

Northern Outer Banks Case Study

This case study illustrates the challenges and opportunities that exist in retrofitting a community to protect water quality.

Summary

The Northern Outer Banks landscape has changed considerably in the last two generations. Before coastal development occurred on the Northern Outer Banks, rainwater quickly infiltrated into the landscape and replenished freshwater lenses that lay under the sand. Coastal development and land use change have affected the natural hydrology of the Northern Outer Banks.

The majority of potentially developable properties along the Outer Banks have been subdivided and platted for residential housing and associated real estate development. In Dare County, approximately 78% of potentially developable parcels have been built upon. Increasing resident and tourist populations have placed pressure on the fragile natural systems as the Outer Banks continue to lose important areas for natural filtration and storm water storage capacity. The natural filtration capacity of the landscape has been compromised by alteration of the terrain through grading, soil compaction, vegetation removal and ever increasing impervious surface. The result of this change in hydrologic function is an increase in excess untreated storm water which can pose significant human health risks through shellfish closures and swimming advisories, negatively impact water quality, and cause damage to both private and public property through flooding events.

A Regional Approach

In an effort to find solutions to protect water quality, human health and property, Senator Marc Basnight established the Outer Banks Hydrology Management Committee¹ in 2004. The Committee identified problems linked to storm water management in the Outer Banks including flooding, closing of shellfish beds, property damage and threatened water quality of receiving waters. Based on the findings and discussions generated from committee meetings, the Outer Banks Hydrology Management Committee made several recommendations to aid in the management of storm water. Recommendations included communities reclaiming their roadside drainage systems to improve their storage and infiltration capacity; developing guidelines for both landscaping and water conservation to ensure that the minimum amount of vegetation is disturbed or lost and the appropriate landscaping is replanted and limiting grading that drains additional water to the streets. One of the study's key recommendations was to explore the implementation of Low Impact Development (LID) techniques into new and existing development. As a result of this recommendation, the Outer Banks Hydrology Management Committee commissioned a LID Feasibility Assessment in 2006.

The LID Feasibility Assessment included a review of existing stormwater ordinances/policies, land use and soils in 11 communities. A number of recommendations, at both the municipal scale and property scale, were generated from the Assessment including development of general stormwater goals consistent with the practice of LID; explicit requirement for compliance with storm water regulations for both new development and redevelopment plots; consideration of developing criteria for a range of storm events as well as peak discharge and establishing buffers around all natural water bodies and drainage ditches to enhance water quality.

¹ Representatives from Dare and Currituck county governments, all the towns in Northern Dare, the UNC Coastal Studies Institute, the N.C. Division of Water Quality, N.C. Division of Environmental Health, N.C. Department of Transportation, N.C. Homebuilders and Realtors Associations and the N.C. Coastal Federation were on the Committee.

Recommendations from both the Outer Banks Hydrology Management Committee and the LID Feasibility Assessment were provided to the towns of the Northern Outer Banks. This case study focuses on the towns of Southern Shores and Nags Head and their approaches to evaluating these recommendations while finding solutions for effective storm water management in an already heavily altered landscape. In examining the methods used by both towns, this case study will demonstrate some of the challenges and opportunities that exist when implementing community-wide retrofit strategies to manage storm water.

Southern Shores

The Town of Southern Shores began taking steps toward providing solutions by forming a Storm Water Policy Advisory Committee and commissioning a series of studies to better inform themselves of their environmental parameters. These included a vegetation inventory study and a drainage study of the entire town of Southern Shores. The drainage study delineates the town's drainage sub-watersheds and identifies problematic flooding areas and their associated contributing properties within each sub-watershed. This study provided additional recommendations for storm water management, mostly focusing on property scale solutions within the sub-watershed areas. The Town also commissioned an Analysis of Flooding within the Chicahawk Community, which provided a detailed look into the fundamental hydrologic and drainage challenges of the area. The study focused on the soil properties, peat layers and ground water table and how these factors, combined with the development patterns within Chickahawk effect the drainage and infiltration of storm water.

Using the information gained from the studies, the Town of Southern Shores Storm Water Policy Advisory Committee made both community and property scale recommendations. Many of the recommendations focused on the need to engage the citizens of Southern Shores in a community education program encouraging the retention and infiltration of rainfall on site and limiting runoff from individual property owners. The Committee also suggested the development of a storm water management plan and the creation of a policy to protect water quality through ordinance changes for new development and redevelopment. In addition, the Storm Water Policy Advisory Committee suggested some potential funding sources for the implementation of these recommendations including grant funding to support water quality protection and the collection of a storm water utility fee. These recommendations mirror and complement recommendations made by the Outer Banks Hydrology Management Committee and the LID Feasibility Assessment.

The citizens of the Town of Southern Shores have a wealth of information relative to their environmental parameters and how they may influence or exacerbate storm water issues. By understanding this relationship, the Town of Southern Shores Storm Water Policy Advisory Committee has made well supported recommendations to address their current storm water issues. While town officials have a wealth of technical information, Southern Shores has not yet begun to develop and implement the recommendations. There are pressures to continue to keep Town operating expenses in check and property taxes and fees low, limiting the ability of Town officials to finance these improvements.

Nags Head

The Town of Nags Head has made significant progress in identifying and addressing their storm water issues. Since the Hydrology Management Committee report was released, the Town appointed a Storm Water Management Task Force, a committee designed to oversee the development of a comprehensive Storm Water Management Plan. The Town enlisted the assistance of the engineering firm WK Dickson in a project funded in part through the North Carolina Coastal Nonpoint Source Program. The study provided data on the local hydrology by delineating sub watersheds within the

town as well as identifying problematic storm water management areas.

The plan identified and prioritized 26 projects to manage flooding and water quality within the town. 19 of these projects were identified as flood control and seven sites as Best Management Practices (BMP) retrofit sites designed to further improve the water quality of storm water discharge. The process used to identify these sites included discussions with town staff, distribution of questionnaire to citizens (14% response rate), and public meetings in addition to the hydrologic and hydraulic modeling.

WK Dickson also recommended that the Town consider more stringent storm water management requirements on redeveloped lots and filling of low depressional areas for development. In addition, they recommended requiring the use of LID techniques for new and redevelopment to help limit the amount of runoff reaching the storm water conveyance system. They also recommended that the Town educate property owners on issues such as maintaining grass swales, disconnecting roof drains from impervious surfaces, utilizing rain barrels and picking up pet waste to minimize bacteria in the runoff.

Along with the development of a storm water management plan, the Town put in place a storm water utility fee to provide a dedicated revenue source to fund storm water projects. Since the completion of the storm water management plan, the Town of Nags Head has prioritized storm water project areas and has begun to fund and complete individual projects through the storm water utility fee.

Additionally, Nags Head actively participated in an ocean outfall monitoring research project, focused on quantifying the pollutant load and flow of stormwater discharging into the ocean. The Town in partnership with the state, NC DOT and research partners will be instituting best management practices to address the issues identified in the study. The Town also partnered with the UNC Coastal Studies Institute, Dare County NC Cooperative Extension Center and the NC Aquarium at Roanoke Island to create an education demonstration site at the Harvey Soundside Access facility which showcases rain gardens and cisterns to control and treat stormwater.

Strategies and Tools

The communities of the Northern Outer Banks are considering implementing several different elements into their storm water management retrofit plans. Some of those elements include:

1. **Low Impact Development (LID) Practices:** LID is the implementation of development in such a manner that the post development hydrologic response mimics the predevelopment hydrologic response (water quantity, character and constituents). While this development technique can be most effective in new development scenarios, there are many remodel and retrofit opportunities that exist. The utilization of rainwater harvesting practices, such as cisterns to reduce runoff and encourage water re-use is a good example of a LID element with practical application on the Outer Banks. All four reports noted in this case study recommended the use of LID techniques to address stormwater management.
2. **Community Education and Outreach:** A well organized and integrated community education and outreach program can be a vital component to a successful storm water management retrofit. A strong education program that incorporates local government interaction with homeowner education to promote individual lot scale onsite storm water best management techniques will reduce the amount of runoff that is added into an already taxed storm water management system.
3. **Storm Water Utility Fee:** Storm water utility fees allow municipalities to collect a dedicated

revenue source for storm water management which can reduce the financial burden on a local government's general operating funds. In addition, storm water utility fees can support a more comprehensive multi-year planning effort for improvements through a consistent financing source. Storm water utility fees are just one financing mechanism available to municipalities, but not necessarily one that can cover the entire cost of a community retrofit. Storm water utility fees can be used in conjunction with other funding sources to tackle large scale storm water retrofit plans.

Lessons Learned

1. A regional storm water management retrofit to protect water quality is a very challenging undertaking that requires the coordination and integration of strategies across municipal and property scales. While the Outer banks Hydrology Management Committee made many recommendations for solutions to storm water management, it is up to each of the individual towns to champion these solutions in a way that best fits with their storm water issues, environmental conditions, political climate and culture.
2. Understanding local hydrology and environmental parameters (soils, topography, vegetation, etc.) is a key initial step in the development of effective storm water management. This basic understanding of how the hydrology of an area functions will leave decision makers better informed to make sound decisions on the implementation of storm water management solutions.
3. An effective regional storm water management retrofit must involve an integrated approach involving measures at both the municipal and property scale. Community wide education and outreach is critical in the development of an effective plan. While many solutions can be implemented on municipal property, educating homeowners to retain and infiltrate their own storm water on site will reduce pressures on already overloaded municipal storm water infrastructure.
4. Implementing an effective storm water management retrofit plan can be a costly and difficult process. It is much more cost effective to incorporate storm water management planning into the initial planning phase of the development process. This can be applied to communities at a variety of scales from the site level to the municipal scale.

Panelists

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Case Study Resources

The following documents will provide additional background information on the Northern Outer Banks Case Study:

1. The full Outer Banks Hydrology Management Committee Report can be found at :
<http://csi.northcarolina.edu/content/education/lidassessment.htm>, an executive summary is on the following page.
2. The Low Impact Development Feasibility Assessment can be found at:
<http://csi.northcarolina.edu/content/education/lidassessment.htm>

Outer Banks Hydrology Management Committee

Report of Findings

Executive Summary

November 3rd, 2005

In an unaltered landscape, the management of rainwater is handled by its natural features. While a small portion runs off the landscape, the vast majority of rainwater infiltrates the ground and is either stored or used and released back into the atmosphere by plants during a process called evapotranspiration. Altered or developed landscapes such as the Outer Banks cannot process rainwater in the same way. Loss of vegetation, increased impervious surfaces and less land available for in-ground storage all lead to increased rates and amounts of rainwater runoff. Excess amounts of runoff and the inability to effectively transport this runoff has led to flooding events on the Outer Banks. Contacting the landscape, rainwater runoff can pick up nutrients, organic matter, pathogens, sediments, metals or volatile organic carbons and become polluted. The resulting polluted runoff water and flooding can lead to negative consequences such as “posted” beaches, shellfish closures and damaged property.

Considering the potential negative effects of excess storm water and runoff, Senator Basnight established and challenged the Outer Banks Hydrology Management Committee to make recommendations to address this problematic issue. The committee, made up of representatives from Dare and Currituck county governments, all the towns in Northern Dare, the N.C. Division of Water Quality, N.C. Division of Environmental Health, N.C. Department of Transportation, N.C. Homebuilders and Realtors Associations and the N.C. Coastal Federation, began meeting on September 21. This committee held 11 meetings over 45 hours and heard 15 speakers on a variety of topics relating to the hydrology of the Outer Banks. Based on the findings and discussions generated from committee meetings, the Outer Banks Hydrology Management Committee made several recommendations to aid in the management of storm water.

As a first step, communities are encouraged to reclaim their roadside drainage systems to improve their storage and infiltration capacity. This would require the reclamation of some ditches that might have been previously filled in by adjacent landowners.

Guidelines need to be developed for both landscaping and water conservation to ensure that the minimum amount of vegetation is disturbed or lost and the appropriate landscaping is replanted. Good irrigation practices should be used on landscaped surfaces as well as limiting grading that would drain added water to the streets. In addition, newly developed and redeveloped communities should provide guidelines to employ the recommended strategies for landscape and storm water management as outlined in the Low Impact Development (LID) guidelines.

Our current storm water outfalls need regular maintenance to function properly. While the dependence on storm water outfalls should be lessened by utilizing strategies to reduce the volume of water coming into the system, these outfalls are not currently performing as designed due to a lack of maintenance. Coordination is also needed in the planning, design, review and permitting process between DOT and local jurisdictions regarding curb cuts, driveways, pipe sizes and road side storage.

At the state and county level, there are incongruities between the septic permitting process from the Department of Health and the goals of this report. The Department of Health recommends using fill as a standard practice to permit new septic systems and this can result in several storm water management issues such as over-saturation and altered local hydrology. There needs to be coordination between the permitting process from the local Department of Health and town and county storm water management strategies.

Consistent with both LID and green building practices, the committee advocates the use of cisterns to reduce the demand on potable water supplies, especially during the summer peak season. The variable rate structure for drinking water could be adjusted to ensure that the program can cover its expenses during the winter months. The use of cisterns is most appropriate for use with individual structures, particularly commercial ones. Properly designed and utilized between rainfall events, cisterns can be an effective storm water treatment and water reuse device.

The Outer Banks Hydrology Management Committee recommends the creation of a consortium made up of representatives from each community to oversee the initiatives proposed in this report. Furthermore, the committee recommends that individual local governments should commit funding to support this consortium and to share costs to implement the needed programs. While this may require the establishment of a storm water fee to generate the funds needed to do the work, funding from other sources will need to be identified as the consultants develop budgets for both the work and the implementation of solutions to storm water issues.

The storm water and runoff issues experienced on the Outer Banks are not unique to this region. Across the state of North Carolina, hydrologic management is coming to the forefront as one of the preeminent environmental issues of our time. Environmental impacts such as losses to groundwater recharge, stream base flows and polluted runoff coupled with extreme flooding, mudslides and property damage make this an issue that demands our attention to assess the effectiveness of our storm water management techniques. The work done by this committee provides a solid framework for what could be truly innovative in the arena of storm water management and hydrologic reconstruction.