nature-based stormwater strategies to restore impaired surface waters can become a policy priority. An element of this includes training for state and local agency staff and contractors.
2. **Increase education, outreach and professional training for nature-based stormwater and watershed management strategies.** State and local leadership, as well as associated professional and educational organizations, need to promote education and professional training on nature-based stormwater and watershed management strategies. These opportunities should be integrated into existing educational platforms, including degree or certificate programs and as part of required continuing education credits across sectors (i.e., developers, regulators, homeowners, surveyors, landscape architects, engineers, planners, municipal staff, attorneys, designers). The training should focus on how best to protect, restore or replicate natural watershed hydrology to reduce flooding and improve water quality, including the mechanics of hydrology such as the benefits of enhancing flood plains, infiltration and runoff lag times. This may also include creating an online repository of federal, state and local and non-governmental organizations (NGO) resources and tools in addition to raising awareness of existing resources. Additionally, state leadership can partner with nonprofits and universities to promote workforce development training for entry-level jobs installing and maintaining nature-based stormwater strategies.
3. **Create a Nature-Based Stormwater Steering Committee to ensure continued stakeholder engagement and leadership in support of long-term, meaningful progress.** A core group of community leaders, business owners, experts and other diverse stakeholders is needed to provide sustained leadership to promote, coordinate and guide Plan implementation. Staff and financial assistance need to be secured to support the work of this team of volunteer leaders. Eventually, this leadership could merge or expand by combining with either existing or new trade associations that benefit economically by encouraging the use of nature-based stormwater strategies.

Watershed-level Management

The four work groups' central recommendation calls for statewide effective watershed management that focuses on protecting, restoring or mimicking natural hydrology to concurrently reduce flooding and improve water quality. It is vital to develop watershed plans if nature-based stormwater strategies are to be used in the most cost-effective and strategic manner. The work groups found that focusing on both flood reduction and water quality enhancements in devising strategic nature-based measures are complementary and can ensure that both objectives are achieved. This is a major new concept since most watershed plans and management actions typically focus either on water quality or water quantity, and do not attempt to develop strategies that will address the two concerns simultaneously. North Carolina could become a national leader in water resource management by combining these two objectives into one comprehensive watershed planning program.

Each watershed has natural characteristics that determine how much rainfall evaporates or is used by vegetation, infiltrates into groundwater, and what remains to runoff into downstream waters. As land uses modify watershed hydrology, the amount and rate of runoff typically increase. This causes increased flooding and water quality issues downstream. Nature-based stormwater strategies that maintain or replicate natural watershed hydrology can measurably reduce flooding and pollution.

Watershed management can help leaders[7] identify and prioritize watersheds where nature-based strategies would be the most impactful and cost-effective tool to minimize and prevent flooding and pollution. Stakeholder advice can further guide state leaders in building a watershed management program that taps into the potential benefits for using nature-based stormwater strategies around the state.

Operating at the watershed-level also can guide state, local and private investments in infrastructure and stormwater projects. Intentionally developing connections between partners within watersheds prevents downstream consequences from upstream decisions. Additionally, collaboration across all sectors (i.e. development, transportation, and working lands), will allow for more creative and cost-effective stormwater solutions.

As recommended by the work groups, watershed-level plans should address all flood risks such as sea level rise, storm surge, riverine flooding, and groundwater flooding, and account for anticipated increases in precipitation levels described in the North Carolina Climate Science Report (NCCSR)[8]. These NCCSR predictions will inform which nature-based stormwater strategies will best address runoff, floods and pollution across the mountains, piedmont and coastal plain into the coming decades. North Carolina is fortunate to be in a position to initiate a comprehensive watershed management effort that addresses both flooding and water quality.

First, North Carolina's Governor has sufficient administrative authority to direct his cabinet agencies to move forward with comprehensive watershed management efforts. Significant funding from the U.S. Department of Housing and Urban Development (HUD), has been provided to the N.C. Office of Recovery and Resiliency (NCORR) to reduce future flooding in the areas struck by Hurricanes Matthew and Florence through projects that are required to comply with federal and state water quality classifications and standards.

The participants in this stakeholder-driven work group process recommend that NCORR allocate significant financial resources to encourage watershed management. The work groups envision that NCORR planning funds will provide technical assistance and augment local government capacity in support of community-led watershed programs. These funds have been provided to North Carolina for the express purpose of reducing the state's vulnerability to future flood disasters and are not to be used to provide disaster relief to existing flood victims.

NCORR and its governmental and community partners' initial focus on watershed management within the target federally declared disaster areas can jump start a comprehensive and strategic planning program based in watershed management. Based upon experiences and lessons learned from the initial focus on these communities, watershed management efforts can then expand throughout the state by gaining legislative support and channeling future disaster relief planning funds to this initiative.

Specific ideas for how to structure and roll out a comprehensive watershed management strategy for North Carolina, and examples of other state programs, are outlined in Appendix A of this Plan.

Where should nature-based stormwater strategies be used?

This Action Plan seeks to ease and uplift the consideration and application of nature-based stormwater strategies whenever practicable. This means that the potential for application of these strategies in private and public infrastructure is given the same, or greater, emphasis than more traditional, "gray infrastructure" designs such as pipes and ponds. The criteria that determine if nature-based stormwater strategies are not appropriate for a site may vary between agencies and communities but would likely focus on feasibility and cost-effectiveness.

Nature-based stormwater strategies such as permeable pavement, cisterns and rain gardens promote infiltration and rainwater reuse. These techniques reduce stormwater runoff even on high density development sites. © L. BERKLEY, B+O: DESIGN STUDIO, PLLC

Individual Work Group Recommendations

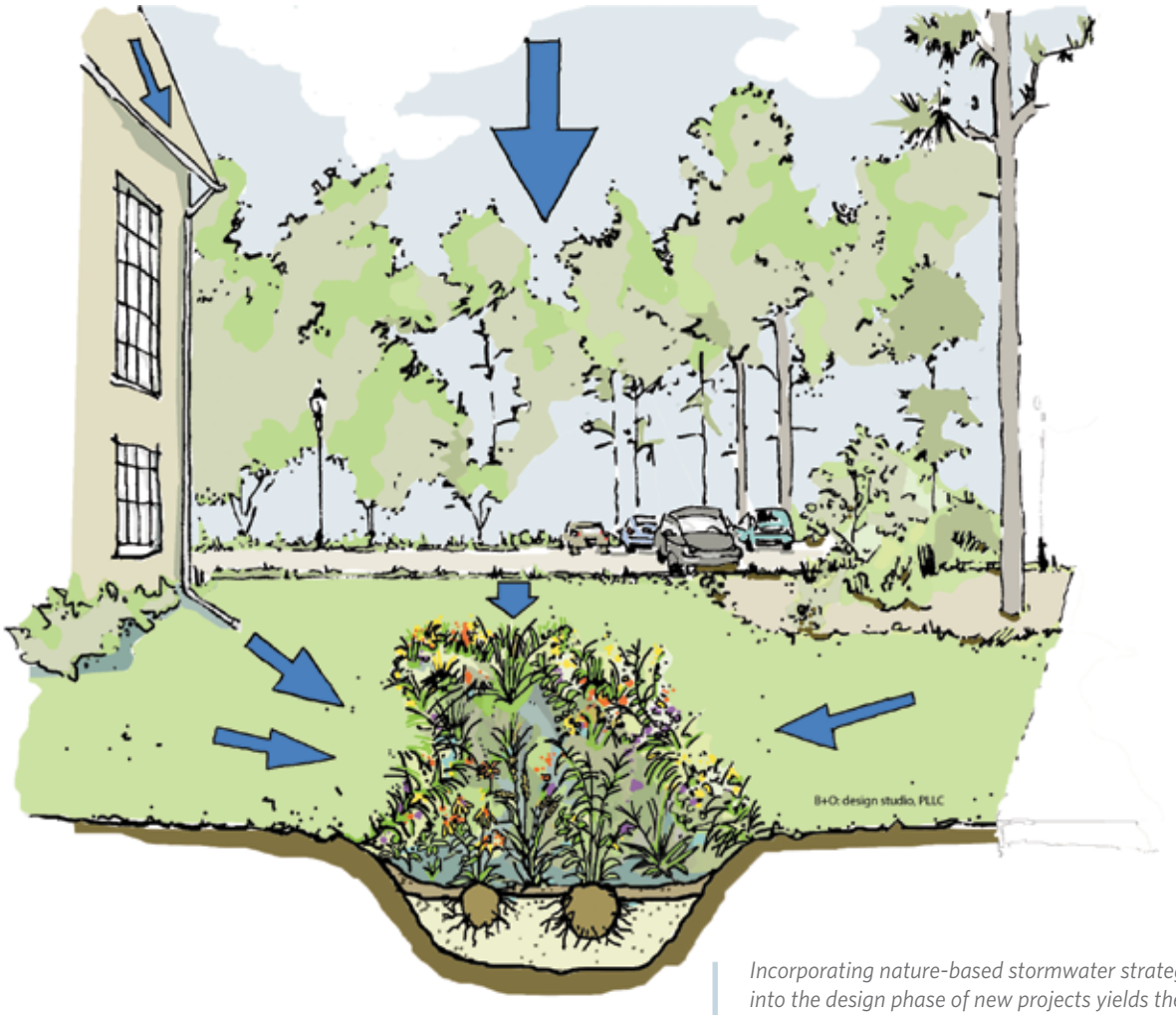
The widespread use of nature-based stormwater strategies will accommodate existing and future land uses while meeting flood reduction and water quality goals. The following recommendations were identified by work group members representing New Development, Stormwater Retrofits, Roadways, and Working Lands.

New Development

Between 2017 and 2018, North Carolina's population grew by 1.1%, adding about 113,000 people. Since 2010, the state's population growth outperformed the nation, expanding by 8.9% compared to the nation's 5.8%.[9] This population growth, combined with millions of tourists that are attracted each year to spend time in the state, results in more new development. While this growth is encouraged to maintain a productive and diversified economy, rapid conventional growth may result in unintended downstream effects. New development often hardens surfaces (i.e. pavement, rooftops), resulting in polluted runoff and flooding.

Proactive implementation of nature-based stormwater strategies by state and local governments can address these challenges, improving the resilience of communities downstream to changing climate conditions.[10] The following recommendations reflect the most critical actions to ensure nature-based strategies are considered for new development and used whenever practicable:

1. **Promote the use of nature-based stormwater strategies and low-impact development decision-making tools already approved by either the state or local government by doing the following:**
    a. Expedite permit applications that are designed to achieve runoff volume matching as specified in the state's stormwater design manual.[11]
    b. Secure additional funding to support technical specialist(s) in DEQ, associated with NCORR's Resilient Communities Program or within other



Incorporating nature-based stormwater strategies early into the design phase of new projects yields the best application of their use. Designs that ensure impervious surfaces are disconnected and infiltration is maximized throughout a site are most effective at preventing runoff.
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agencies and organizations, including universities and NGOs, and through private-public partnerships who can meet with project designers and developers in early stages of the design phase to evaluate, advise and provide technical assistance on site suitability for nature-based stormwater strategies. Specialists should also assist local permitting authorities.

c. Develop detailed informational maps to assist with watershed management plan development and guide where and what types of nature-based stormwater strategies are most practical and economical for potential new development sites, including land acquisition strategies, stormwater mitigation banks, etc. Obtain site characteristics necessary for these maps by relying upon existing geographic information system databases.

d. Train industry and trade professionals, government staff and decision-makers so that they understand the benefits and limitations of nature-based stormwater strategies. Elements of this training need to include:

i Continuing education credits for training courses that review: permitting procedures; design criteria for individual measures and practices; operation and maintenance requirements, including life-cycle costs compared to conventional treatment systems; benefits of nature-based systems; and legal instruments used to ensure permit compliance with permittees.

ii Workforce training: Promote skills training on construction and maintenance of low-impact development to employees of landscape and maintenance firms.

iii Peer-to-peer forums and trade shows: Create and facilitate regular opportunities for practitioners,

including private business sector as well as public entities, to share experiences, collaborate and inspire each other to expand the use of nature-based stormwater strategies. This initiative includes: biannual trade show with conference and training workshops; list-serve that convenes the community of practice online; and periodic luncheons, gatherings, and webinars that provide formal and informal opportunities to discuss experiences and ideas.

e. Facilitate local government review of development codes and ordinances for potential inclusion of nature-based solutions. State agencies, nonprofits and academic partners should work together to assist local officials in an organized and consistent approach, including community outreach and technical assistance, to highlight nature-based strategies as a priority resilience measure.

f. The N.C. General Assembly requests a study to determine the degree to which promoting nature-based solutions saves the state money in addressing flooding and water quality concerns, and an economic impact analysis of jobs created, improved property values and other benefits as a result of applying nature-based solutions. Evaluate how these cost savings and economic benefits, if found, can be used to provide and inform financial incentives such as tax breaks, design/planning assistance, to promote the use of nature-based stormwater strategies. This study should include state-funded institutions of higher learning.

g. Establish a standardized life-cycle cost analysis for disclosure, as is currently being documented in research at N.C. State University, and include these costs for operating and maintaining permitted stormwater systems as an update to the state's stormwater design manual. Update periodically to ensure accuracy of cost estimates.[12]

h. Ensure that maintenance plans prepared as a requirement of state and locally issued stormwater permits include an estimated budget of life-cycle costs for operating and maintaining the authorized stormwater system. This critical information will disclose these costs to current and future permit holders so that they can budget each year to fulfill their long-term financial responsibilities. In many places, systems that use nature-based stormwater strategies will be more cost-effective to operate and maintain.

Located in the mountains in Mills River, N.C. the Sierra Nevada Brewing Co. uses bioswales and native vegetation to disconnect impervious surfaces. The site includes over 2.5 acres of permeable pavers that makes multi-functional use of the landscape for parking and stormwater management. © SIERRA NEVADA BREWING CO.

Left - stormwater runoff flows from this conventional home when rain hits the roof, walkway and driveway. It then funnels into the storm drain and nearby surface waters.
Right - stormwater runoff is significantly reduced with simple techniques to disconnect impervious surfaces. © L. BERKLEY, B+O: DESIGN STUDIO, PLLC

i. Create a state-sponsored awards program administered by DEQ and/or NCORR that recognizes notable low-impact development projects and communities leading in applying nature-based stormwater strategies each year. These awards may highlight creative approaches to coordinating, funding, and designing nature-based stormwater strategies, and could highlight the successes of the N.C. Resilient Communities Program and other state technical assistance offerings.

2. **To exemplify support and state leadership, all state-funded construction projects use nature-based stormwater strategies when technically and economically feasible.**

   a. Issue appropriate executive orders and policies that promote the use of nature-based stormwater strategies by the governor's cabinet agencies to the extent allowed by existing laws and rules. For certain defined projects, nature-based stormwater strategies should be the default and must be demonstrated to be impracticable before using conventional methods.

   b. Request that the N.C. General Assembly evaluate if it should encourage the use of nature-based stormwater strategies by enacting a state law that includes provisions similar to those in the Federal Energy Independence and Security Act Section 438. This federal law requires large construction projects financed by the federal government to "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."[13]

3. **To exemplify support and local leadership, all local government construction projects use nature-based stormwater strategies.**

   a. Develop model policies, incentives and ordinances that local governments can adopt that promote the use of nature-based stormwater strategies for local government construction projects.[14,15]

   b. The steering committee will organize local stakeholders to approach local governments to seek adoption of model incentives, policies and/or ordinances. State agency technical specialists will support communities in developing and implementing these changes.

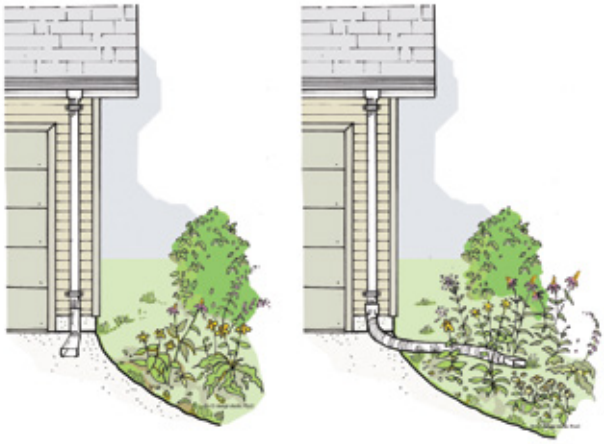
Stormwater Retrofits

Regular maintenance of existing properties and stormwater systems is key to successfully reducing flooding and improving water quality. Work group members shared that many stormwater systems are failing and require immediate attention in order to prevent further water quality degradation. The goal of these retrofit projects for existing developments should be to disconnect impervious surfaces, slowing and reducing runoff and allowing water

to filter through soil or other engineered material. There are a range of retrofit options, from simply redirecting downspouts to green spaces to resurfacing parking lots. This range of nature-based stormwater strategies are financially feasible and can provide savings over repairing and replacing traditional stormwater infrastructure, when designed and sited right, based upon factors such as average precipitation rates and soil type. By choosing nature-based stormwater strategies supported by the state[16], local and downstream communities will be more resilient to future climate conditions. The following recommendations reflect the most critical actions to employ nature-based strategies in stormwater retrofits whenever practicable.

1. **Promote nature-based stormwater strategies as a cost-effective and preferred way to retrofit stormwater systems to reduce flooding and protect water quality.**

    a. Use nature-based stormwater strategies to bring failing stormwater systems into regulatory compliance. Devise a streamlined process for modifications of existing state and local permit requirements so that nature-based stormwater strategies can be used to obtain regulatory compliance.



Using a downspout extender, roof runoff can be directed away from impervious surfaces to vegetated areas so the rain soaks into the ground. This is a simple and cost effective retrofit option. © L. BERKLEY, B+O: DESIGN STUDIO, PLLC

    b. Add a new chapter to the DEQ Stormwater Design Manual to provide guidance on the appropriate uses of nature-based strategies to address compliance issues with its existing permits. This promotes practices that mimic "hydrologic matching" as already defined in the manual. This guidance should be written with the intention to simplify the review process.

The Market at Colonnade Center in Raleigh, N.C. utilizes three cisterns (totaling 43,000 gallons) that collect rooftop runoff. The cisterns are used in conjunction with a 2,500 ft. subsurface gravel and pipe trench system to collect the first one-inch of runoff which is then infiltrated into the underlying soils.
© REGENCY CENTERS

c. Add a new chapter to the DEQ Stormwater Design Manual to include guidance on how best to use nature-based stormwater strategies to retrofit existing land uses that may or may not have existing stormwater permits. The chapter needs to explain how these measures can be adapted so that they are cost-effective to use even when site limitations constrain the ability to meet all optimal design specifications.

2. Prioritize the locations and types of nature-based stormwater strategies that can be used to retrofit existing land uses whenever a watershed management and restoration plan is prepared or updated.

a. Enact new state legislation to resolve out-of-compliance stormwater permits that no longer have an identifiable party responsible for maintaining their compliance. The law needs to outline procedures and provide funding opportunities or incentives to fix these compliance issues and should explicitly encourage the use of cost-effective nature-based stormwater strategies to fix and upgrade failing systems. Local governments should establish a program or mechanism to absorb financial risk and use collective funds to fix noncompliant systems.

3. Expand the use of nature-based stormwater strategies by state and local agencies when retrofitting government-owned existing properties, especially capital improvements already being undertaken.

a. Consider nature-based approaches first when upgrading, updating, or redeveloping existing government facilities.

b. Educate the public about nature-based stormwater strategies by incorporating these practices into facilities that are frequently visited by the public, such as government office buildings, parks, boat ramps, schools and beach access areas. Include educational signage and exhibits in these retrofit projects to spread public awareness and use of these strategies.

4. Allocate state resources and secure significant additional financial resources to finance retrofit projects that use nature-based stormwater strategies.

a. Develop and identify significant new sources of federal, state and local funding to support retrofit projects that reduce flooding, improve water quality and reduce economic disruptions by achieving "hydrologic matching."

b. Direct federal and state disaster mitigation funding to plan, design and install nature-based stormwater strategies as part of recovery programs.

c. Adopt policies within all state-administered financial assistance grant and loan programs used to acquire and retrofit public lands and infrastructure that promote the use of nature-based stormwater strategies.

This rain garden at the Winding River Community in Brunswick County, N.C. collects and absorbs rain from the boat ramp parking lot. It is often dry again within several hours of a 1.5" rain event. © PAM DUNCAN

This road includes curb cuts to guide runoff to a roadside infiltration system. Permeable paving on the bike path disconnects runoff and a living shoreline reduces erosion to protect infrastructure.
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Roadways

Roadways in North Carolina are either owned and operated by the N.C. Department of Transportation (NCDOT), a city government or private communities. Property dedicated for roads comprises one of the largest uses of land in the state, and these transportation facilities by their very nature must manage water to ensure public safety. Drainage systems for roads must provide for safety while being designed, constructed and installed across the mosaic of landscapes, land uses and soil types throughout the state. In addition to providing for the stormwater management requirements of the roads themselves, in many cases road drainage systems are also relied upon to provide drainage for surrounding land uses.

These characteristics of linear transportation corridors present unique challenges for managing stormwater and demand innovative and holistic solutions throughout the planning, design and construction process. In the context of roadways, nature-based stormwater solutions are sustainable planning, design, environmental management and engineering practices that weave natural features or processes into these disciplines. When applied broadly and where practicable, these strategies build more resilient transportation infrastructure.

1. **Develop educational and technical resources to improve the understanding of transportation planners, designers, roadside operations managers, and executive decision makers on the value of nature-based stormwater solutions tailored to transportation infrastructure.** These resources will need to be developed and adapted from other entities by NCDOT, consultants, researchers, NGOs and other governmental agencies.

    a. Develop a guidance manual for transportation planners that illustrates effective incorporation of nature-based stormwater strategies into transportation planning and project development decision making processes.

b. Develop a list of nature-based environmental impact avoidance and minimization actions which can be evaluated as agencies comply with federal and state environmental review (NEPA/SEPA) processes.

c. Develop roadway typical sections that illustrate nature-based stormwater solutions in the design context to guide comprehensive transportation planning, project planning and project design.

d. Develop technical guidance tailored for roadside operations personnel on techniques for optimizing the infiltration and evapotranspiration capacity of the roadside environment.

e. Include more information and technical guidance on nature-based stormwater strategies that are appropriate for the transportation system in the NCDOT best management practices toolbox and share that information with municipal transportation agencies.

2. Complete a technical review of existing regulations and guidance that serve as disincentives or impediments to the use of nature-based stormwater strategies along roadways. State and local transportation agencies, state and federal regulatory agencies, as well as academic and nonprofit interests should contribute their expertise to conduct this review.

a. Based on this review, recommend changes to existing laws, rules, ordinances, policies, funding sources and procedures that facilitate the use of nature-based stormwater strategies.

b. Revise NCDOT's qualification standards for designers, engineers, contractors and other professional consultants to include demonstrated training and experience in nature-based stormwater strategies.

c. Additionally, NCDOT should ensure contract awardees are trained in nature-based design strategies and are committed to receiving continuing education on these design options annually. NCDOT may consider making this a new prequalification code or an amended one, and these trainings may be developed in partnership with the education programs proposed in the "New Development" recommendations.

3. Increase and prioritize the use of nature-based stormwater strategies by state, local and private agencies that build and maintain roadways to mitigate flooding impacts and water quality programmatically and as part of a watershed strategy.

a. Provide agency leadership with briefings and supportive materials necessary to secure their support and guidance on how best to promote the use of these strategies as part of their decision-making.

A Greensboro, N.C. green street collects stormwater runoff in bio retention cells to reduce the amount of runoff. This in turn reduces street flooding and downstream pollution. © HUNTER FREEMAN

This ditched and drained wetland was restored to its natural stream bed hydrology to collect runoff from adjacent farm lands.
© L. BERKLEY, B+O: DESIGN STUDIO, PLLC

b. Formalize policies and internal guidance as needed to institutionalize agency leadership support for prioritizing the use of nature-based stormwater strategies.

4. Engage transportation agencies as partners in community-wide efforts that seek to maximize the use of nature-based stormwater strategies.

   a. Engage transportation agencies, who are among the largest landowners in the state, as major partners in the proposed watershed planning effort. Seek to incorporate stormwater strategies for roadways into overall watershed management strategies recommended in the plans. Explore opportunities that exist beyond the established right-of-way for cost-effective use of nature-based stormwater strategies.

   b. Coordinate agreements between transportation agencies and disaster recovery programs that expand opportunities to rely on nature-based stormwater strategies to promote the agency missions of all parties. Seek to direct hazard mitigation investments so that stormwater needs of transportation agencies are achieved whenever possible.

Working Lands

Working lands in North Carolina host the growth of trees, food, fiber and other farm products. Other land uses that could be affected by the recommendations made by this work group include properties that are undeveloped because they are vacant and yet unused for specific land uses, or because of land use restrictions or public investments the properties are set aside as open space or otherwise preserved in an undeveloped condition. The potential to protect, restore or replicate natural hydrology on working lands to better manage floods and water quality has not been fully realized.

To overcome these impediments, and use nature-based stormwater strategies through the conservation and management of working lands whenever feasible, the work group made the following recommendations:

1. **As the primary land use in North Carolina, working lands already serve nature-based stormwater functions to significantly reduce flooding and improve water quality.** Additional funding should be secured for financial support and incentives to owners of working lands to maintain the working landscape of North Carolina and its many natural services.

a. Promote the use of forest and agricultural products grown in North Carolina to maintain and expand these markets so that landowners have strong economic returns from their working lands. Develop a partnership between trade organizations, conservation interests and academic institutions to help with this outreach effort. Work with the Leadership in Energy and Environmental Design (LEED) standard to enable forest products from smaller forest landowners to be used in LEED certified buildings, further promoting the use of these products.

b. Increase economic incentives from local, state and federal sources to landowners, including industrial owners, to preserve wetlands within forest lands, and to preserve forested and agricultural floodplains. Support ongoing efforts to identify forest lands that are a high priority to maintain and determine financial assistance or economic incentives needed to keep these lands working.

c. Integrate efforts to maintain working lands into a state watershed management program. Secure additional funds to support technical, legal and financial assistance to integrate efforts to maintain working lands through watershed management strategies designed to reduce flooding and improve water quality.

d. Mount a coordinated campaign that works with state leaders, the North Carolina Congressional delegation and engaged stakeholders to pursue substantially increased financial resources from the federal Farm Bill and other programs for conservation. Financial parity with other states could finance wetland restoration, conservation easements and large-scale hydrologic restoration projects in North Carolina.

   i Direct more federal funds, including disaster mitigation program funding, to support consistent staffing capacity at the state, regional and local levels to help identify, plan, design, fund and construct projects that protect, restore or replicate natural hydrology. Partner with the

Replicating natural hydrology on farm and forest lands reduces flooding and improves water quality. Restored wetlands at North River Wetlands Preserve filter and absorb runoff before it reaches the river.

Natural Resources Conservation Service to increase the staffing capacity of federal, state, local and nonprofit organizations to plan and execute nature-based stormwater strategies on working lands.

ii Work with NCORR, N.C. Department of Agriculture and Consumer Services, and other agencies that administer disaster mitigation funding that is available to enhance staffing levels and consulting services to aid in the developing and administering hydrology-related projects.

2. Pursue strategic partnerships and regional planning to protect, restore or replicate natural hydrology on working lands that provide mutual benefits to landowners and the state.

a. Continue and expand watershed level initiatives to identify and maximize strategic opportunities that provide water quality and flood reduction benefits to local and downstream communities. Seek to incorporate watershed initiatives with other ongoing landscape level programs that have different but compatible benefits including:

i Coordinate with a new landscape initiative work group comprised of private and public stakeholders with funding from U.S. Fish and Wildlife Service to identify locations in coastal North Carolina where private and public funds can be focused on large-scale hydrologic restoration projects.

ii Work with military stakeholders to identify target properties that are essential for military training where hydrologic restoration projects are also feasible. The operations of the Department of Defense (DoD) collectively constitute North Carolina's second largest industry. Preserving working lands is critical to the military's ability to function, and the Sentinel Landscapes Partnership is an important vehicle to facilitate preservation of working lands. It should become an active partner in implementing this work group's strategy.

iii Implement the Lake Mattamuskeet Watershed Management Plan working with private landowners, U.S. Fish and Wildlife Service, N.C. Wildlife Resources Commission, Hyde County and N.C. Coastal Federation.

iv Identify existing and emerging regional conservation partnership opportunities outside the coastal counties that provide opportunities for hydrologic restoration and management.

b. Create opportunities to hold more water on working lands to provide downstream benefits while compensating for potential crop loss due to the additional water being held on these lands.

c. Using the most up-to-date projections available, determine where production zones for working lands may change due to climate change to inform agricultural management, land use and conservation decisions.

Department of Defense as a key partner in implementing nature-based stormwater strategies

DoD has provided conservation leadership on many levels, especially under Section 438 of the Energy Independence and Security Act of 2007 (EISA), requiring many federal developments to maintain or restore pre-development hydrology.

DoD is also the steward of vast tracts of undeveloped lands and depends on the preservation of off-base "working lands" to protect the bases and their training missions. Each DoD facility plans for the management and protection of its natural resources, which must now include consideration of climate change risks and resilience. DoD emphasizes the importance of climate change risk assessment and resilience planning, with an emphasis on natural solutions, as key to protecting the facility's mission readiness.

This emphasis on resilience, natural solutions and considerable land holdings make the DoD a key federal partner to North Carolina in promoting and implementing nature-based stormwater strategies.

Critical First Steps

With this action plan in hand, over the next year the organizations and stakeholders engaged in this planning effort intend to focus on a number of initial steps that will be necessary to accomplish these recommendations.

The North Carolina Coastal Federation will continue to work with The Pew Charitable Trusts and engaged stakeholders to:

1. **Obtain commitments to move forward with comprehensive watershed management framework.** State leaders will devise and fund a multi-year planning framework that encourages watershed management to reduce flooding and enhance water quality concurrently. This will be supported and informed by relevant stakeholders drawing on the work group attendees.
2. **Economic study on costs and benefits of nature-based stormwater strategies.** The N.C. General Assembly will be encouraged to request a study to prepare an economic analysis that details the cost savings associated with using nature-based stormwater strategies to mitigate flooding. This research may be carried out by a private consultant in partnership with North Carolina experts such as those at (universities, stakeholders, and other interests).
3. **Promote demonstration projects.** Identify and implement projects (new development, retrofits, roadways and working lands) that demonstrate the value of nature-based stormwater strategies with real world projects.
4. **Provide accurate information on maintenance cost for nature-based stormwater strategies.** The steering committee will work with state officials and stakeholders to amend the stormwater design manual to include this data so that users are able to budget for life-cycle costs of these measures and learn about the savings regular maintenance can provide over time.
5. **Streamline modifications to existing stormwater permits to encourage use of nature-based stormwater strategies.** Secure a commitment from DEQ to evaluate processes and work with stakeholders to devise standard operating procedures that provide a streamlined process for modifications of existing permit requirements so that nature-based stormwater strategies can be used to achieve regulatory compliance.
6. **Advance state and local policies promoting nature-based stormwater strategies.** The steering committee and its various stakeholders will engage with key state and local leadership to promote recommendations in this plan and seek adoption of formal policies that enable the government to lead by example.
7. **Form the Action Plan Steering Committee.** This leadership group of dedicated individuals from various stakeholder interests should spearhead implementation of recommendations in the plan. The group will meet periodically to set priorities and oversee accomplishments.
8. **Establish a consistent mechanism for continuing education and outreach.** A work group will be organized to coordinate future planning for education and outreach. The group will seek the necessary financial resources support regularly scheduled, targeted programming and provide the necessary training and awareness building to advance action plan priorities.
9. **Organize NCDOT work group.** The steering committee will work to assist NCDOT leadership and staff in putting together a work group to tackle NCDOT's highest priority recommendations including updating its toolbox to more fully include nature-based stormwater strategies and reviewing regulatory constraints that discourage the use of these measures.
10. **Congressional education on working land opportunities:** Form a work group of stakeholders to develop components of a coordinated campaign that works with state leaders, the U.S. Congressional delegation and engaged stakeholders to substantially increase the amount of financial resources for conservation coming from the federal Farm Bill and other federal programs.

APPENDIX A

Watershed Management Framework Concept for North Carolina

Introduction

Watershed management strategies proposed by this Action Plan can guide the location of future investments in public infrastructure such as roads, sewers, as well as the use of funds from federal, state and local governments for a wide variety of flood reduction and water quality enhancement mitigation measures, including appropriations and grants made by federal and state agencies. The program can seek to achieve the following results:

- Reduce the potential for future flood damages to better protect housing, business and lives.
- Reduce future flood damages to essential public and private infrastructure including roadways, utilities, schools, etc.
- Protect and enhance nature-based industries that include fishing and shellfishing, farming, forestry and tourism as well as military installations by making these industries and land uses less vulnerable to floods and water quality degradation, caused by floods.
- Protect public health, welfare and safety by reducing social, economic and environmental disruptions resulting from flood events.

The scale of watershed plans supported by this recommended program should be determined based upon the extent and causes of the flooding and water quality needs to be addressed. For some communities, 12-digit hydrologic unit watershed plans are needed while larger, and more regionally focused plans are necessary for flooding and water quality issues that cover larger geographic areas. Plans should be designed to address the nature of the flood risks that exist such as those from sea level rise and storm surges, riverine flooding, and/or groundwater flooding.

Planning Framework

The use of NCORR planning funds or other state governmental funds to support the development of volume-based watershed management needs to be directed by a framework of policies that assure that funds will achieve desired outcomes in terms of reduced flooding and improved water quality. Specifically, there needs to be:

1. **Strong policy guidance.** State leadership needs to issue policy guidance that could include an executive order outlining the necessity for volume-based watershed management programs, which concurrently address the need to reduce flooding and improve water quality. This policy guidance should stress the need for these plans to guide future state level decision-making regarding investments in public infrastructure and flood mitigation measures.
2. **Effective administration.** Planning funds need to be spent where volume-based watershed management holds the most promise for reducing flooding and improving water quality. Scoring criteria to evaluate requests for financial support for watershed management should be devised to direct funds to locations where these plans are most needed.
3. **Required elements of plans.** Plans supported by this initiative should be required to include minimum elements that ensure that:
    a. The public is informed and engaged in plan development.
    b. Plans adequately characterize historic (natural) and altered (current) watershed hydrology with sufficient accuracy to devise quantifiable numeric goals for the rate and volume of future runoff that the plan seeks to achieve.
    c. Plans describe realistic and feasible mitigation measures and practices to be implemented with enough detail so these projects can be prioritized for funding necessary for their implementation.
    d. Any additional minimum requirements from the Environmental Protection Agency for watershed plans.

4. **Timeframe.** The initial phase of this program should focus on spending budgeted planning funds over a three-year time period. The program should then be continued by direct state appropriations or future planning funds that may come to North Carolina after future disasters.

5. **Use of plans developed.** Plans should be used by NCORR and other federal, state and local agencies to prioritize their future expenditures for infrastructure and mitigation measures.

6. **Coordination with existing watershed planning efforts.** Watershed planning that is being promoted by DEQ through various programs should be incorporated into this program to result in plans that serve the needs of each of these agencies, such as the Section 319 grants administered by DEQ and the priority shellfish growing areas being identified by the North Carolina Oyster Blueprint.[17]

The volume-based watershed planning concept that is being recommended is not new, and there already exists both a planning guide[18] as well as numerous watershed plans that have been supported by federal, state and local funds in coastal communities.[19] The North Carolina Land and Water Fund has also funded watershed plans including one for Stump Sound in Onslow County.

The cost of preparing a watershed plan varies based upon the nature of the problems being addressed and the need for more detailed analysis of existing hydrology as well as defining needed mitigation measures to be implemented. The more work that goes into investigating implementation actions, including determining feasibility given land ownership and engineering needs, the more useful these plans become in strategically using available dollars to design, permit and construct mitigation measures. Having a good list of needed projects that can quickly be implemented when funding is available is critical. Plans that this program should enable are likely to cost between $35,000 and $175,000 depending on local conditions and needs. It is recommended that sufficient planning funds be allocated to demonstrate the value of these watershed management efforts in seeking to mitigate future damages caused by flooding and pollution within communities declared as federal disaster areas following Hurricanes Matthew and Florence.

State Models for North Carolina

The Louisiana Watershed Initiative is an example of a comprehensive state program initiated via the administrative powers of a state governor. In 2018, state and local leaders launched this endeavor to use scientific data, transparent decision-making, nature-based stormwater strategies and regional watershed-based management of flood risk to try to reduce the state's future flood losses. The program is largely financed through and helps direct the spending of billions of dollars of federal disaster mitigation funding that has come to Louisiana because of repeated natural disasters experienced in the state. The program was initiated by state agencies without state enabling legislation nor state financial appropriations.[20]

Other states have comprehensive watershed-based planning programs that are authorized through their state constitutions, laws and annual appropriations. For example, Minnesota directs state funding for infrastructure and water quality enhancements based upon the Minnesota Water Management Framework. This framework resulted from the Clean Water, Land, and Legacy Amendment to the state's constitution in 2008 that provided a dedicated source of funding for the state's Clean Water Fund. The amendment requires coordination among the state's main water management agencies, and its funds are used for monitoring, planning, and restoration and protection activities. Watershed plans are conducted on a ten-year cycle to systematically and comprehensively consider water-quality monitoring, restoration and protection planning needs. These plans are prepared with local partners to set goals, milestones and measures to guide state and local government implementation efforts.[21] While sweeping, the Minnesota framework does not explicitly coordinate flood control needs with its watershed planning program, which is mostly oriented to water quality concerns.

APPENDIX B
Impediments

New Development

There are perceived and real barriers to implementing nature-based stormwater strategies. The new development work group identified the following impediments:

Lack of Awareness and Education

- Developers, homebuilders, realtors, lenders, engineers, surveyors, landscape architects, regulators, legislators, state and local agencies, homeowner associations, and homeowners are still largely unaware of nature-based strategies and their effectiveness at protecting and restoring water quality while meeting stormwater requirements.
- Tools and guidance to implement low-impact development strategies are available for use, but are not readily promoted during the design process.

Inflexible Regulation and Policy

- Many local governments' development ordinances, flood control requirements, and project review and permitting processes are not designed to promote the use of nature-based stormwater strategies.
- Low impact development is viewed as an alternative measure in state regulatory guidance rather than a conventional method.
- Life-of-project costs are not considered when making initial construction decisions.

Design Challenges

- Lack of incentives to maintain existing vegetation that maximize on-site water retention and lack of awareness of the benefits to maintain the natural landscape while developing new sites.

High Cost and/or Lack of Funding

- Low consumer demand for nature-based strategies in home development.
- A thorough economic analysis of non-market values of low-impact development has not yet been conducted.
- Few incentives exist for early adopters of nature-based stormwater strategies in new developments.
- Need for simple cost comparison between conventional and nature-based stormwater strategies for design, construction, and maintenance.

Inadequate Operation & Maintenance

- There are limited operation and maintenance guidelines available on a local or statewide scale for nature-based stormwater strategies.

Lack of Monitoring & Evaluation

- Currently no monitoring and evaluation system is in place for nature-based stormwater strategies to measure success over time.

Stormwater Retrofits

The work group identified a number of impediments to using nature-based stormwater strategies to retrofit existing communities. These included:

Lack of Awareness and Education

- Lack of awareness by developers, regulators, and homeowners that reduction of stormwater volume can achieve stormwater permit water quality goals, and that use of nature-based stormwater strategies are an effective way to do this.
- Low impact development strategies are typically not considered when homeowner association covenants and restrictions are developed or re-developed.

Inflexible Regulation and Policy

- Current stormwater permits are difficult to modify to allow for nature-based stormwater strategy upgrades.

Design Challenges

- Low impact development strategies may be resisted for retrofits if their benefits and purpose are overstated or oversold to homeowners and developers.
- Need a cohesive response for retrofit designs that will be accepted by state and local governments for strategies to bring permits into compliance.

High Cost and/or Lack of Funding

- Funding restrictions preventing federal dollars from being used to bring people into compliance with the Clean Water Act.
- There is uncertainty of maintenance costs for nature-based strategies.
- No stormwater maintenance and budgeting tools for HOAs and homeowners to budget for operation and maintenance.

Roadways

The roadways work group identified impediments to using nature-based stormwater strategies that need to be overcome. These included:

Lack of Awareness and Education

- Civil engineers, construction crews, developers have limited access to specialized training on nature-based stormwater strategy implementation.
- Relevant evidence for the return on investment for nature-based stormwater strategies is unavailable or difficult to find.
- State and local transportation agencies lack policy guidance on nature-based designs.

Inflexible Regulation and Policy

- Current subdivision road design standards may not allow for certain nature-based stormwater strategy designs.
- Different standards for state and municipal roads make it difficult to implement nature-based stormwater strategies.
- Lack of coordination between agencies, state-level and municipal, and with utilities.
- Design for safety and stormwater are not aligned in roadway design processes which can cause them to be competing priorities instead of complimentary.

Design Challenges

- Design planning does not incorporate stormwater management early enough in the process to fully realize where and how nature-based stormwater strategies could be implemented.
- Limited space in urban areas, as nature-based stormwater strategies on roadside takes away valuable property, increase maintenance costs when implemented in medians, and may interfere with utility line placement (water and sewer lines).
- Roadways are not currently integrated in watershed planning, making it difficult to account for how stormwater and water quality goals will be impacted.
- Limited space in roadway right of way causing an inability to design nature-based stormwater strategies that could take advantage of the broader surrounding landscape.
- Nature-based designs are not emphasized in bid standards used to hire designers and other contractors.

High Cost and/or Lack of Funding

- Limited funding is available for maintenance of stormwater practices for roadways.
- Integration with other government programs that could help pay for roadway stormwater infrastructure is lacking (i.e., disaster relief funding).

Inadequate Operation and Maintenance

- Many nature-based stormwater strategies require specialized maintenance, making them sometimes difficult to implement.
- Long-term maintenance responsibilities must be determined and planned for.

Lack of Monitoring and Evaluation

- Monitoring is required for best management practices, and smaller devices require more monitoring which can be costly and time consuming.

Working Lands

The work group identified a number of impediments to using nature-based stormwater strategies to reduce flooding and improve water quality on these properties. These impediments included:

Lack of Awareness and Education

- Lack of awareness for how nature-based stormwater strategies apply to agriculture and limited capacity among land owners, agencies and non-profits to accomplish these projects.
- Difficult to change perception around the benefits of keeping water on the land longer, as there has been a longstanding desire to remove water from the land rapidly.
- Currently no incentives exist to keep forests intact instead of developing forestland.
- Lack of expertise and capacity to develop watershed plans.
- N.C. Congressional representation may not be aware of the needs of rural/coastal areas, especially as they relate to the nexus of working lands and flood resilience.
- Shortage of local staff to communicate with landowners, advocate for, and provide local expertise about nature-based stormwater strategies and service programs that encourage stormwater strategies.

Inflexible Regulation and Policy

- Regulatory obstacles were developed before nature-based strategies were being used, making it difficult to implement new strategies.
- Prioritization and identification of most important lands to maintain for flood risk reduction and water quality benefits is needed.

Design Challenges

- Nature-based stormwater strategies must be specific to the region where they are being implemented (i.e., coastal plains, piedmont, mountains).
- Water movement over the landscape changes so rapidly it is difficult to determine where it is most useful to fund nature-based stormwater strategies to have the greatest positive impact.

High Cost and/or Lack of Funding

- Funding that is available to the agriculture sector is difficult to obtain, and typically does not apply to funding staff to accomplish the nature-based stormwater strategy maintenance or retrofit projects.
- Lack of private and public partnerships to facilitate innovative funding opportunities.
- Funding that is available is slow to be released to landowners and landowners often must pay out of pocket.
- Landowners are invested in existing conventional drainage infrastructure making it difficult to consider new practices.
- North Carolina share of federal conservation dollars provided by the federal Farm Bill is inadequate and not proportional to the size of state farm economy.

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19 Existing examples of plans include: (1) Mattamuskeet Association Watershed Management Plan (Hyde County): www.nccoast.org/project/hyde-county/; (2) Lake Mattamuskeet Watershed Restoration Plan (Hyde County): www.nccoast.org/protect-the-coast/stormwater/lake-mattamuskeet-watershed-restoration/; (3) Bradley and Hewletts Creeks Watershed Restoration Plan (New Hanover County): www.nccoast.org/project/bradley-hewletts-watershed-restoration; (4) Lockwoods Folly Watershed Restoration Plan (Brunswick County): www.nccoast.org/project/lockwood-folly-watershed-restoration/; (5) Pine Knoll Shores Watershed Restoration Plan (Carteret County): www.nccoast.org/project/pine-knoll-shores-watershed-restoration/; (6) Beaufort Watershed Restoration Plan (Carteret County): www.nccoast.org/project/beaufort-watershed-restoration/; (7) White Oak Watershed Restoration Plan (Carteret County): www.nccoast.org/project/white-oak-watershed-restoration/; (8) Swansboro Watershed Restoration Plan (Onslow County): www.nccoast.org/project/swansboro-watershed-restoration-plan/; and (9)Lower Cape Fear River Blueprint (Pender, New Hanover and Brunswick Counties): www.nccoast.org/protect-the-coast/advocate/lower-cape-fear-river-blueprint/.

20 Louisiana Watershed Initiative, "Managing Future Flood Risk in Louisiana Through Watershed-Based Solutions," accessed October 13, 2020, www.watershed.la.gov.

21 Minnesota Board of Water and Soil Resources, "One Watershed, One Plan," accessed October 13, 2020, bwsr.state.mn.us/one-watershed-one-plan.

North Carolina Coastal Federation®

Working Together for a Healthy Coast

The North Carolina Coastal Federation empowers coastal residents and visitors from all walks of life to protect and restore the water quality and critically important natural habitats of the N.C. coast.

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