LID

LOW IMPACT DEVELOPMENT

for the North Carolina Coast

LID: A Way to Grow Smarter

More than a million new residents will move to eastern North Carolina by 2025. Accommodating this growth while still protecting our beautiful beaches and bountiful coastal rivers and sounds will be one of our major challenges.

The reason is simple: More people mean more roads, more rooftops, more driveways, and more parking lots. Rain running off these hard, constructed surfaces carries a host of pollutants – fertilizer, sediment, heavy metals, bacteria, gasoline and oil. This polluted stormwater flows untreated to the nearest river, sound or beach. Stormwater is now the major source of water pollution along the coast, and it will only get worse as more of our natural landscape is altered and built on.

The traditional ways of dealing with stormwater – the ponds, pipes and ditches – haven't been very effective. We have, for instance, lost more than 100,000 acres of our most sensitive shellfish-growing waters to stormwater contamination. It's time to grow smarter.

Low Impact Development (LID) can help us do that. This is a relatively new approach to designing and developing land that reduces and often prevents stormwater pollution. Instead of clear-cutting a construction site and moving mountains of dirt, LID developments work with the land, mimicking the safeguards that nature provides.

In a mature coastal forest, very little rainwater runs off the land and into the water. It slowly soaks into the ground to nourish trees and plants and to recharge streams, groundwater and wetlands. The rainfall can also pool on the surface where it evaporates.

LID seeks to mimic this, the natural hydrology that existed before development took place. It works effectively to protect water quality when land plans are designed based upon natural landscape features, and with proper site design and construction, as well as long-term maintenance. LID techniques can also be used to improve existing development.

LID techniques include rain gardens, cisterns, use of native vegetation, minimal land disturbance, reduced impervious surface, and clustering buildings along natural drainage patterns. These small-scale approaches used throughout a development capture rainwater as close to where it falls as possible, before it has a chance to become polluted runoff.

Not only can it reduce stormwater, but LID can make communities greener and more beautiful and, in many cases, can save developers money by reducing the costs of preparing a site and of building and maintaining stormwater infrastructure. It's also proven to be very versatile and can be used with residential, commercial and industrial projects and for "retrofitting," or fixing, existing sources of stormwater.

We at the N.C. Coastal Federation like LID. We hope that after you read through these pages, you'll like LID, too. Whether you're a developer, a homeowner, or a local-government official, LID offers something for you. We think it's a viable alternative to the pipe-and-pond approach of stormwater control, which is expensive and hasn't worked very well to protect our coast. We feel so strongly about LID that we have actively promoted it and have used it in our own projects, some of which you will read about here.

LID Strategies

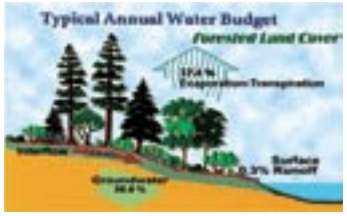
Optimize Conservation: Optimize the conservation of natural resources (trees, wetlands, and special areas), drainage patterns, topography, and soils.

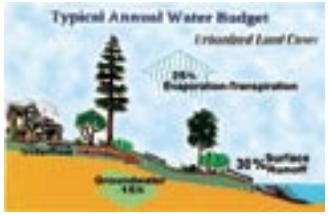
Reduce Footprints: Reduce grading, clearing, use of impervious surfaces and use of pipes to minimize water quality impacts.

Maintain Concentration Time: Slow runoff to encourage more infiltration and contact time with the landscape by saving natural drainage patterns, directing runoff away from impervious areas, using sheet flow and vegetative swales, lengthening flow paths, and flattening slopes.

Create Storage, Treatment: When additional storage volume, detention or treatment capacity are needed, use engineered landscape features such as infiltration devices, bio-retention systems, depression storage, filter devices, porous surfaces, and collection systems.

Encourage Pollution Prevention: Despite our best efforts to capture and treat pollutants using LID techniques, improper use, handling and disposal fertilizers, car care products and other chemicals can overwhelm treatment systems. It is necessary to educate property owners/managers on a wide array of pollution prevention measures to reduce the introduction of pollutants into the environment.





Working with Nature at Hoop Pole

Allowing the land to treat and reduce polluted stormwater flows is one of the main benefits of LID techniques, especially here on the coast where the sandy soils readily absorb runoff. The N.C. Coastal Federation (NCCF) put the land to work to help protect the last creek open to shellfishing in Atlantic Beach in Carteret County.

Using a grant from the N.C. Clean Water Management Trust Fund, NCCF in 1997 bought 31 acres surrounding Hoop Pole Creek and turned it into a nature preserve. A culvert installed by the state Department of Transportation ran through the property and discharged stormwater into the mouth of the creek. To enhance water quality in the Hoop Pole, something had to be done with the stormwater.

One plan called for removing the culvert and diverting the runoff, but that would have required extensive land clearing and disturbing the lush maritime forest. Instead, we put nature to work by devising a stormwater management plan that incorporates the site's topography, hydrology and native vegetation. With a grant from the N.C. Division of Water Quality, NCCF eliminated the need for the culvert and redirected the stormwater to flow naturally across the forested area. We built an elevated walkway that acts as a berm to help pool the runoff and allows it to soak into the soil before discharging into the creek.

Everyone wins: The creek is cleaner, the highway is still safely drained, and the town and public have a wonderful recreational amenity with the new boardwalk. The project illustrates the multiple benefits provided by LID practices.

Cover Photo: Fort Fisher Aquarium. *Photo by North Carolina State University*

Local ordinances that regulate lot size, road widths and setbacks can hinder LID design and promote monotony.

OLD WAYS CAN HINDER LID USAGE

There's a lot to like about LID. It can protect water quality by reducing stormwater flow. It can be cheaper than conventional ponds, pipes and ditches. And rain gardens and green space are a heck of a lot prettier than holes in the ground.

So why do we see so many of those ugly holes?

Part of the reason is that LID is relatively new, and it takes time to change the way we've been doing business for decades.

Our local laws are also part of the problem. Zoning and subdivision ordinances can contain some real LID roadblocks. Most coastal towns, for instance, have laws that require commercial buildings to have a minimum number of parking spaces based on their size. To meet the requirement, developers have to pave more land, thus increasing stormwater flow. Maybe they would like to add a bioretention area in the parking to capture runoff, but that would take up parking spaces they need to comply with the rules.

Most subdivision ordinances have rules about minimum road widths and the turning radius for cul-de-sacs. Meeting them means more asphalt and less control of stormwater. Other more regulatory common roadblocks that discourage LID are street and parking standards, grading and sidewalk requirements and prohibitions on using permeable paving.

Developers who want to use LID have to work around these rules by applying for variances and special-use permits. Since anything out of the ordinary can take more time to be approved by county boards, developers logically do what's easiest and less time-consuming. The result is yet another cookie-cutter subdivision.

Things, thankfully, are beginning to change. Several coastal towns and counties are beginning to study ways to incorporate LID practices into their codes as alternatives. Some local governments have made exceptions to existing codes to allow LID in subdivision design. A few, with NCCF's help, are crafting new ordinances and resolutions to support LID.

Changes are occurring on the state level, too. A recent evaluation showed that the N.C. Division of Water Quality's stormwater guidance manual doesn't currently promote LID because those who wrote it didn't envision LID being used to control stormwater. The manual does allow many LID practices such as infiltration, reducing impervious surfaces and vegetative filters to treat and prevent stormwater runoff. But the state is currently writing a statewide LID manual that will be useful. NCCF staff serves on the advisory committee for development of the new manual, which is due to be finished in December 2008.

Some Local Governments Consider LID Ordinances

Some local governments on the coast have recognized that their local laws can hinder developers from using LID and are taking steps to make it easier.

New Hanover and Brunswick counties and the city of Wilmington are fashioning local ordinances that will allow developers to voluntarily integrate LID techniques into their projects. NCCF is helping them with the project.

Officials in New Hanover and Brunswick have been working on their model LID ordinance since January 2007. Each county empanelled a technical review committee made up of engineers, developers, county staff and planners. Larry Coffman, a nationally recognized leader in the development of LID, worked with the committees to prepare model resolutions and a draft LID manual. They should be adopted later this year.

By removing the usual regulatory hurdles, the resolutions and manual will encourage developers to choose LID techniques instead of conventional stormwater approaches. The manual will describe site-planning principles and practices and also provide specific design standards for many typical LID techniques. Using them, developers could save money and still meet federal, state and local stormwater regulations.

Other local governments have been watching the progress in New Hanover, Brunswick and Wilmington. Already, town officials in Manteo in Dare County are considering a similar project as are officials in Cedar Point and Cape Carteret in Carteret County.

SOME LID TECHNIQUES

Bioretention Areas. Also called rain gardens, these are planted, shallow depressions designed to capture runoff, treat it and allow it to infiltrate the ground. In some places, porous soils are added, but the sandy soils of the coast usually need no amendments.

Cisterns. These are plastic or metal tanks used to capture rain water from roofs and reduce the volume of runoff. The captured water can be re-used for landscaping.

Green Roofs. Vegetated roofing systems that consist of a number of layers, including a drainage system, growing media and vegetation.

Permeable Pavement. ***(shown above)*** This covers a wide range of paved surfaces that allow water to pass rapidly through the surface and into the ground below.

Porous Concrete and Asphalt. Unlike regular concrete and asphalt, these have open spaces that allow water to pass through. They create a smooth paving surface.

Tree Box Filters. These bioretention systems are enclosed in concrete boxes that treat runoff that enters the boxes from a storm drain.

Vegetative Swales. These are broad, shallow channels designed to infiltrate stormwater runoff.

Spreadsheet Could Spread Way for LID

They call it "LID EZ." It's just a spreadsheet, really, but it could end up changing the way we regulate and treat stormwater.

In designing their local LID ordinances, officials in New Hanover and Brunswick counties and Wilmington needed a standardized way to determine if certain LID techniques would meet state, federal or local regulatory requirements.

Withers & Ravenel, an engineering firm, helped the counties develop a spreadsheet to accompany the LID design manual that the counties are currently devising. Each technique in the manual can be plugged into the Excel spreadsheet. It will then calculate the stormwater storage capacity of a technique or a combination of LID and conventional stormwater collection methods.

It all sounds pretty arcane, but the spreadsheet provides a standardized and easy way for state and local regulators to assess LID permit applications. Developers now have a time-saving tool to ensure that the LID techniques they're using will meet state requirements. The state Division of Water Quality has examined the spreadsheet and has indicated that it is an acceptable way to calculate LID's effectiveness for permit applications. That kind of assurance should promote the use of LID.

The Somerset LID saved hundreds of thousands of dollars. *Photo by Larry Coffman*

LID Designs Shown to Save Developers Money

About half the 200 houses in the Somerset subdivision outside Washington were built as a conventional subdivision using curb and gutters, stormwater ponds and the like. LID techniques were used on the other half. Using LID saved the developers almost $800,000.

Somerset isn't unique. The U.S. Environmental Protection Agency studied 17 residential and commercial developments to compare the costs of conventional designs to those that used LID methods. LID saved developers 15 percent to 80 percent in capital costs compared to conventional methods, the EPA concluded in a report released in December 2007. The report also noted that LID practices led to less polluted runoff and were generally better for the environment.

The more developers integrated LID into the site planning, the more they saved. At Somerset, developers eliminated the four ponds to hold runoff in the LID section, knocking $650,000 off construction costs. Removing the attendant pipes and ditches saved another $150,000. Building roads without curbs and gutters trimmed an additional $350,000 off the final costs. Add the $370,000 for the needed rain gardens and the savings totaled $780,000.

NCCF asked N.C. State University to do a similar comparison in North Carolina in early 2007. That study developed an alternative LID plan for a 39-acre subdivision that was originally designed using conventional methods and included an 8,500-square-foot stormwater pond. The LID alternative converted driveways and portions of roads from asphalt to pervious concrete and added a rain garden along a road. The study also evaluated the cost of further treatment of polluted runoff by putting more LID practices on individual properties.

Overall the study found that eliminating curbs and gutters and stormwater ponds and using narrower streets saved money. Developers could cash in on a real bonanza if the land reserved for the pond were then converted into developable lots.

Restoring Nature's Balance Is Key to LID Subdivisions

The houses line the street in cookie-cutter style. They are built on one- to three-acre lots and are coupled together by pipes and ditches that carry polluted runoff to the nearest drain. Concrete driveways connect to 40-foot wide asphalt roads that drain down to the marina, where the boat ramp acts like a funnel for the runoff.

These are the kind of waterfront subdivisions we normally build in coastal North Carolina. They are built to move runoff as quickly as possible away from the houses and streets, using practices developed in the 1970s and '80s. Our coastal rivers, creeks, and sounds have paid the price.

There must be a better way. If we are to preserve what's left of our coastal waters, we must learn to grow smarter.

We must learn to build more places like the Prairie Glen subdivision in Wisconsin. All right, it's not on the coast, but many of the conservation features that developers used there could be easily used here. A significant portion of the site – 59 percent–was preserved as natural open space. Wetlands were built to manage stormwater runoff, and the open space allowed for the reintroduction of native plants and wildlife habitat. The site layout incorporated hiking trails, which were designed to allow the residents to have easy access to natural areas.

Project	Conventional	LID	Cost Difference	Difference
Bellingham City Hall	$27,600	$5,600	$22,000	80 %
Auburn Hills	$2,360,385	$1,598,989	$761,396	32 %
Donovan Park	$52,800	$12,800	$40,000	76 %
Gap Creek	$4,620,600	$3,942,100	$678,500	15 %
Garden Valley	$324,400	$260,700	$63,700	20 %
Prairie Glen	$1,004,848	$599,536	$405,312	40 %
Somerset	$2,456,843	$1,671,461	$785,382	32 %

Source: U.S. Environmental Protection Agency

And you ready for this? Using LID techniques saved the developers almost $600,000 in construction costs.

To realize those kinds of savings, though, developers had to do more than just add a rain garden here and there. Controlling polluted runoff, for instance, means mimicking as much as possible the natural capacity of the land to capture and treat pollutants. That usually means distributing LID controls throughout the subdivision.

Hydrology, says LID expert Larry Coffman, is the key. A subdivision, he explains, must be engineered in a way that maintains the land's natural water balance. The goal is to minimize development's effects and restore vital ecological processes necessary to restore and maintain the quality of our waters.

Coffman recommends that developers of LID subdivisions follow a few basic steps:

Define Project Objectives and Goals. Identify the ecological needs of the site including runoff volume and water quality. Determine the feasibility for LID techniques.

Evaluate and Analyze the Site's Potential for LID. This will ease LID design by providing site details that will help the engineer choose the best LID techniques for each project. Special consideration must be given for the individual constraints of each site and the goals for the receiving waters.

Maximize the Use of Natural Features and Open Space. It's important to conserve and protect open space, areas of native vegetation and natural drainage corridors, such as dry channels that convey water during storms.

Minimize Effects at the Lot Level. In general, conserve wetlands, trees, and natural drainage patterns. Once conservation is optimized, more can be done at the lot level to further minimize effects, such as disconnecting roof drains and reducing paving.

Use Engineered LID Techniques. If site planning isn't enough to meet the regulatory objectives, engineered LID practices may be needed. An important goal of LID is to create ways to contain runoff to meet regulations. Engineered techniques include bioretention, vegetated swales, permeable concrete and collecting rainwater from rooftops.

Create a LID Master Plan. A master plan helps identify the all key issues and areas for LID. To minimize the runoff potential of the development, evaluating its hydrology should be an ongoing part of the design process.

Incorporate a Pollution Prevention Plan. Developers, property owners and property managers all need to play a role in teaching others about the importance of LID techniques in their development and on individual properties. This can include a mission statement for the development, interpretive signs, and LID information in marketing materials.

Create an Operations and Maintenance Plan. Post-construction inspections and maintenance of LID structural and non-structural practices are important to ensure effectiveness. Annual inspections are recommended.

SUBDIVISION STRATEGIES

Minimize grading a clearing.

Maintain native vegetation.

Conserve soils that infiltrate well and place LID techniques in these areas.

Disconnect impervious surfaces by draining them to natural features.

Landscape with rain gardens to hold runoff on the lot and to filter of rainwater and to recharge the groundwater.

Direct gutters and downspouts to a rain garden.

Retain rooftop runoff in a rain barrel or cistern to use in lawn and garden watering.

Combine the rain gardens with grassed swales to replace a curb and gutters.

Use permeable pavers for walkways and parking areas.

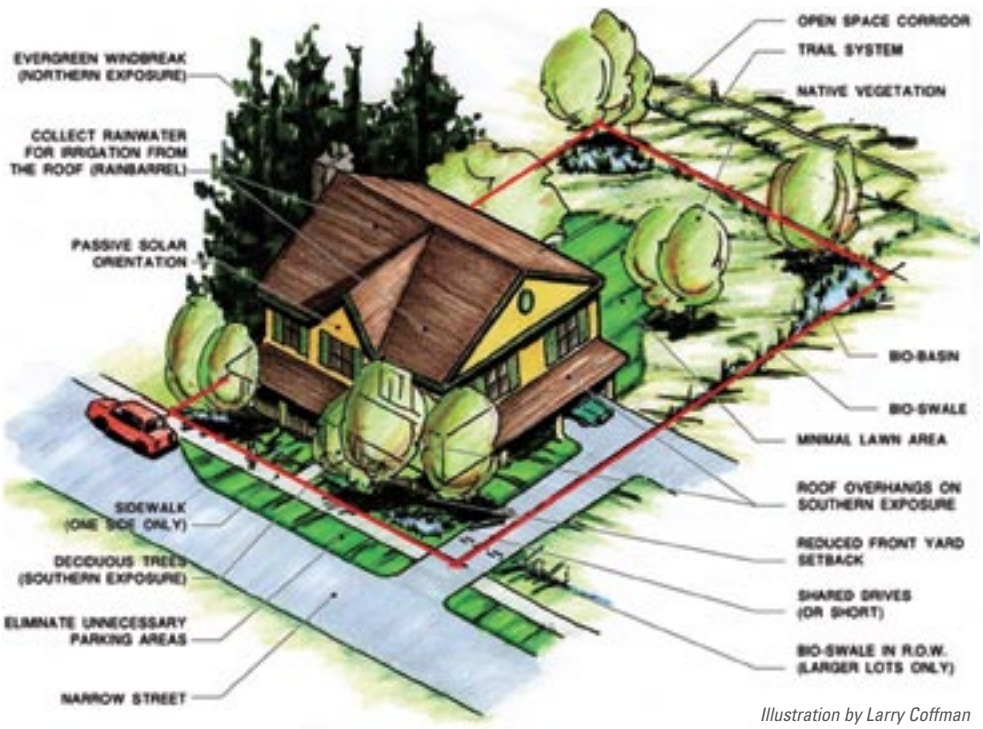


Illustration by Larry Coffman

Homeowners Can Do More to Protect Waters

What we do in our own backyards can greatly affect the surrounding coastal waters we enjoy for swimming, fishing and boating. Traditional landscaping and the maintenance of our lawns and gardens can have negative effects on water quality, especially when everyone in the neighborhood is doing the same things.

Builders often clear lots of natural vegetation before homeowners even buy the property. The new owners then add to the problem by planting large lawns, which require watering, fertilizer and herbicides on a regular basis. We often inadvertently add invasive plants that out-compete the native species.

But there are some simple LID techniques that you can use to ensure that your home and yard contribute as little as possible to pollution of our coastal waters:

- **Direct your gutters and downspouts away from driveways and into a rain garden or naturally vegetated area.**
- **Collect rain draining off roofs into barrels or cisterns.** Use it to water your garden, flower beds and lawns.
- **Minimize lawn areas by replanting with natural vegetation and trees.** Native trees provide shade, filter and soak up water and are habitat for birds and wildlife. Natives also generally require less care and can tolerate a wide range of conditions.
- **Landscape with rain gardens to provide specific areas that collect and soak up rain.** Rain gardens also help recharge groundwater supplies which are critical in these times of drought.

Photos by Larry Coffman

- **Use permeable pavers for walkways and parking areas.** The pavers allow rain to infiltrate into the soil, preventing runoff and recharging groundwater supplies.
- **Minimize or discontinue using fertilizers and herbicides.** These chemicals easily run off into rivers and streams, triggering algae blooms and fish kills.

New State Program Pays to Control Stormwater

A new state program is helping towns, schools, businesses and homeowners on the coast control stormwater. It's also picking up much of the bill.

The N.C. Soil and Water Conservation Districts started the Community Conservation Assistance Program (CCAP) to encourage local governments and individual landowners to use the best practices on their land to fix existing stormwater problems. As an incentive, the CCAP will pay 75 percent of the average installation costs of these practices.

Those practices include such LID techniques as rain gardens, cisterns, conversion of impervious surfaces, permeable pavement and backyard wetlands.

The program is modeled after a similar one that farmers have used to address numerous water-quality issues. The soil and water districts hope that CCAP will be as successful as its Agriculture Cost Share Program.

NCCF has already helped coordinate several CCAP projects, including those at Hammocks Beach State Park, on Jones Island in Onslow County, and at White Oak and Smyrna elementary schools in Carteret County.

Native Plants, Rain Gardens A Perfect Fit

Like love and marriage, native plants go perfectly with rain gardens.

Native plants have adapted to survive in a wide variety of local environmental conditions, including droughts, heavy rainfall and high and low temperatures. Their tolerance to these local conditions makes native plants easy to maintain and healthy without fertilizers or pesticides. Native plants also provide habitat for butterflies, birds, insects, and other types of wildlife. Some native plants develop extensive root systems that further increase the ability of soil in rain gardens to retain and absorb stormwater.

Wal-Mart Uses LID for Cedar Point Store

Wal-Mart, the momma of all Big Boxes, announced in 2006 that it was coming to Cedar Point, a small town on the far western end of Carteret County. Unlike the state, the town had no rules regulating stormwater. Unlike the county, it had no building inspectors, no large planning staff. But it still wanted to ensure that the runoff coming off the proposed store's six acres of parking lots wouldn't further pollute an already polluted creek.

Though it knew that its program was a failure in protecting the quality of the coast's most sensitive waters, the state Division of Water Quality would have required that the Wal-Mart merely meet the minimum standard of holding 1.5 inches of rain in 24 hours. The excess would have flowed into Boathouse Creek, which the state had recently closed to shellfishing because of high bacteria levels.

That wasn't good enough for the town. Its Planning Commission refused to sign off on the store's site plan until the company looked at ways to more effectively control stormwater. The commissioners asked the Wal-Mart engineers to consult with NCCF and come back with a better plan. The engineers could have ignored the town and submitted a stormwater application that satisfied the state's minimum requirements. Like the town, though, they wanted to do the right thing.

The site plan had already been devised, and it would have been too expensive to redesign the plan to include LID methods. The engineers decided to use a combination of LID and conventional stormwater techniques. They greatly enlarged the stormwater ponds that surround the site and replaced a part of the asphalt parking lot with permeable pavement. The town waived a landscaping ordinance that would have required the store to evenly space small trees throughout the parking lot for aesthetic reasons. Instead of dozens of small dirt islands that would have done nothing to control stormwater, the parking lot will contain several large rain gardens and the parking lot will be sloped to direct some of the runoff to them. By using this combination of methods, engineers think they'll be able to hold as much as 10 inches of rain in 24 hours, far exceeding what the state would have required.

Cedar Point's town council approved the new site plan, and the state gave Wal-Mart a stormwater permit that included the combination of controls. The company was to start construction in 2007 but has delayed the project until at least 2010.

Photo by Larry Coffman

Thinking Outside the Big Box

It has become part of our language – the "Big Box." They are large, usually more than 100,000 square feet, and are off major roads with high visibility. They are surrounded by acres of parking lots to accommodate our cars, trucks and vans, and most Americans love them. These giant stores provide one-stop shopping for a variety of goods at low prices. What's not to like?

Visit the two big boxes in the Morehead Crossing Shopping Center in Morehead City during a heavy rain, however, and see what all that asphalt will do. You'll be lucky to make it to the main road. Vast amounts of rain stream off those huge parking lots, overflowing the series of ponds meant to hold it, flooding the entranceway and spilling out onto the main road. Those two-by-fours or that CD player from China may have been cheap, but what are their real prices?

Big-Box LID Methods That Make Sense

- Preserve native vegetation
- Reduce size of parking lot
- Use permeable pavement instead of asphalt
- Rain gardens in parking lots
- Minimize the generation of pollutants
- Use vegetated swales
- Collect rainwater for reuse

Fixing existing Big Boxes likes the ones in Morehead Crossing will be expensive, but building new ones so that they don't flood roads and pollute water doesn't have to be. According to the Low Impact Development Center and LID expert Larry Coffman, LID techniques can be incorporated into the site design of large-scale commercial projects without significantly altering traffic flow, parking capacity or building footprints. They suggest that typical LID techniques used for high-density developments could include: buffers, swales, bioretention systems, green roofs, porous pavers and planter boxes. Stormwater can also be stored and detained under parking lots by using porous pavers.

The key, they say, is to use multiple LID systems on the site and to include them early in the planning phases of the development in order to maximize the land's natural ability to control runoff. In the best of conditions, LID methods could manage all stormwater; in more challenging circumstances LID can be used in combination with more traditional stormwater methods. Overall, the relative ease of using LID is a function of local site constraints including soil and groundwater conditions, climate, topography and local regulations.

Existing regulations and current development practices present barriers, both perceived and real, to using LID in large commercial development. Many towns and counties on the coast have rules, for instance, that require a minimum number of parking spaces and a minimum size for each space. Such rules encourage more paving and thus more stormwater. As government officials and big-box builders become more aware of the benefits and effectiveness of LID, these barriers will eventually come down. Government, though, needs to lead the way by providing new standards, education and incentives. Until then, the big-box builders must be willing to accept some risks, try new things and look at the economic, social and environmental costs and benefits when designing their boxes.

www.lowimpactdevelopment.org/bigbox/lid%20articles/bigbox_summary.pdf
Fact Sheet from LID Center on LID for Big Box Retailers

dnr.metrokc.gov/wlr/stormwater/low-impact-development.htm
Model Low Impact Development Strategies for Big Box Retail Stores describes low impact development (LID) methods for designing stormwater systems for "big box" retail stores. The report was developed by King County Washington.

www.mdp.state.md.us/planningact/download/bigbox_v3.pdf
LID design for Big Box Retailers out of Maryland

Cistern at the Core Sound Waterfowl Museum

Rain Garden at Hammocks Beach State Park

Public Places Become LID Showcases

What better place to showcase LID designs than in our public buildings and spaces – our museums, schools and public parks. They should be the models for good development practices, where people go to learn how to grow smarter.

NCCF has worked with various partners on a variety of LID projects at parks, schools and museums. There, visitors can learn about the effects polluted runoff can have on coastal water quality and can discover cost-effective and simple techniques that can be used at their own homes to reduce runoff and improve water quality in our estuaries.

Core Sound Waterfowl Museum

We're trying various techniques at the Core Sound Waterfowl Museum and Heritage Center and Cape Lookout National Seashore Visitor Center on Harkers Island to reduce bacteria concentrations in Core Sound. The LID treatments, which include a cistern to capture rainwater, rain gardens and a wetland, will help to absorb and filter stormwater and its pollutants at the two sites and should reduce stormwater flowing into the sound and thus protect shellfishing waters.

Through grants from the N.C. Clean Water Management Trust Fund and North Carolina Sea Grant, engineers from N.C. State University have created a comprehensive stormwater management plan that will identify additional possible locations for stormwater treatment at the two sites, suggest appropriate LID treatments and provide preliminary designs and cost-estimates for each treatment. This master plan will be used for future growth and improvement at these sites as additional money become available.

Hammocks Beach State Park

With more money from the Clean Water Management Trust Fund, NCCF worked with Hammocks Beach State Park in Swansboro on an LID project to reduce the amount of stormwater entering shellfish waters around the park.

Nearly half of the asphalt covering an old parking lot near the park's maintenance area was removed and replaced with a natural planted buffer. Several rain gardens and vegetated swales now treat stormwater runoff from the remaining parking lot area. We also reduced the width of the access road to the parking lot and diverted stormwater from building roofs to vegetated areas.

An ongoing education program will inform people of the value and function of stormwater controls.

The stormwater retrofit project will reduce the volume and velocity of stormwater throughout the site and should improve the quality of the water surrounding the park. The state currently considers those waters as being "impaired" because they temporarily close to shellfishing after moderate rains.

Schools to Get Rain Gardens

The NCCF has partnered with numerous organizations to install LID techniques at three schools in Eastern North Carolina. Rain gardens are being installed at the following schools in 2008 and will help to reduce stormwater runoff from school parking lots and building roofs:

Chocowinity Middle School, Beaufort County. Funded by: Wal-Mart. Project Engineers: Biological and Agricultural Engineering Department, N.C. State University

Smyrna Elementary School, Carteret County. Funded by: N.C. Department of Transportation (DOT); N.C. Community Conservation Assistance Program (CCAP), N.C. Division of Soil and Water Conservation; and Wal-Mart. Project Engineers: DOT.

White Oak Elementary School, Carteret County. Funded by: CCAP and Wal-Mart. Project Engineers: Withers & Ravenel.

GLOSSARY OF LID TOOLS

Bioretention Areas: Also known as rain gardens, these provide onsite retention of stormwater through the use of vegetated depressions engineered to collect, store and infiltrate runoff.

BMP: Best Management Practice. A practice or combination of practices that are the most effective and practicable means of controlling pollutants at levels compatible with environmental quality goals.

Buffer: A vegetated zone adjacent to a stream, wetland or shoreline where development is restricted or controlled to minimize the effects of development.

Cluster Development: Buildings concentrated in specific areas to minimize infrastructure and development costs while achieving the allowable density. This approach allows the preservation of natural open space for recreation, common open space and environmentally sensitive features.

Hydrology: The science dealing with the waters of the earth, their distribution on the surface and underground, and the cycle involving evaporation, precipitation, flow to the seas, etc.

Impervious Area: A hard surface area, such as a parking lot or rooftop, that prevents or retards water from entering the soil, thus causing water to run off the surface in greater quantities and at an increased rate of flow.

Low Impact Development: The integration of site ecological and environmental goals and requirements into all phases of urban planning and design from the individual residential lot level to the entire watershed.

Nonpoint Source Pollution: Water pollution caused by rainfall or snowmelt moving over and through the ground and carrying with it a variety of pollutants associated with human land uses.

Open Space: Land set aside for public or private use within a development that is not built upon.

Permeable: Soil or other material that allows the infiltration or passage of water or other liquids.

Rain Barrels: Barrels designed to collect and store rooftop runoff.

Rain Garden: See bioretention area. Synonymous with bioretention area, this term is typically used for general audience discussions.

Runoff: Water from rain, melted snow, or irrigation that flows over the land surface, picking up pollutants that are on the ground.

Swale: An open drainage channel designed to detain or infiltrate stormwater runoff.

Watershed: The topographic boundary within which water drains into a particular river, stream, wetland or body of water.

Wet pond: A stormwater management pond designed to detain urban runoff and always contain water.

Want to Know More?

Commercial Development

Model Low Impact Development Strategies for Big Box Retail Stores. Produced by Kings County, Wash., this is a general reference on LID and large commercial buildings. dnr.metrokc.gov/wlr/stormwater/low-impact-development.htm

Low Impact Development for Big Box Retailers. East to read one page fact sheet by the Low Impact Development Center. www.lowimpactdevelopment.org/bigbox/lid%20articles/bigbox_summary.pdf

Economics

Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices. This EPA study analyzes the costs of LID compared to conventional development practices. www.epa.gov/owow/nps/lid/costs07/documents/reducingstormwatercosts.pdf

General

Low Impact Development Center. This a non-profit organization dedicated to the advancement of LID technology. www.lowimpactdevelopment.org

North Carolina Coastal Federation. We are a non-profit organization dedicated to protecting and restoring the coast. For general information about LID, visit www.nccoast.org.

Homeowners

Urban Design Tools. Link to tips and graphic showing what homeowners can do to protect water quality. www.lid-stormwater.net/general_residential.htm

Center for Watershed Protection. Links to resources on community watershed protection, including information on how to build rain gardens and rain barrels. www.cwp.org/Community_Watersheds/educating_constituents.htm

Ordinances

Promoting Low Impact Development in Your Community. This fact sheet from Maine includes information on codes and subdivision strategies. efc.muskie.usm.maine.edu/docs/LID_Fact_Sheet.pdf

Public Buildings

Low Impact Development Center. The Sustainable Schools Project website offers curricula and design criteria for developing school rain gardens. www.lowimpactdevelopment.org/school/index.html

Benefits From LID

To the Coastal Environment

- *Helps protect water quality by reducing sediment and stormwater pollution*
- *Protects shellfish growing areas and beaches from bacterial contamination*
- *Preserves trees, natural vegetation and open space*
- *Helps recharge groundwater aquifers and supplies*

To Developers

- *Reduces costs of infrastructure such as curbs, gutters and stormwater ponds*
- *Reduces costs of site grading and clearing*
- *Helps meet state stormwater regulations*
- *Can help produce more attractive developments that sell faster*
- *Can increase the number of lots by reducing the size of stormwater ponds*

To Local Governments

- *Balances growth with environmental protection*
- *Helps reduce flooding*
- *Helps reduce the cost of maintaining curbs, gutters and other infrastructure*
- *Promotes positive public and private partnerships in stormwater management*
- *Creates more attractive neighborhoods*

To Homeowners

- *Creates aesthetically pleasing landscape gardening*
- *Attracts birds and butterflies*
- *Provides free water for landscaping*
- *Helps reduce yard flooding*

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Join The North Carolina Coastal Federation

MEMBERSHIP APPLICATION

Yes, I want to help protect and restore our coast. Please enter my membership in the North Carolina Coastal Federation today.

Name

Address

City State Zip

Phone

Email

Individuals or Families:
☐ $35 ☐ $50 ☐ $100 ☐ $250 ☐ $500 ☐ $1,000

Businesses, Groups & Organizations:
☐ $50 ☐ $100 ☐ $250 ☐ $500 ☐ $1,000

Additional benefits: $100 level – NCCF hat; $250 level – NCCF shirt and hat; $500 level - NCCF hat and shirt and listing in NCCF's Annual Report; $1,000 level – NCCF hat and shirt, listing in Annual Report and invitation to a private NCCF event.

Please make your check payable to NCCF and mail with this form to 3609 Highway 24 (Ocean) Newport, NC 28570 or complete the credit card information:

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Signature

Membership fees minus the value of benefits received are tax-deductible. Fair market value of benefits are: $35-$50 level: 0; $100 level - $10; $250 level - $20; $500 level - $25; $1,000 level - $50.

☐ Check here if you wish to waive benefits and receive the maximum deduction.

PLEASE RECYCLE.

North Carolina Coastal Federation
3609 Highway 24 (Ocean)
Newport, North Carolina 28570
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