



# Who Will Stop the Rain

LID Strategies for  
Stormwater Management and  
Water Resources Protection  
in North Carolina

2007



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Water Resources Permitting Manager

# The Issue

## A Question of Balance



**THE TRIANGLE IS BOOMING AGAIN!**

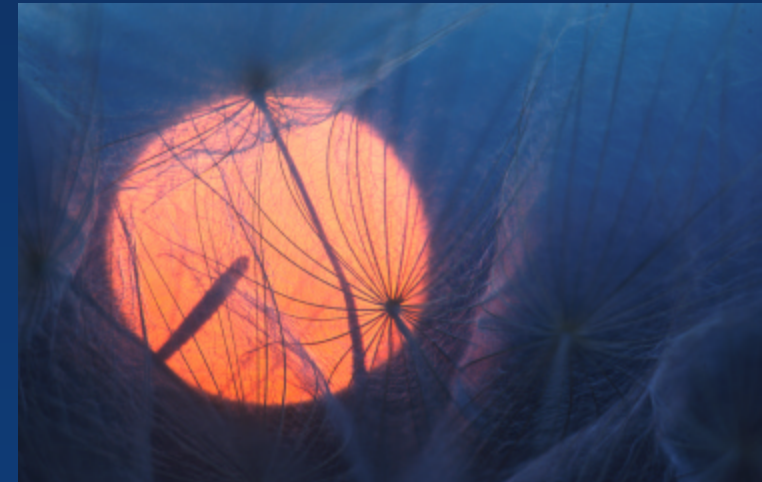
How do we balance ...

Water Resources Protection/Permitting  
with  
High Quality Economic Development?

# The Answer

## Low Impact Development (LID)

- Designs with Nature
- Protects Valuable Resources
- Maximizes Green Space
- Maintains Wildlife Corridors
- Expedites Permitting
- Produces Top Quality Projects
- Enhances Marketability
- Increases Profits
- Provides Proven Technology
- VA, MD, MN, WI, OR, WA, MA, NJ, EPA, NAH, ASCE AIA, HUD
- Google = 79 million hits



# Water resources permitting

## Direct Impacts Are NOT the Primary Problem

- USACE –  
DWQ Regulations
- (Section 404/401, etc.)
- Effectively Control  
Stream/Wetland Filling



# **Water resources permitting** **Off-Site Impacts ARE the Primary Problem**

- **Premium  
on Protecting**
- **Downstream**
- **Water Quality &  
Flow Rates/Volumes**



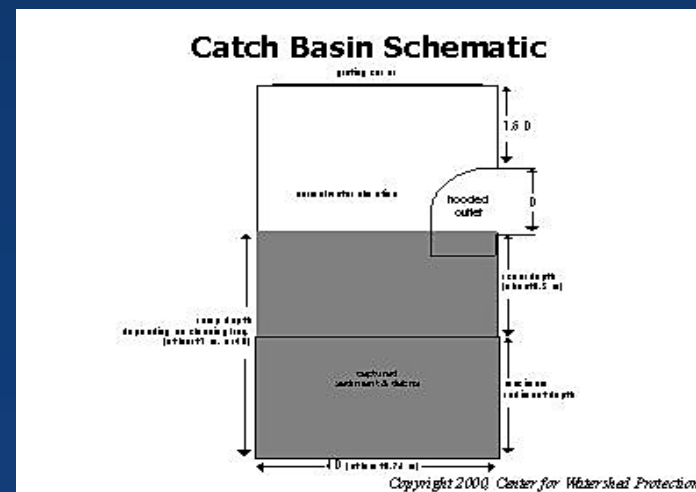
# Stormwater Management

## The Conventional Approach

- “Pipe-and-Pond”
- Hard Engineering
- Centralized Runoff
- Heavy-Duty Infrastructure
- High Cost
- Low Aesthetics
- Safety Risks

# Conventional Approach Catch Basins

- Poor TSS-pollutant removal rates
- Can become a source of pollutants
- Frequent maintenance
- Cannot remove soluble pollutants
- Cannot remove fine sediments





# Conventional Approach

## Large Detention Basins/Ponds

- “End-of-pipe” treatment
- High infrastructure cost
- Lost developable area
- Groundwater pollution
- Low aesthetics
- Safety hazard
- Require fencing
- Stagnation
- Mosquito breeding



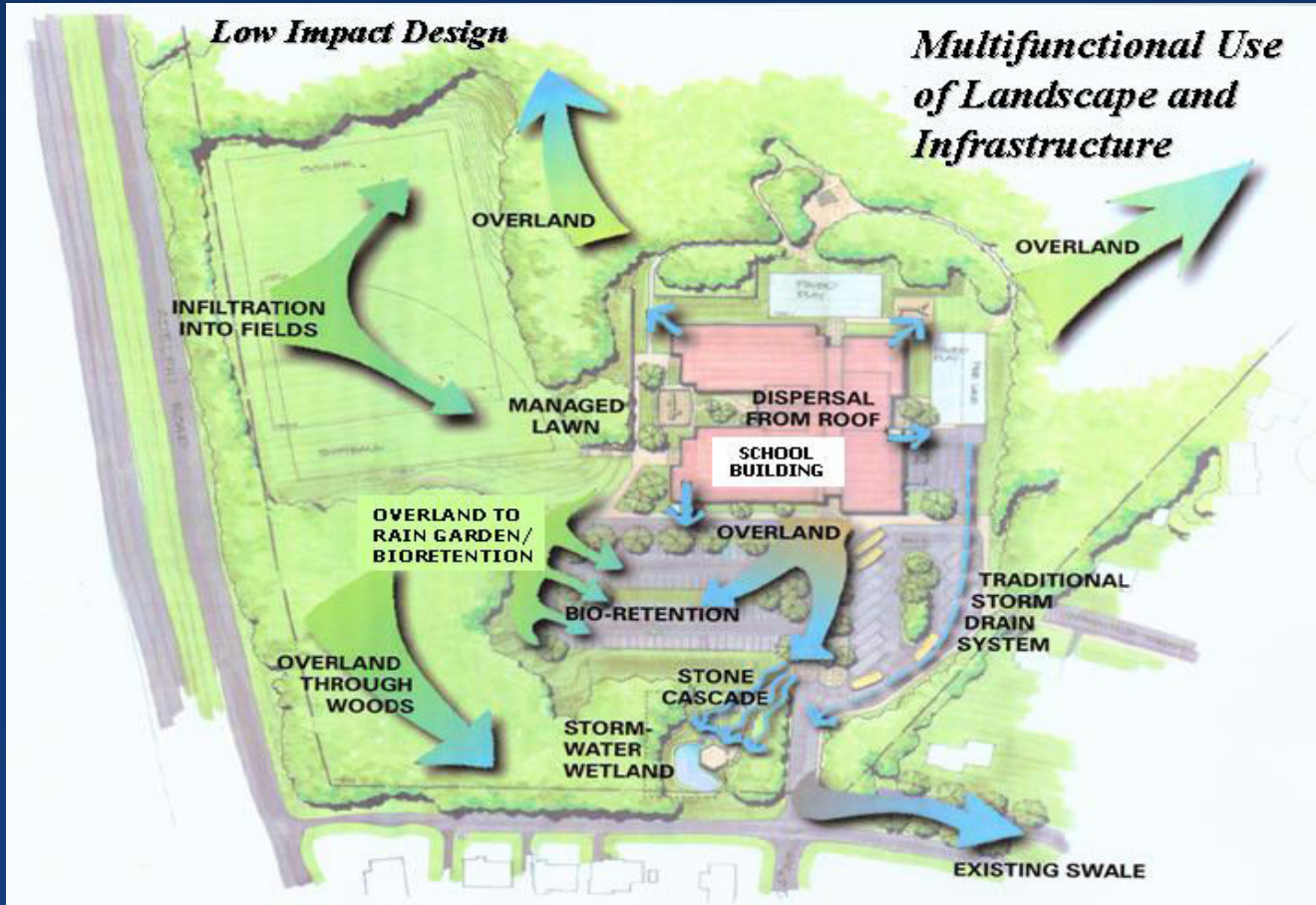
# Stormwater Management

## The Innovative Approach

### Low Impact Development (LID)

- Non-structural engineering
- Works with natural topography
- Mimics natural hydrology
- Blends built and natural environments
- Uses decentralized mini-watersheds
- Yields customized site designs

# How does LID work?



# LID – Benefits



# Comparison Overview

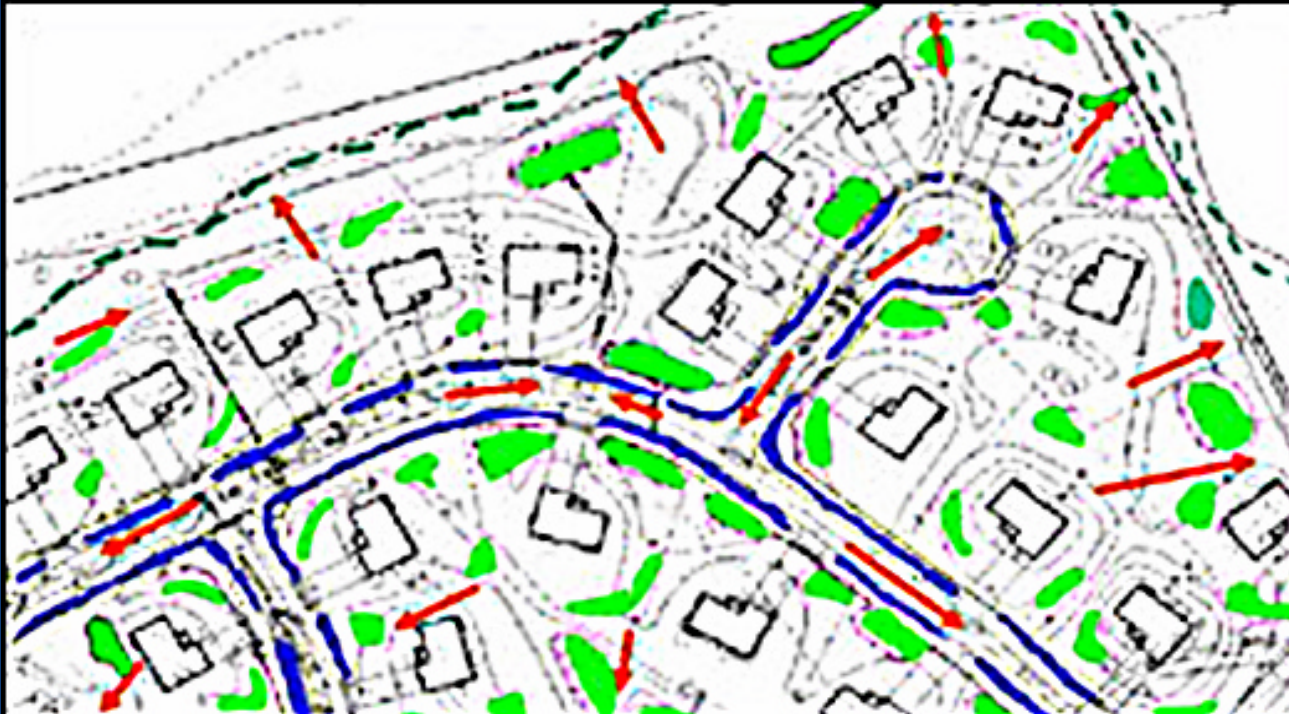
## Conventional - Flow Paths



Centralized runoff collected and discharged into one primary BMP (large detention basin).

# Comparison Overview

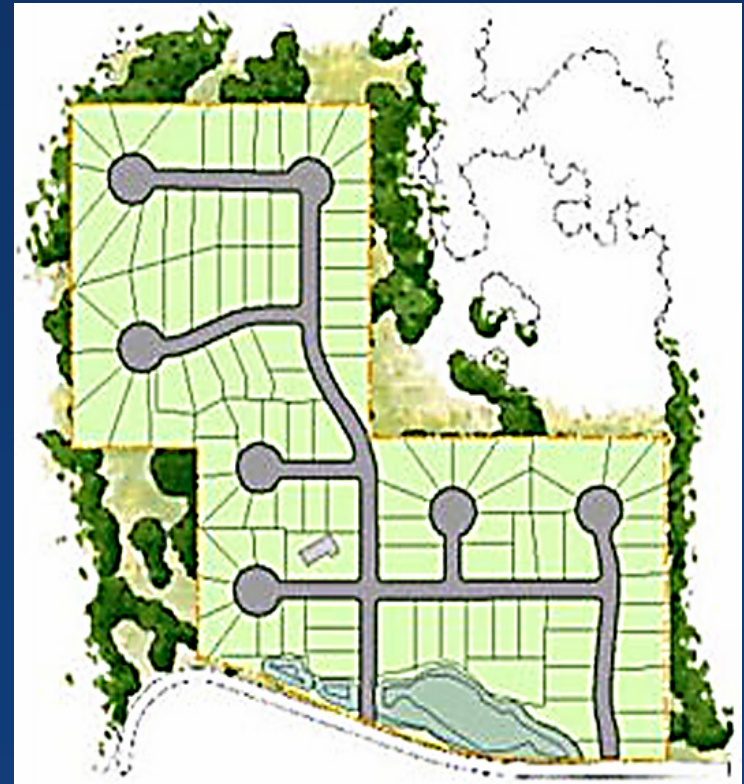
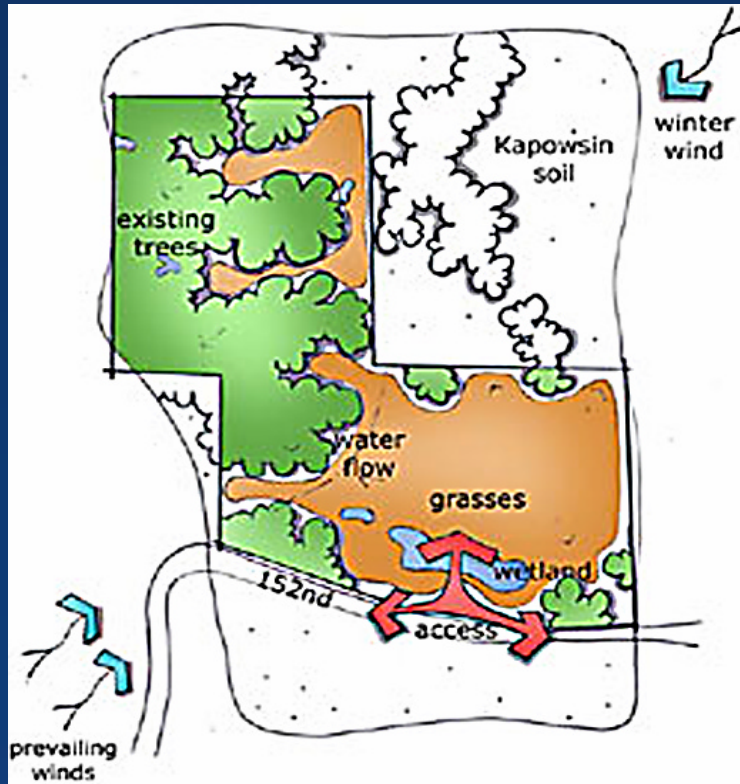
## LID - Flow Paths



Runoff decentralized into sub-watersheds, then contained & treated at source by multiple BMP's.

# Comparison Overview

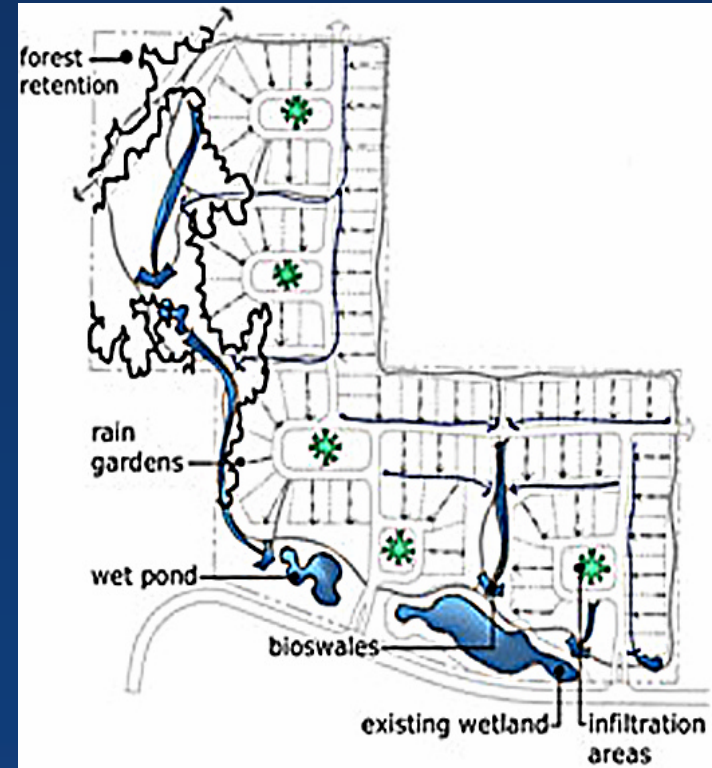
## Conventional – Site Plan



Design alters existing topography and drainage patterns while maximizing buildable area.

# Comparison Overview

## LID – Site Plan



Site design is compatible with existing topography,  
native vegetation and drainage patterns.



# Comparison Overview

## LID – Detail



Stormwater is managed at its source on a lot-by-lot basis.

# LID Design Sequence

- Conduct site assessment
- Define building envelope
- Develop conceptual plans
- Use natural contours
- Create sub-watersheds
- Treat runoff at source
- Size for low-intensity storms
- Emphasize small, local BMP's



**BMP's =**

**Best Management Practices**



**BMP's**  
are the  
**Building Blocks**  
of  
**LID**

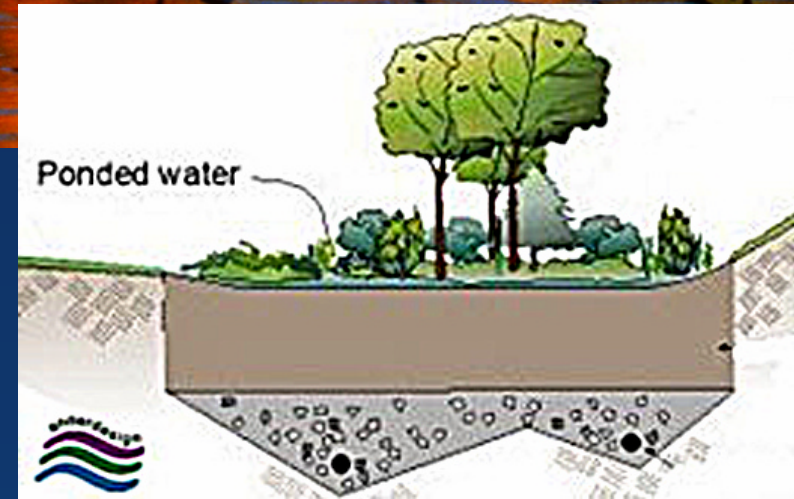
# Erosion controls

- Clear in phases
- Minimize bare ground
- Dual controls
- Double silt fence
- Silt fence & haybales
- Fiber rolls/vegetation
- Filter fabrics
- Stockpile extras



# Bioretention Swales Design

- Sheet flow runoff
- No curbs/gutters
- Proper grading
- Design flexibility
- Parking lot islands
- Roadway medians
- Multi-functional designs
- Routine maintenance
- ~ \$10 per square foot



# Bioretention Swales Types



# Bioretention Swales

## Development #1

### Excavation & Preparation





# Bioretention Swales

## Development #2

Third Growing Season



# Bioretention Swales

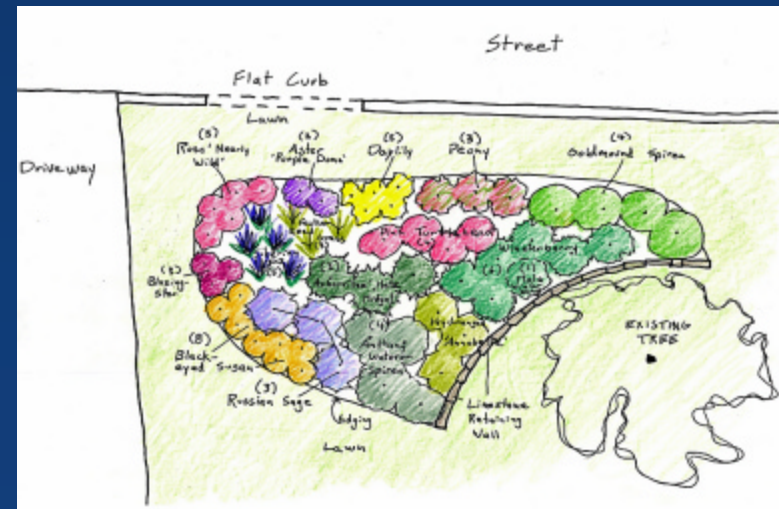
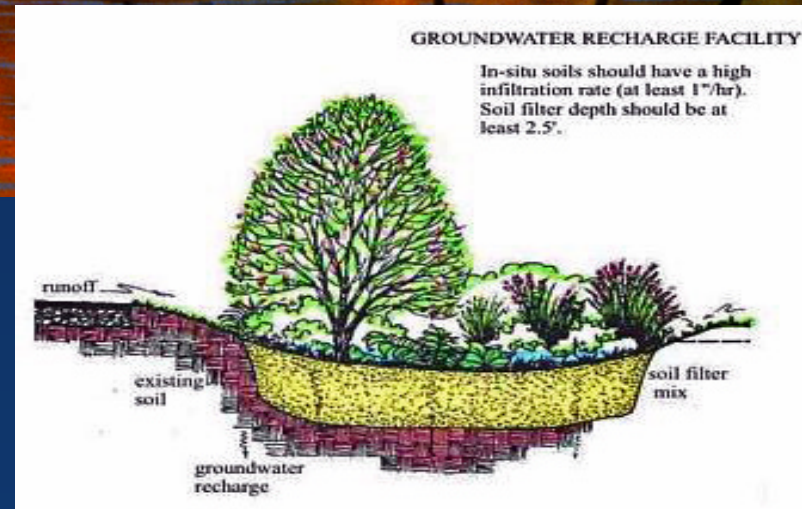
## Development #3

Fifth Growing Season



# Rain Gardens

- Essentially same design
- Emphasis on plantings
- Individual lots
- Organic growing medium
- Native plants
- Wildlife habitat
- Aesthetics
- Irrigate with roof runoff
- Routine maintenance

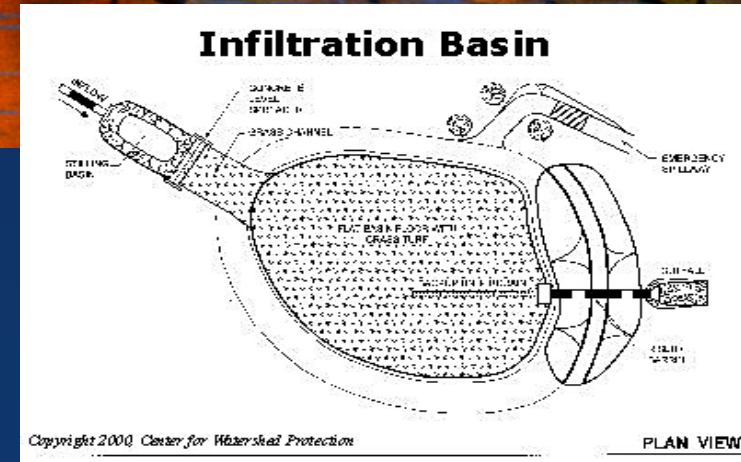


# Rain Gardens



# Infiltration Devices

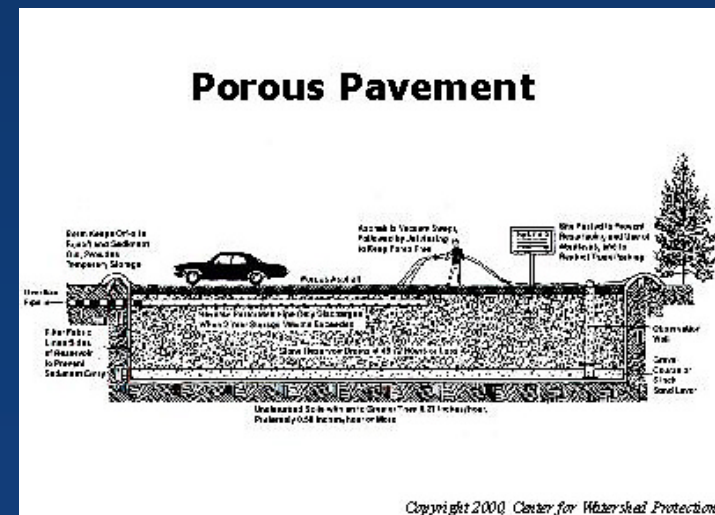
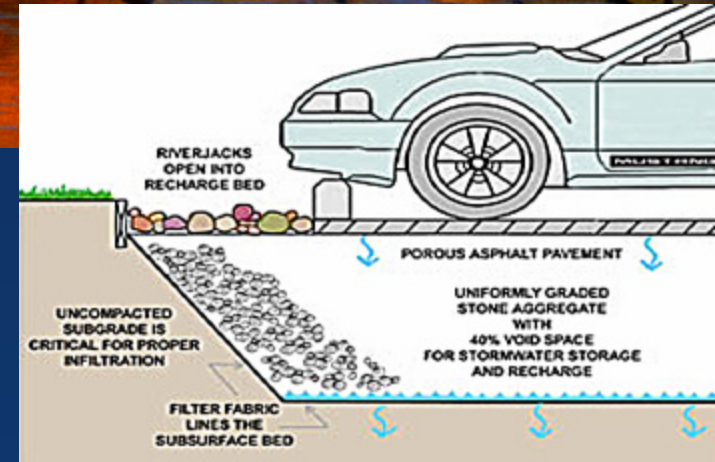
- Groundwater recharge
- Linear designs
- Flexibility
- Parking lot perimeters
- Driveway perimeters
- Plant herbaceous cover





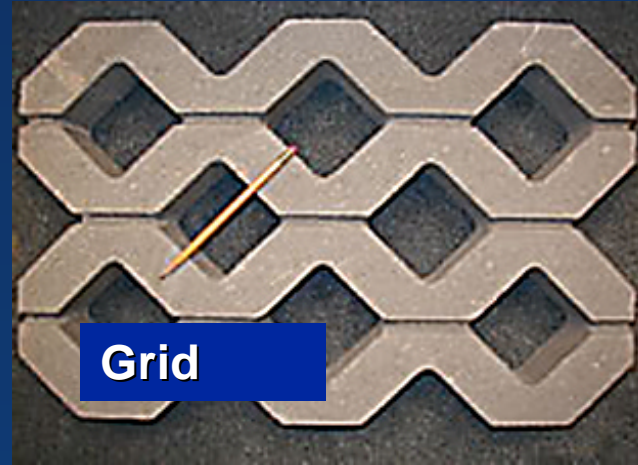
# Permeable Pavements

- Infiltrate runoff
- Groundwater recharge
- Reduce flow volumes
- Increase aesthetics
- Low traffic areas
- Overflow parking lots
- Driveways
- Vacuum sweeping



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# Permeable Pavements Types





# Permeable Pavements Uses & Maintenance



Driveways



Side streets



Parking lots



Vacuum cleaning

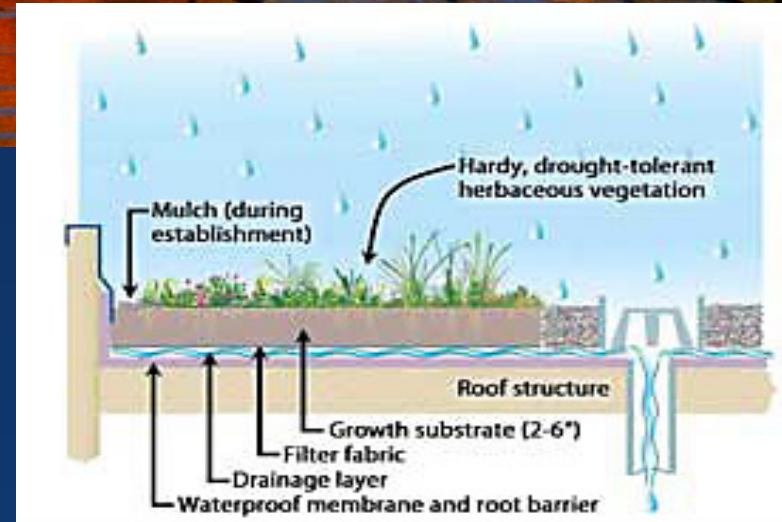
# Green Roofs

- Reduces runoff
- Increased aesthetics
- Saves energy (HVAC)
- Sound insulation
- Fire protection
- Extends roof life
- Urban “heat island”



# Bioretention Swales Design

- Use wasted space
- Waterproof membrane
- Filter fabric layer
- Lightweight planting substrate
- Hardy, native plants
- Load limitations
- Best for new buildings
- Greater initial cost
- Same long-term cost



# Wildlife Edge Habitat Plantings

- Sides and rear areas
- All native species
- Attract songbirds
- Reduce maintenance
- Enhance aesthetics
- Passive recreation
- Interpretive nature trails
- Community PR
- Increase property values



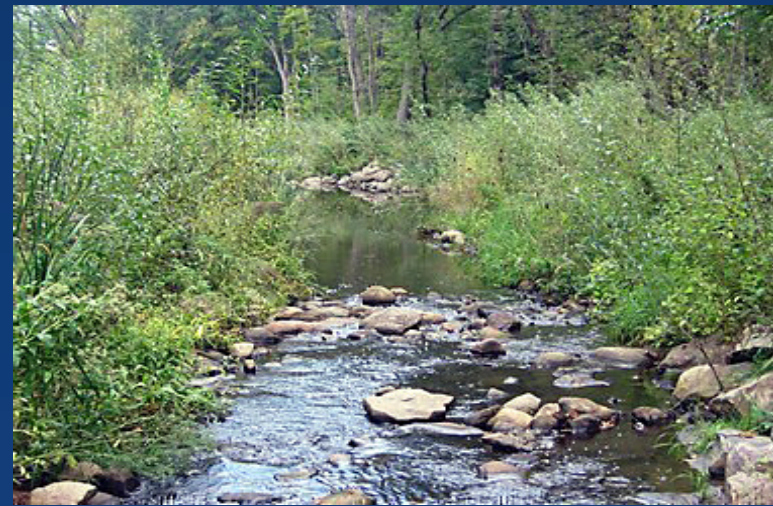
# Buffer Strips

- Create dense vegetation
- Treat sheet flow runoff
- Remove sediment & pollutants
- Reduce nutrients
- Increase recharge
- Control erosion
- Stabilize streambanks



# Buffer Strips

- Add to open space
- Increase wildlife habitat
- Establish riparian corridors
- Provide visual – privacy screening
- Create goose barriers
- Require minimal maintenance



# Buffer Strips

## Man-Made

### STEP #1 – Install Erosion Controls



# Buffer Strips

## Man-Made

### STEP #2 – Preliminary Grading





# Buffer Strips

## Man-Made

### STEP #3 – Stabilization & Seeding



# Buffer Strips

## Man-Made

### STEP #4 – Planting



# Buffer Strips

## Man-Made

### STEP #5 – Growing In



# Buffer Strips

## Man-Made

### STEP #6 – First Growing Season



**Who Benefits from LID?**

**EVERYBODY!!!**

# For developers & investors, LID ...

- **Increases Developable Area**
- **Lowers Clearing/Grading Costs**
- **Reduces Impervious Surface**
- **Decreases Infrastructure Costs (25-30%)**
- **Reduces Utility Fees**
- **Increases “Permitability” – Saves Time**
- **Decreases Maintenance Costs**
- **Lowers Energy Costs**
- **Promotes Corporate Good Will**
- **Increases Long-Term Marketability**

# For abutters & the local community, LID ...

- Balances Growth & Resource Protection
- Increases Open Space/Wildlife Habitat
- Maintains/Creates Buffer Zones
- Protects Streams, Wetlands & Aquifers
- Protects Water Quality
- Maintains Runoff Volumes/Rates
- Avoids Increased Flooding
- Enhances Scenic/Aesthetics Values
- Increases Property Values

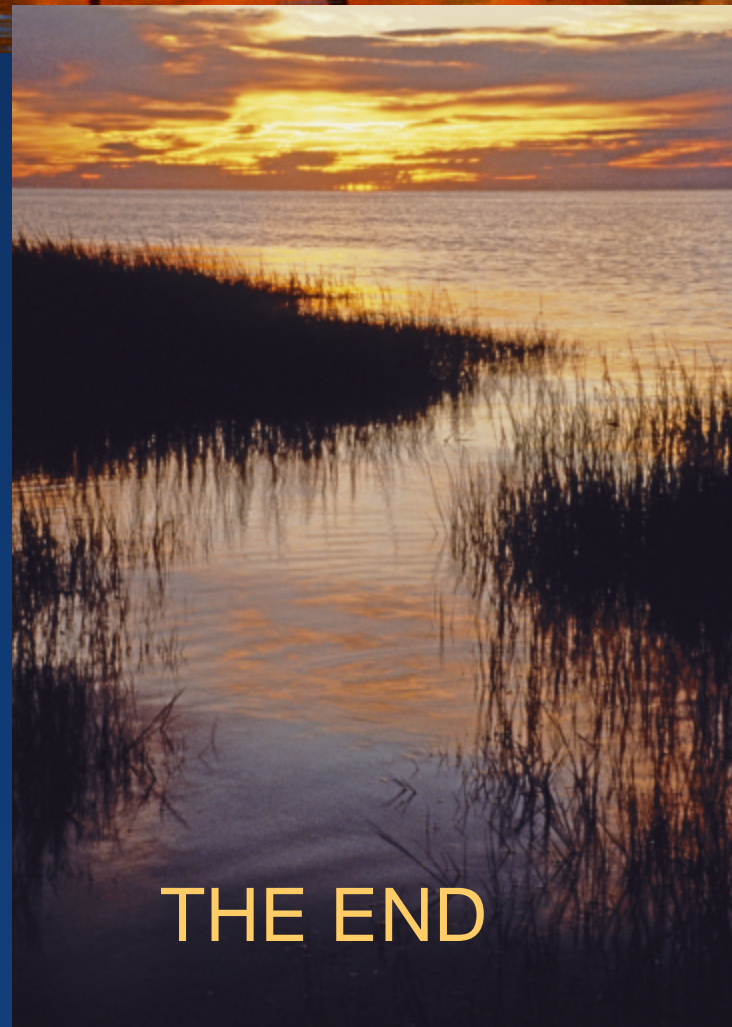
# Doggy Station

## The Ultimate BMP





# Obligatory Sunset Closing



# Questions → page #1

## **Q#1 – How does freezing affect porous pavers?**

**A#1:** Pavers are typically installed on a sand bed without mortar. They can expand and contract without cracking or spalling.

## **Q#2 – What are the cost differences – conventional v LID systems?**

**A#2:** LID-BMP systems are generally cheaper than conventional systems for the following reasons:

- Reduced construction costs – clearing, grading, landscaping
- Reduced infrastructure costs – pavement, curbing, catch basins, piping
- Reduced maintenance costs – irrigation, pesticides, fertilizers, detention basin dredging, parking lot repairs
- Increased market value – both short & long-term

# Questions → page #2

## **Q#3 – What are the relative maintenance requirements?**

**A#3:** LID-BMP systems generally require less maintenance than conventional systems, primarily because most LID-BMP's are non-structural.

## **Q#4 – Provide a summary of the Neuse River Buffer Rules (NRBR).**

**A#4 :**The NRBR were established on 12-9-99 in response to a series of fish kills caused by excessive nitrogen loading. They establish a 50-foot wide riparian buffer along waterways in the basin.

# Questions → page #3

**Q#5 – Are there LID-BMP's that are cost-effective for multi-family residential units with limited open space?**

**A#5:** Yes, one of the primary advantages of bioretention swales, rain gardens, and infiltration units is that they can be sized to fit any development scenario.

**Q#6 – Does NC-DWQ give developers credit for using pervious pavements?**

**A#6:** Yes, although a specific formula for calculating reduced impervious surface has not been developed.