

Stormwater BMP Inspection and Maintenance in North Carolina

Bill Lord
N.C. State University











Register Here!



Why is Stormwater BMP Inspection and Maintenance Needed?

Communities across the State of North Carolina must manage rainfall that runs off roads, streets and parking lots. This runoff is called stormwater. To manage stormwater, many treatment devices, called BMPs, have been built. These devices include: wet retention ponds, bioretention areas, swales, stormwater wetlands, permeable pavement, rainwater harvesting systems,



Opportunities in Stormwater

BMP Inspection and Maintenance also presents a business opportunity for inspection by licensed professionals such as engineers and landscape architects, and maintenance by landscape and other green industry professionals. Designers will learn to design SCMs/BMPs with maintenance in mind; landscapers can diversify their business to ensure year-round work in a recession proof area of work; and suppliers of materials and technology to the stormwater industry can learn about new and existing opportunities to support the stormwater industry.



Who Should Attend

Commercial Landscapers
Property Managers
Owners
Homeowners Associations
Professionals with Licensure (PE's, PLS's, RLA's)
Regulators
Municipal and County Landscape Personnel



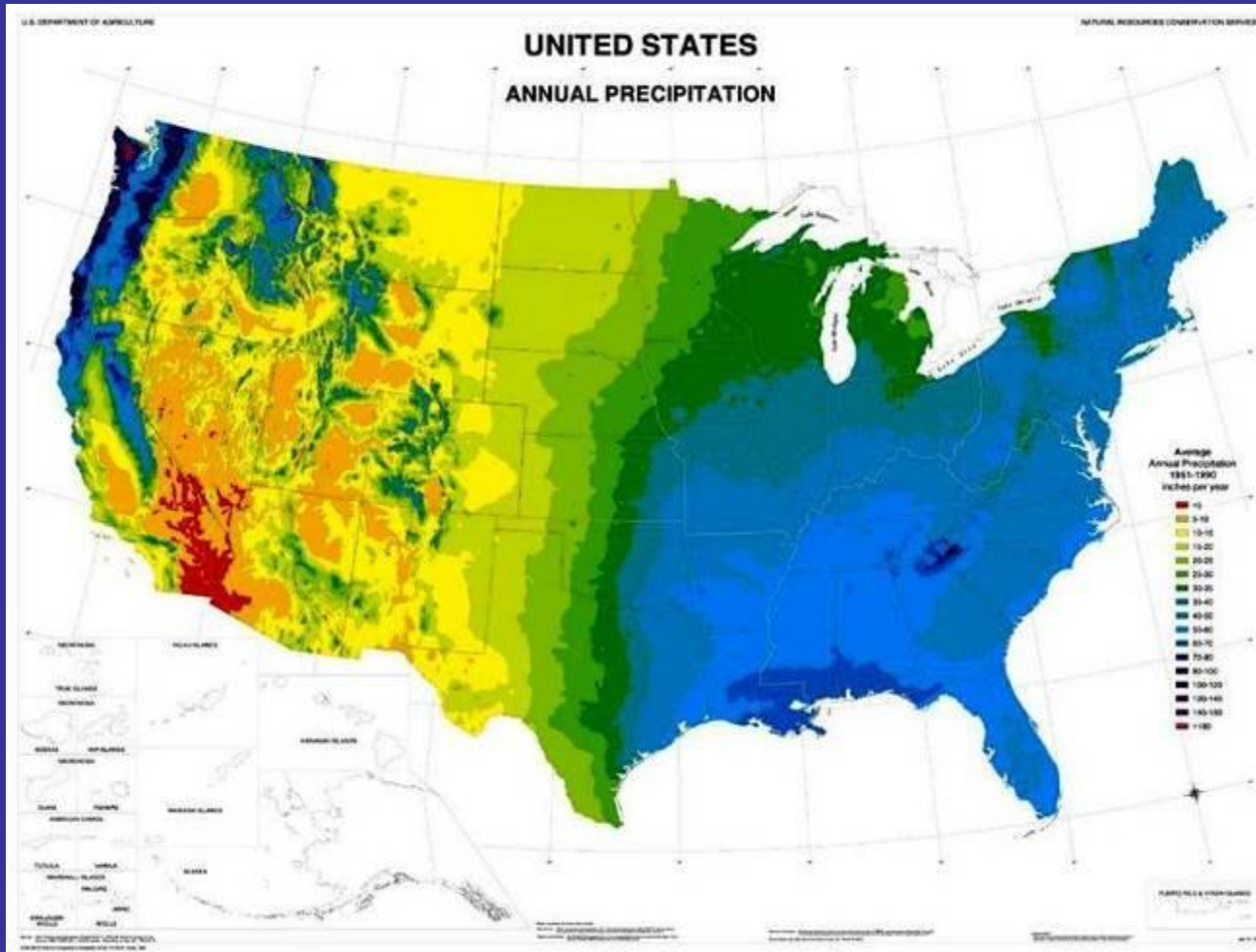
Certification Goals:

- Understand stormwater, how it affects water quality, and regulations associated with it.
- Understand stormwater management devices used in North Carolina and how they function.
- Understand inspection and maintenance requirements of each stormwater practice.

Recertification

UPDATE classes are available to renew certificates. When registering, please have your certificate number ready. This class will be 5 hours of lecture with no exam. Upon completion, receive an updated

North Carolina is rainy!



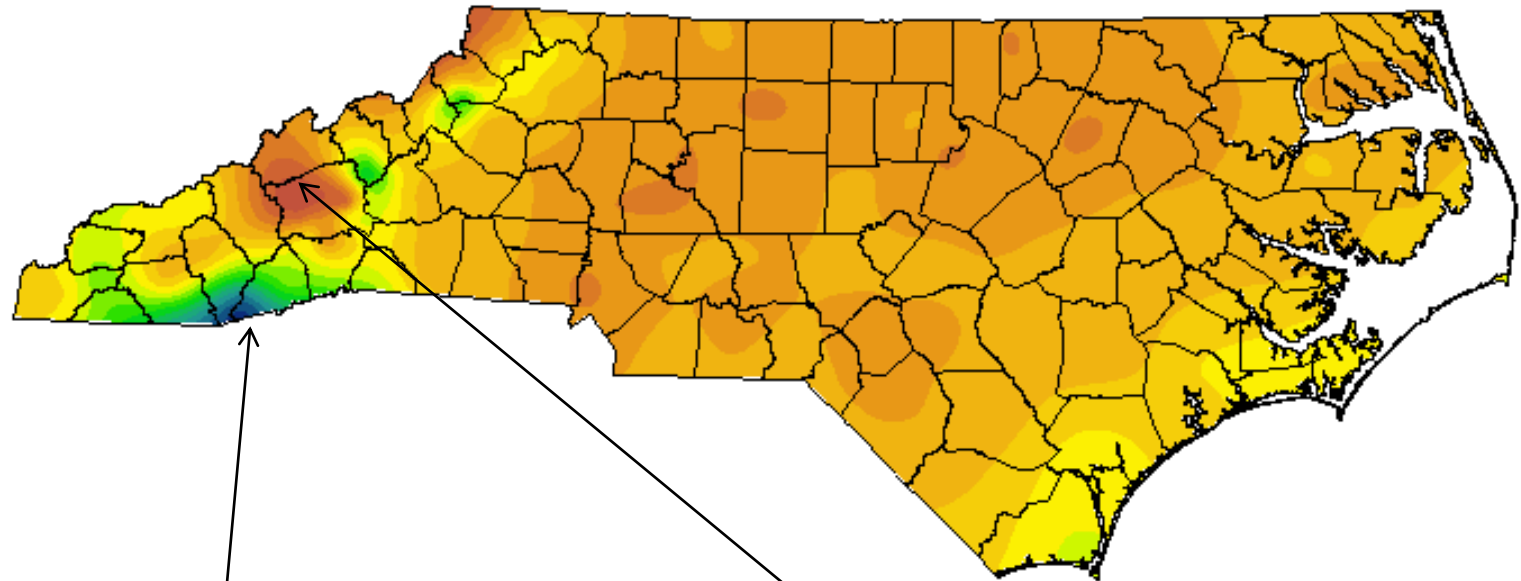
Stormwater BMP Maintenance &
Inspection

Stormwater BMP Maintenance & Inspection

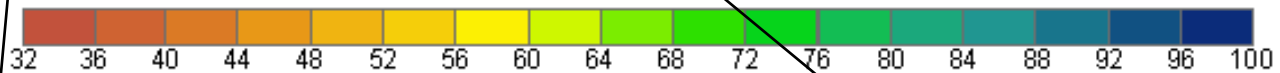
Normal Precipitation

Based on 1971-2000 normals

Annual



Precipitation (in.)



90 inches in Highlands

37 inches in Horseshoe....

Stormwater BMP Maintenance & Inspection

Stormwater BMP Maintenance & Inspection

Is there a connotation to clean water in our culture?



Is water related recreation important to North Carolina?



Water related recreation is important to North Carolina!



In a 2008 study, trout fishing contributed to more than \$174 million to NC's economy



**ZALOO'S
CANOES**

Tourism and Water ???

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BUSINESS

NC pulls in record \$20B in tourism revenue

Posted May 7

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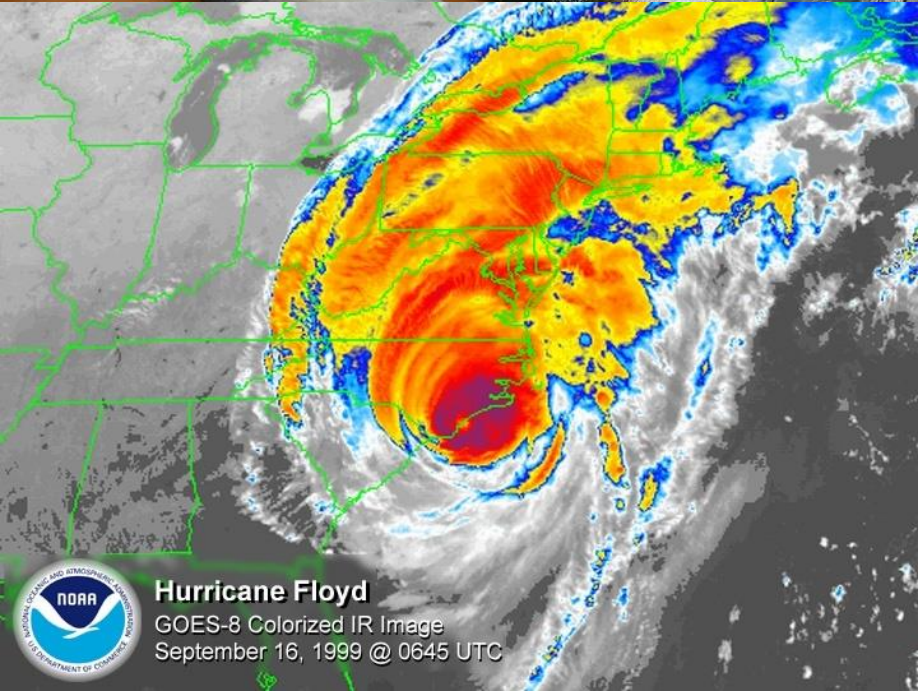
RALEIGH, N.C. — The North Carolina tourism industry generated record visitor spending of \$20.2 billion last year, officials said Wednesday.

About 52.5 million people visited the state during the year, up almost 16 percent from 2012, making North Carolina the sixth-most-visited state.

"The growth of our tourism industry gives us a lot to celebrate," Gov. Pat McCrory said in a statement. "The money they spent while visiting our mountains, beaches, cities and places in between directly supported nearly 200,000 jobs and more than 40,000 businesses."

10
 AA

Why NC Cares



Hurricane Floyd

GOES-8 Colorized IR Image
September 16, 1999 @ 0645 UTC



NC 6th fastest growing state, 10th most populous

POPULATION CHANGE BY COUNTY: 2000-2010

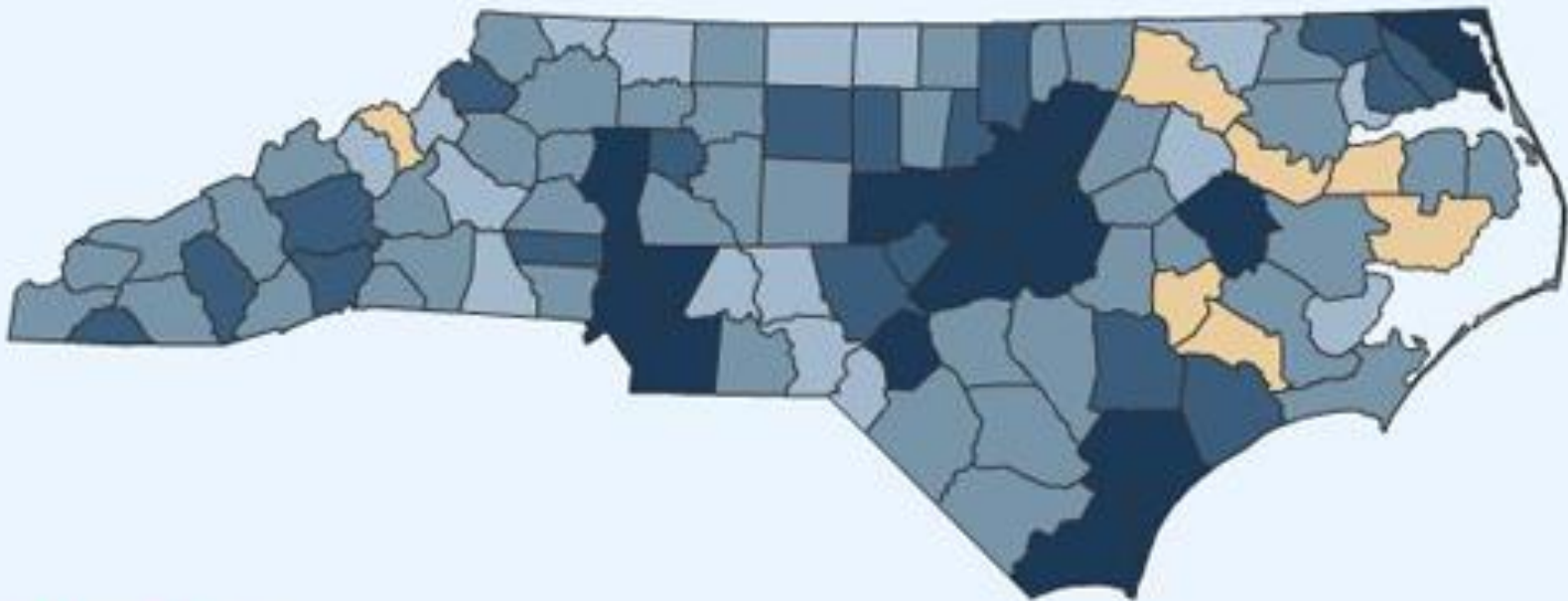
LOSS

0-5%

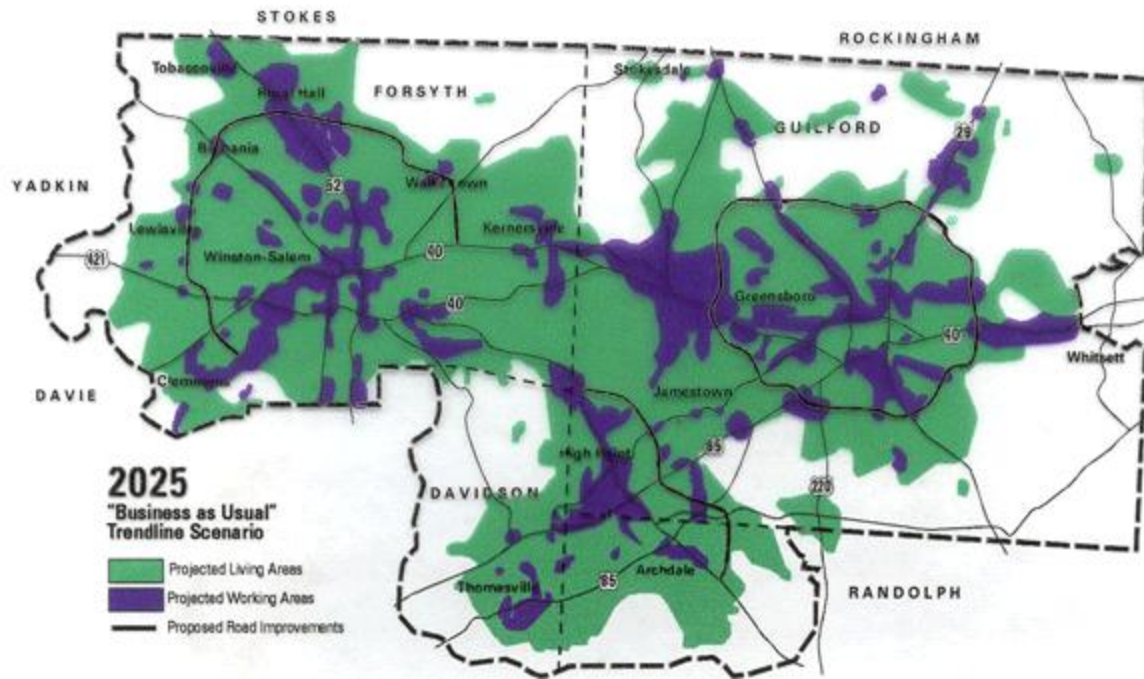
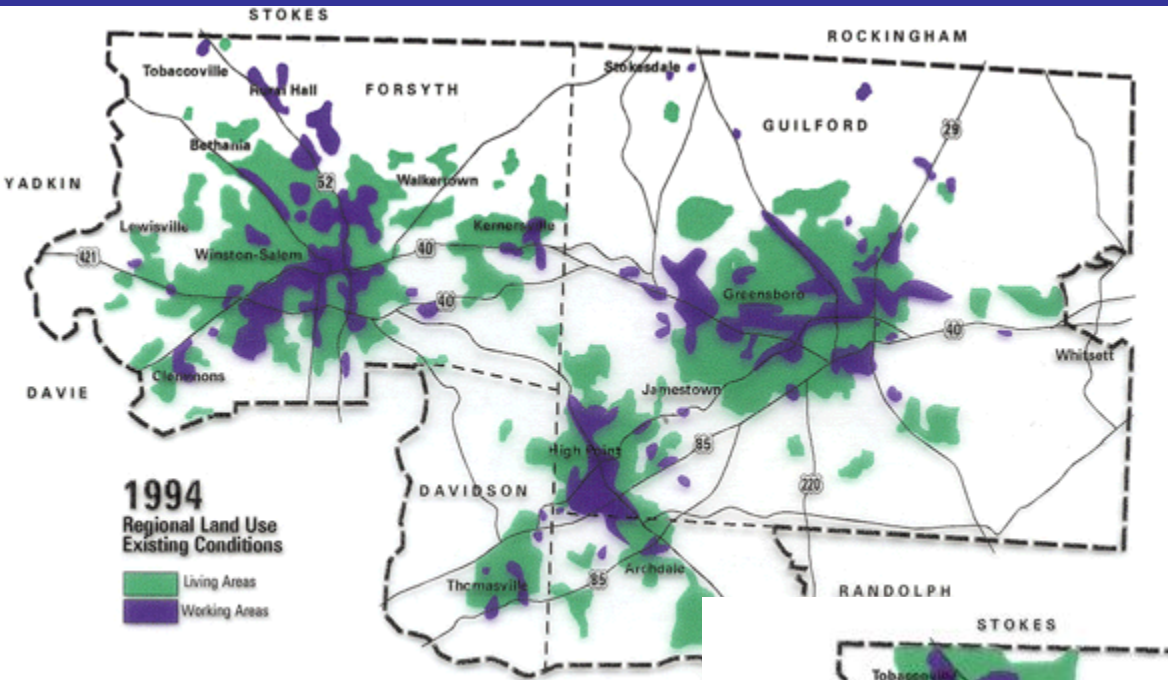
5-15%

15-25%

25% +



Urbanization Increases Stormwater Flows



Boone, NC



Stormwater effects

Boone Mall January 2013



In the news...



The **SUNDAY**
News & Observer

JANUARY 5, 2014 newsobserver.com

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**DUKE, N.C.
STATE LOSE
ACC OPENERS**
Sports



Coastal owners face higher rates

Congress may help by delaying end of flood insurance subsidy

By BRUCE SODOFF
bsodoff@newsobserver.com

Sybil and Bill West have never fled a hurricane or filed a flood claim, but they're trapped in their Wrightsville Beach cottage by rising flood insurance rates.

They're in their 70s, eager to sell their two-bedroom home and move inland where their grandchildren live. So after a young couple signed a contract in October to pay more than their asking price of \$295,000, the Wests began house-shopping in Greensboro.

Then the buyers backed out of the deal. A second couple made an offer and later backed out, too. The buyers were alarmed by the

onset of sharply higher flood insurance premiums mandated by Congress and the Federal Emergency Management Agency. With the National Flood Insurance Program running a \$24 billion deficit after huge payouts from Hurricanes Katrina in 2005 and Sandy in 2012, Congress in 2012 ordered radical changes to make premiums more closely reflect the true risk of damage for Americans who own in-

land property in floodplains near rivers and along the coast.

The changes began taking effect in 2012 and prompted protest from coastal residents and real estate interests across the country. Rep. Maxine Waters of California, one of the law's co-sponsors, criticized FEMA's implementation of the new law and supported legislation aimed at postponing the insurance premium increases. North Caroli-

nians including Sen. Kay Hagan and Reps. Walter Jones and Mike McIntyre also are pushing for the delay, which could require a Senate vote as soon as this week.

The loudest support for action has come from New Jersey, Louisiana and other states where the impacts are showing up more quickly than in North Carolina. In states where

BY FLOOD, PAGE 4A

Freeze could break records

Deadly lows lie ahead for Midwest, beyond

By CARSON WALLACE
Associated Press

SIOUX FALLS, S.D. The deep freeze expected soon in the Midwest, New England and even the South will be one to remember.

Part of 3

CAROLINA DREAMERS

UNC's junior varsity team gives regular students a chance to play. Access to the Smith Center is cool, too.





WAKEFIELD ADVANCES TO STATE SEMIFINALS

PAGE 8N



SIGNS FOCUS ON CHILD ILLITERACY

PAGE 3N

NORTH RALEIGH NEWS

SERVING NORTH RALEIGH

northraleighnews.com

Residents want answers to flooding

Older neighborhoods struggle as runoff issues increase

By COLIN CAMPBELL
ccampbell@newsobserver.com

RALEIGH When Tony Lombardo bought his house in 1994, he thought the backyard creek was a nice amenity. Now a heavy rain turns it into what he calls a "raging

river" that damages his property. And as more homes are built upstream from Lombardo's Hampton Oaks neighborhood off Ray Road, the problem is getting worse. "In June, the first flood that we had wiped out my retaining wall," he told a City Council committee last week. "It made my yard basically unusable. It flooded my garage." Lombardo is among numerous North Raleigh residents dealing

with a growing flooding problem. While new neighborhoods on Raleigh's outskirts are built with strong runoff systems to protect property, homeowners in the city's older neighborhoods downstream aren't as lucky. "Every time a new development goes in, it has a significant impact on the folks that were there originally - the folks downstream," said Councilman Randy Stagner, who

represents North Raleigh and called for last week's special committee meeting. "There's no easy solution to this, and that's why I've asked for the policy review and the resource review." Lombardo's situation is a prime example of the stormwater challenges Raleigh faces as it continues to grow, as well as the constraints facing the city's established neighborhoods. Lombardo says city officials pro-

posed a solution to erosion problems around his creek. Through a cost-sharing program, he and several neighbors would pay \$5,000 each, with the city picking up the remainder of the tab. But he said his neighbors don't want to pay, which leaves him with a much larger bill to fix the problem. And the city's solution, he says, doesn't address the root cause: substantial runoff flooding the creek. **SEE FLOODING, PAGE 3N**



Election brings new faces

Tuesday, January 13, 2015 6:00 AM

A New Focus on Beach Warnings

By: [Kaspersen, Janice: Stormwater Editor](#) | [Comments](#)



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A sad event last month in San Diego is drawing attention both to the dangers of swimming in water potentially contaminated with bacteria and, more generally, to the quality of urban stormwater runoff.

On December 25, Barry Ault, an avid surfer who was well known in the southern California surfing community, died from a severe staph infection. Days earlier he and several friends had been surfing off the San Diego coast, even though a warning was in place to avoid the water for three days following a recent storm.

Although the infection was treated with antibiotics, Ault, 71, who apparently had some underlying medical issues, died after falling into a coma. Two of the people who had been surfing with him also developed flu-like symptoms.

It's not certain that bacteria in the stormwater runoff led to the infection, although his wife has called the connection "too big of a coincidence." She said she hopes Ault's death will lead people to take such warnings more seriously.



Water Works plans to sue three counties



Timothy Meinch, tmeinch@dmreg.com

8:05 p.m. CST January 6, 2015



2189



105



8



96



(Photo: Charlie Neibergall/AP)

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MORE

Des Moines Water Works is expected to pursue a lawsuit against three northwestern Iowa counties that manage drainage districts with high concentrations of nitrates.

Water Works officials say the nitrates, which flow into the Raccoon River, threaten the city's water quality.

The Board of Water Works Trustees will vote Thursday to move forward with the lawsuit in what's expected to be a unanimous decision, according to chairman Graham Gillette.

"We really feel we have no choice," he said.

"This is the only way that we see that we can engage the government, especially the state of Iowa, in a serious discussion about regulating those pollutants that are dumped into our source water."

Funny Bone

Mar...
The meet...
Way...
Hold...
feat...
limit...
joint...
cont...

560 S. PRAIRIE VI
WEST DES MO

Readings showed regular high concentrations of nitrates — at times six times greater than the federal limit of 10 milligrams per liter for drinking water, Stowe said.

Stormwater effects

- Streambank erosion from 'flashy' flows



Stormwater BMP
Maintenance & Inspection

J Soils Sediments

DOI 10.1007/s11368-013-0758-3

WATERSHED SEDIMENT SOURCE IDENTIFICATION: TOOLS, APPROACHES, AND CASE STUDIES

Fingerprinting the sources of suspended sediment delivery to a large municipal drinking water reservoir: Falls Lake, Neuse River, North Carolina, USA

Mark T. Voli • Karl W. Wegmann •
DelWayne R. Bohnenstiehl • Elana Leithold •
Christopher L. Osburn • Viktor Polyakov

Received: 13 March 2013 / Accepted: 17 July 2013

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Streambank Erosion

Results and discussion Radiocarbon and magnetic susceptibility measurements confirmed the presence of “legacy” sediment in the Ellerbe and New Light Creek valley bottoms.

Mixing model results demonstrate that stream bank erosion is the largest contributor to the suspended sediment load in New Light Creek (62%), Ellerbe Creek (58%),

Conclusions We find that stream bank erosion is the largest nonpoint source contributor to the suspended sediment load in three of the four catchments and is therefore a significant source of turbidity in Falls Lake.

Fingerprinting the sources of suspended sediment delivery to a large municipal drinking water reservoir: Falls Lake, Neuse River, North Carolina, USA

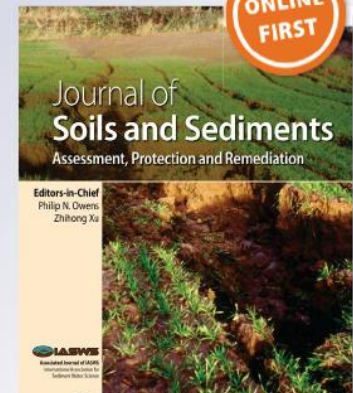
**Mark T. Voli, Karl W. Wegmann,
DelWayne R. Bohnenstiehl, Elana
Leithold, Christopher L. Osburn &
Viktor Polyakov**

Journal of Soils and Sediments

ISSN 1439-0108

J Soils Sediments

DOI 10.1007/s11368-013-0758-3



Common runoff pollutants

- Dumpster juice



Car Juice???

DRAFT

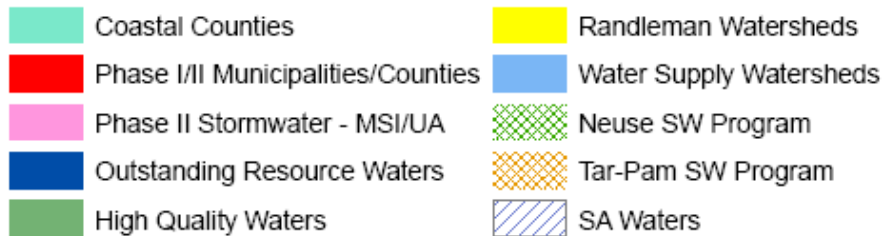
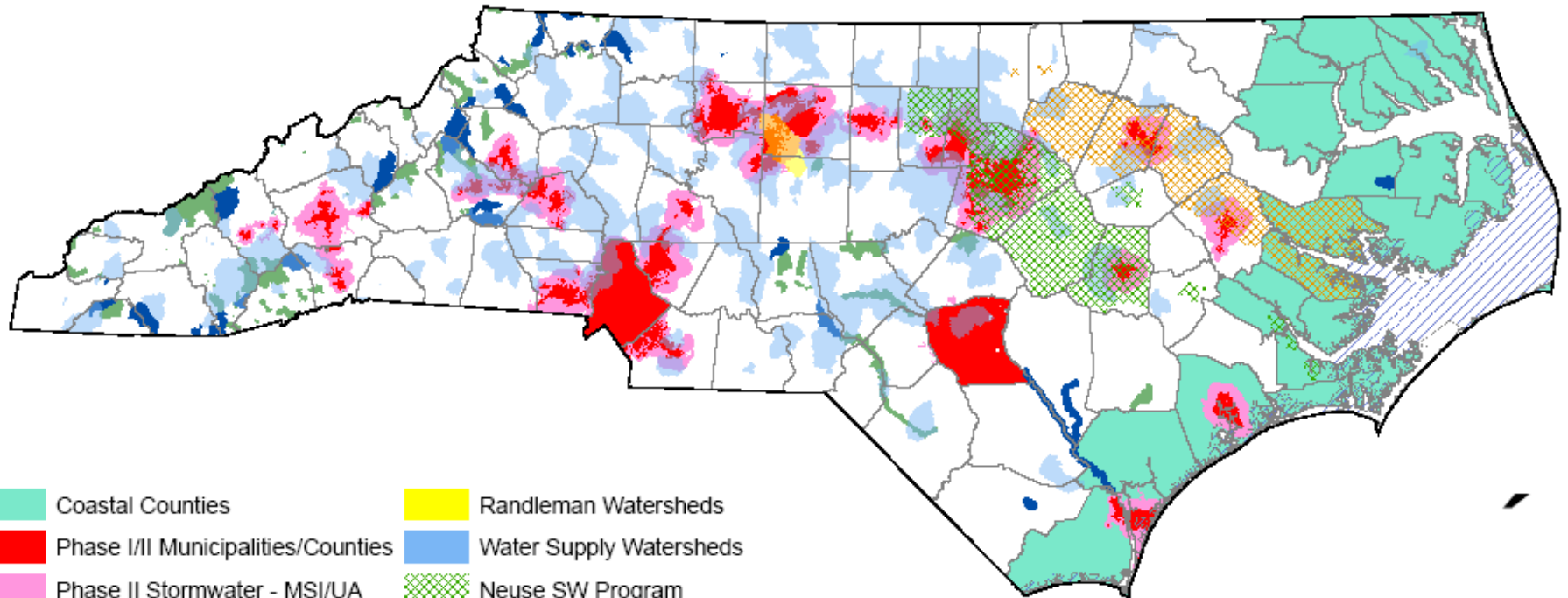


Stormwater Rules and Regulations

- EPA Phase I of NPDES
 - Cities > 100,000
- Neuse Rules
 - 1998
- Tar Rules
 - 2001
- EPA Phase II of NPDES
 - Communities > 10,000 – 114 listed as of 2014

Stormwater Regulated Areas of NC

NC Water Quality Protection Strategies - Stormwater



N.C. Cities/ Communities Requiring BMP I&M

- Forsyth County
- Wilson
- Jacksonville
- Cary
- Apex
- Charlotte/Mecklenburg
- Durham
- Greensboro
- Asheville/ Buncombe County
- Greenville
- NC State University & UNC-Chapel Hill

Old Habits...

Drop the leaf blower
and step away
from the sewer grate!

WILSON POLICE
STORM
WATER
TROOPERS

DiFilippo



Inspection and Maintenance?

- Should cars and trucks be maintained?
 - Life span with no maintenance is....
- Should roads be maintained?
- Are BMPs any different?

BMPs are specialized landscape features designed to control stormwater quantity and quality

- Regular inspections are needed
- Inspect during rainfall events
- Use a maintenance checklist
- Focus on preventive maintenance to avoid costly corrective maintenance and repairs

If We Ignore BMPs There Are Safety and Liability Issues...

- Dam Failure



Safety and Liability

- Outlet failure will lead to dam failure



Safety and Liability

- Windfall or tree death could lead to dam failure



Fire Ants can Cause Dam Failure



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How deep are fire ant colonies?

Imported Fire Ants February 28, 2012 | [Print](#) [Like](#) 1 [Tweet](#) 0 [Pin it](#) [g+1](#) 0



Fire ant mounds go deep into the ground.

Fire ants live in an extensive network of tunnels in the soil. How deep this network extends into the ground depends on age and size of the colony, soil texture, and depth of the water table.

Tunnels in fire ant nests **have been found to a depth of 10 feet or more, but most tunnels are shallower**, starting just beneath the soil surface. Colonies in clay soils have deeper tunnels than those in sandy soils. **Mounds are not necessary for colony survival** as long as there is a dark, moist area for protection of the queen.

A **rule of thumb to use when drenching mounds** with an insecticide is to assume that there will be tunnels an inch and a half below ground for each inch in height above ground. For flat mounds, assume there will be tunnels an inch and a half below ground for every inch in mound diameter. This is why it is necessary to use more liquid insecticide on a bigger mound than on a smaller mound.

Safety and Liability

- Failed bioretention = ideal mosquito habitat



Safety and Liability

- Trash = mosquitoes, outlet clogging



Safety and Liability

- Structural failure



Do they need to look good?

Landscape Ecol (2007) 22:959–972

DOI 10.1007/s10980-007-9110-x

PERSPECTIVE

The shared landscape: what does aesthetics have to do with ecology?

Paul H. Gobster · Joan I. Nassauer · Terry C. Daniel · Gary Fry

If a BMP or landscape looks good, people are more inclined to respect them and take care of them

Safety and Liability

- Line-of-sight barriers and hide-outs....



Safety and Liability

- Localized flooding



Safety and Liability

- Dangerous Outlet.....



Safety and Liability

- Dangerous Outlet.....





Drowning hazard

**'Old style pond – steep banks,
deep water**

**BMP Manual: slopes no steeper
than 3:1, include vegetative shelf**

Safety and Liability

Safety Shelf Helps



We have a lot of practices in the ground

- Our university campus alone has over 110 practices



Are they being maintained?

Cary Stormwater BMPs (2007)

- Approximately 425 BMPs in Cary
- According to one of Cary's inspectors: Timothy Grady, RLA:
- 95% of BMPs **failed** initial inspection as they require repairs
- Most repairs are maintenance related: erosion, trash removal, tree removal

Enter the...BMP Inspection & Maintenance Certification



NCSU Stormwater BMP Inspection & Maintenance Certification Workshops

Certification

Classes

List of Certified Professionals



Register Here!



Why is Stormwater BMP Inspection and Maintenance Needed?

Communities across the State of

Opportunities in Stormwater

BMP Inspection and Maintenance also presents a business opportunity for inspection by licensed

Who Should Attend

Commercial Landscapers
Property Managers
Owners

Certification Goals:

- Understand stormwater, how it affects water quality, and regulations associated with it

Our (Initial) Target Audience...





The man with the mower...

- ‘Walks’ the property every time he mows
- Should be trained to recognized early signs of problems such as:
- Erosion, clogged outlets, security breaches, etc



In practice, who does the work

Inspections

- Engineers, Landscape Architects, and local govt. officials do annual inspections
-

Maintenance

- Private landscape companies
- Private BMP maintenance companies
- Local govt. maintenance crews

Attendees...

- 19 % Engineers and Landscape Architects
- 24% Landscapers
- 57% government officials
 - Inspectors
 - Maintenance workers

Why Are We Here?

Cary Stormwater BMPs 2014

- Approximately 950 BMPs in Cary
- Cary has digital tracking system for BMPs
- Strong educational program for contractors
- Must pass initial inspection to get C/O
- ~ 95% pass first annual inspection now

Cary Inspection Program Requirements

- Annual report with photos
- Submitted electronically
- Inspection by qualified professional
- 30 days to correct if failed
- NOV and enforcement afterwards

List of Certified Professionals

List of Certified Professionals

This table lists program participants who have successfully passed the Stormwater BMP Inspection & Maintenance Certification Exam. The certification lasts for up to three years. To renew certification, certified professionals must attend Update courses. There is NO further testing required with the 5 hour Update courses. The recertification lasts an additional 3 years. The certification is NOT intended to be a replacement for professional licensure (like PE or RLA), and is only

Show 10 entries

Search:

Certification #	Name	Affiliation	Test Location	Test Date	Expiration Date
001	Bill Adams		Cary, NC	5/15/06	12/31/09
002	Kenneth Abrecht		Cary, NC	5/15/06	12/31/09
003	Mark Altman		Cary, NC	5/15/06	12/31/09
004	James Bailey		Cary, NC	5/15/06	12/31/09
005	Jenny Baines		Cary, NC	5/15/06	12/31/09
006	Thomas Baines		Cary, NC	5/15/06	12/31/09
007	Ozan Bas		Cary, NC	5/15/06	12/31/09
008	Ricky Beasley		Cary, NC	5/15/06	12/31/09
009	Jeremy Beckett	Commercial Site Design	Raleigh, NC	12/17/13	12/31/16
010	Rebbie Bell	BNK, Inc.	Raleigh, NC	2/24/15	12/31/17

Showing 1 to 10 of 2,769 entries

[Previous](#) [Next](#)

BMP I&M is good for Business *and* the Environment

- Landscape maintenance business goes up and down with the economy
- BMP I&M is required by many communities
- Companies are starting (and flourishing) that do nothing but BMP I&M



Retention Pond Services, Inc.

Specializing in all phases of aquatic and wetland maintenance

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Take a look at what Retention Pond Services does best:

Click play to watch each slideshow.

Outfall Box Rebuild



STOP | PLAY

Monthly Maintenance Cut and Clean



Stormwater Management And Retention Pond Services

At Retention Pond Services, Inc. (RPS), we understand the complexities of the regulatory standards for stormwater BMPs and retention basins. We strive to adapt our services to stay up-to-date with the amendments made to those standards. Our ultimate goal is to help our clients understand the regulations and demonstrate to them how we are able to provide them with the most comprehensive, stormwater management program.

RPS evaluates each BMP structure and develops a regulatory-centered maintenance plan to most efficiently manage it. The appropriate equipment and maintenance or remediation specialists will be teamed up to ensure each structure is compliant and environmentally safe.

Stormwater BMP consulting

- Education on Federal, State, Local stormwater BMP regulations and maintenance methods
- Notification of Violation consultation, liaison, and remediation services
- Initial site inspections for HOA's in final phase of construction

Stormwater BMP Compliance and Repairs

- Slope stabilization and repairs
- Dredging
- Sediment and erosion control management



Restoration and Recovery



Water Quality Excellence Through Superior Stormwater Management

Restoration and Recovery (R&R) is a full service stormwater management company serving the eastern United States – a one stop shop for all aspects of SWM, including consulting, designing, constructing, inspecting, maintaining, and repairing BMPs. R&R uniquely offers both comprehensive experience and an exclusive focus on stormwater.

[Read More](#)

- Storm Water Control
- SWPPP Preparation
- Permit Documentation
- River Engineering
- Water Sampling
- Erosion Control
- Vegetation Control
- Filter Bed Maintenance
- NPDES Inspection
- BMP Implementation
- Watershed Planning
- Regulator Response
- Streambank Protection
- Construction Inspection
- Debris Removal
- Structure Cleanings
- Restoration and Maintenance

Water Quality Excellence Through Superior Stormwater Management

Stormwater Management

R&R has more than a decade of experience helping communities, businesses, and municipalities transition from traditional, quantity-based programs to comprehensive

Water Quality Practices

R&R integrates stormwater conveyance measures, flood control, floodplain management, and water quality goals to protect developed areas, preserve waterways, and expand

About BMP East, Inc

Retention Pond Maintenance, Service and Management

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BMP East, Inc.

John Brown started BMP East, Inc. after years of living on the East Coast and observing, first hand, the damaging effects of poorly managed water resources. John's background is research-based, and his education is in applied cultural anthropology with a minor in oceanography. He has been involved in numerous water-based research grants and CAMA (Coastal Area Management Act) access issues. It was through this research John first realized how harmful poor water quality is to the environment and humans. As an ongoing effort to better the quality of water, improve coastal living, and protect the environment, John started BMP East, Inc. specializing in stormwater management.

Our staff is college educated and certified as BMP specialists. We have the highest level of certification by NC's DOT as level 1 NC DOT Erosion & Sediment Control Specialists, and we are certified as NC Stormwater Best Management Practices Inspection & Maintenance Professionals. We have an extensive background in research and implementation of regulatory issues. All of which, have built the foundations of our BMP management practices.

BMP East, Inc. cares about clean water for all.

Inspection

DC Adams
Engineering,
Inc

Clayton, North Carolina - (919)-763-7278

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Development

Stormwater BMP
Inspections

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Stormwater BMP Inspections

Many municipalities are requiring stormwater control devices (also called BMPs) to be inspected annually by a qualified professional. As a duly licensed professional engineering company in North Carolina, DC Adams Engineering is qualified to perform stormwater BMP inspections. We are currently offering services in Cary, Apex and Raleigh.

Why choose DC Adams Engineering as your NC Stormwater BMP Inspector?

1. **We are qualified:** Who is better suited for your compliance inspection needs than an engineering company that has participated in all facets of the development process. DC Adams Engineering has over 10 years experience in residential and commercial related development that included design, construction and inspection of stormwater best management practices.
2. **We are service oriented:** DC Adams Engineering will partner with you to ensure that your site will maintain or achieve compliance with the appropriate municipality. If there is work to be done on your BMP, you don't have to worry about who to call; we can make all the contacts for you. We realize that your time is important and will work hard to allow you to focus on your business.
3. **We are prompt:** DC Adams Engineering is committed to our stormwater inspection business and guarantee to turn around your inspection and

Inspection

STORMWATER MANAGEMENT ENGINEERING



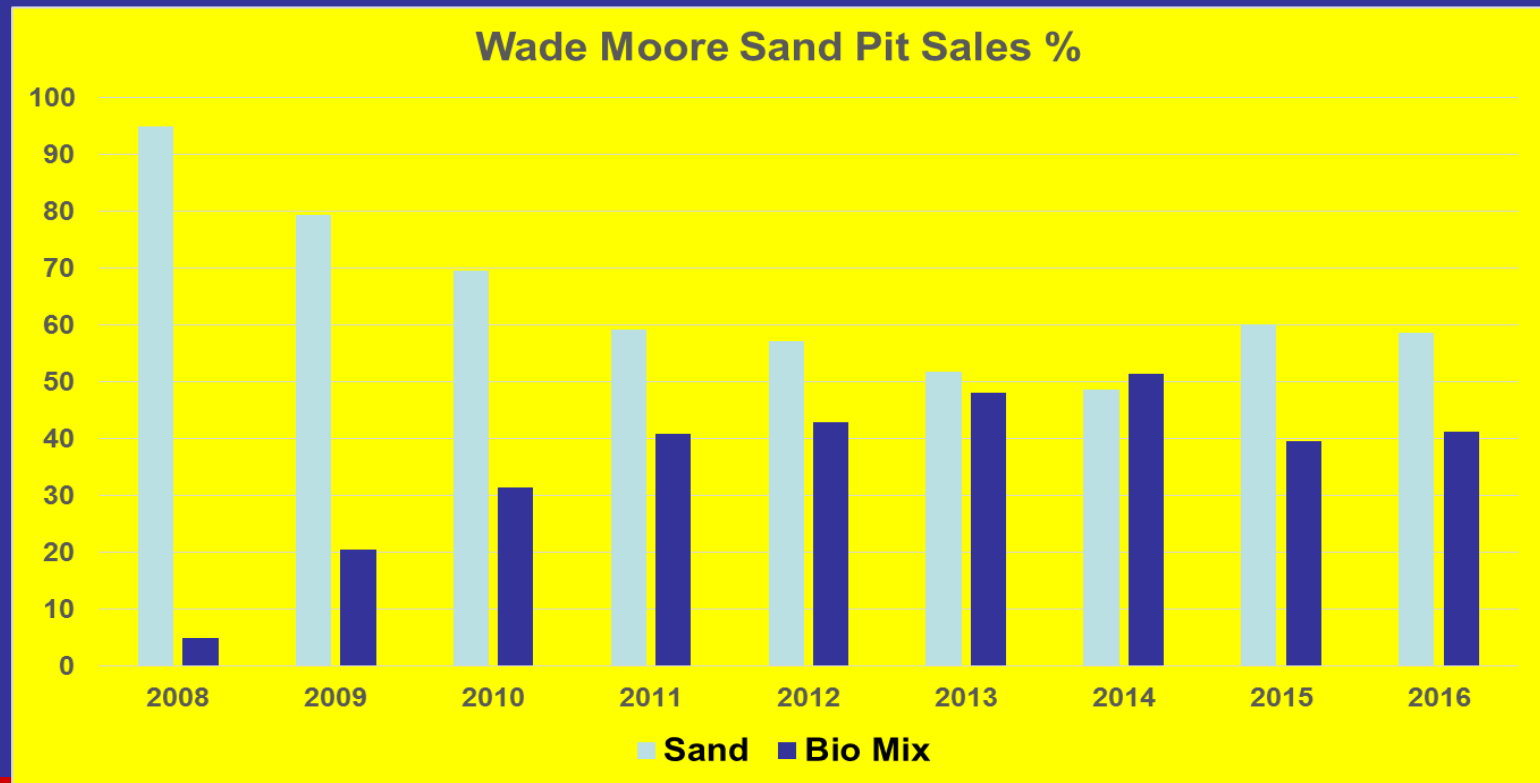
EMBRACING OUR ENVIRONMENT/ensuring our future

SERVICES

- High Hazard Dam Inspections
- BMP Annual Inspections and Operations and Maintenance (O&M)/BMC Certifications
- BMP Inventory Management
- Field Support Services
- BMP Design, Retrofit, and Modification Engineering
- BMP As-built/BCE Certifications
- Stormwater Impact Analyses, Feasibility Studies, and Drainage Investigations
- Design Innovation and Product Development (Go to Our Product Website at [*Easadjust Water Management Systems*](#))

The Business of BMP I&M suppliers

- Wade Moore Sand Co., Louisburg, NC
- Concrete sand \$8.00/T
- Bioretention mix \$14.00/ton



Stormwater Management vs. Landscaping

- BMPs are built for control of runoff and flooding
- BMPs are built for water quality improvement
- Landscape and aesthetic value is important but secondary...
- Think about it: Why hire an engineer to design a landscape bed??????

But...With Landscapers we Have to Stress:

- Fundamentally BMPs are water quality treatment devices NOT landscape features
- So, *think clean water, not lush landscape*
- Avoid fertilizers and pesticides

Can Compost be used in BMPs?

- Remember, BMPs are water quality and quantity treatment devices, NOT landscape features
- Compost can have very high nutrient levels

Use compost to remediate poor soils, do not use inside BMPs



We learn from our students...Forebay Depth Measurement







A Depth Finder!

BMPs: Pay now or pay later...

- Durham sand filter failure 2008
- \$30,000 re-build job
- Could have been prevented with annual maintenance of \$1500



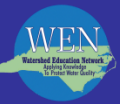


12/04/2007



12/04/2007

er BMP Maintenance & Inspection



BMP Maintenance

- Why must BMPs be maintained?
 - Aesthetics – they are usually part of the landscape
 - Drainage – they usually are the only means of drainage in the landscape
 - Legal requirements – they are required by law in many jurisdictions
 - Investment – most landowners want return on BMP investment

Stormwater BMP Functions



Regenerative Stormwater Conveyance



<http://www.ncpc.org/Notices/Oregon>





Rain Water Harvesting



Bodie Island Light House

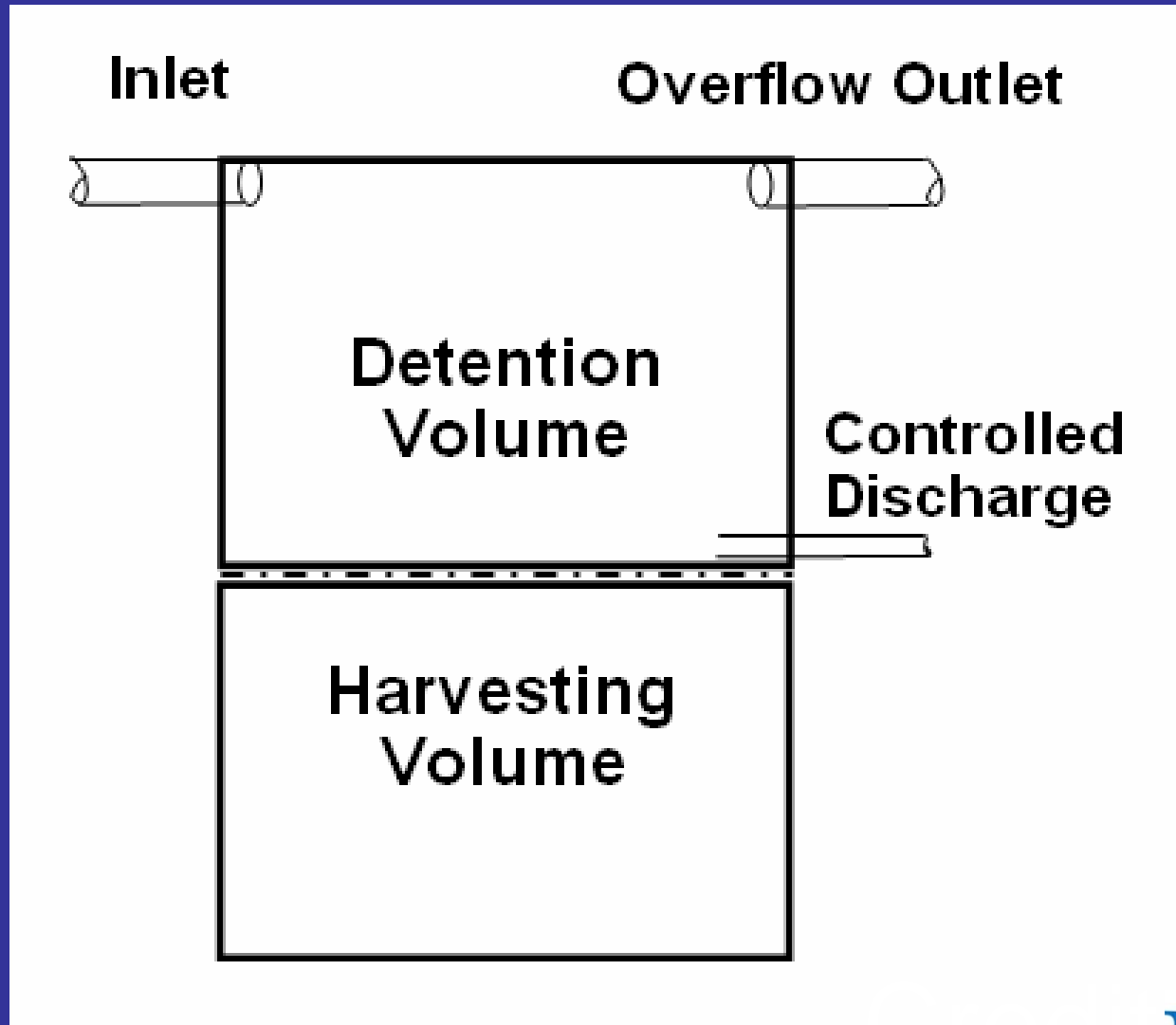


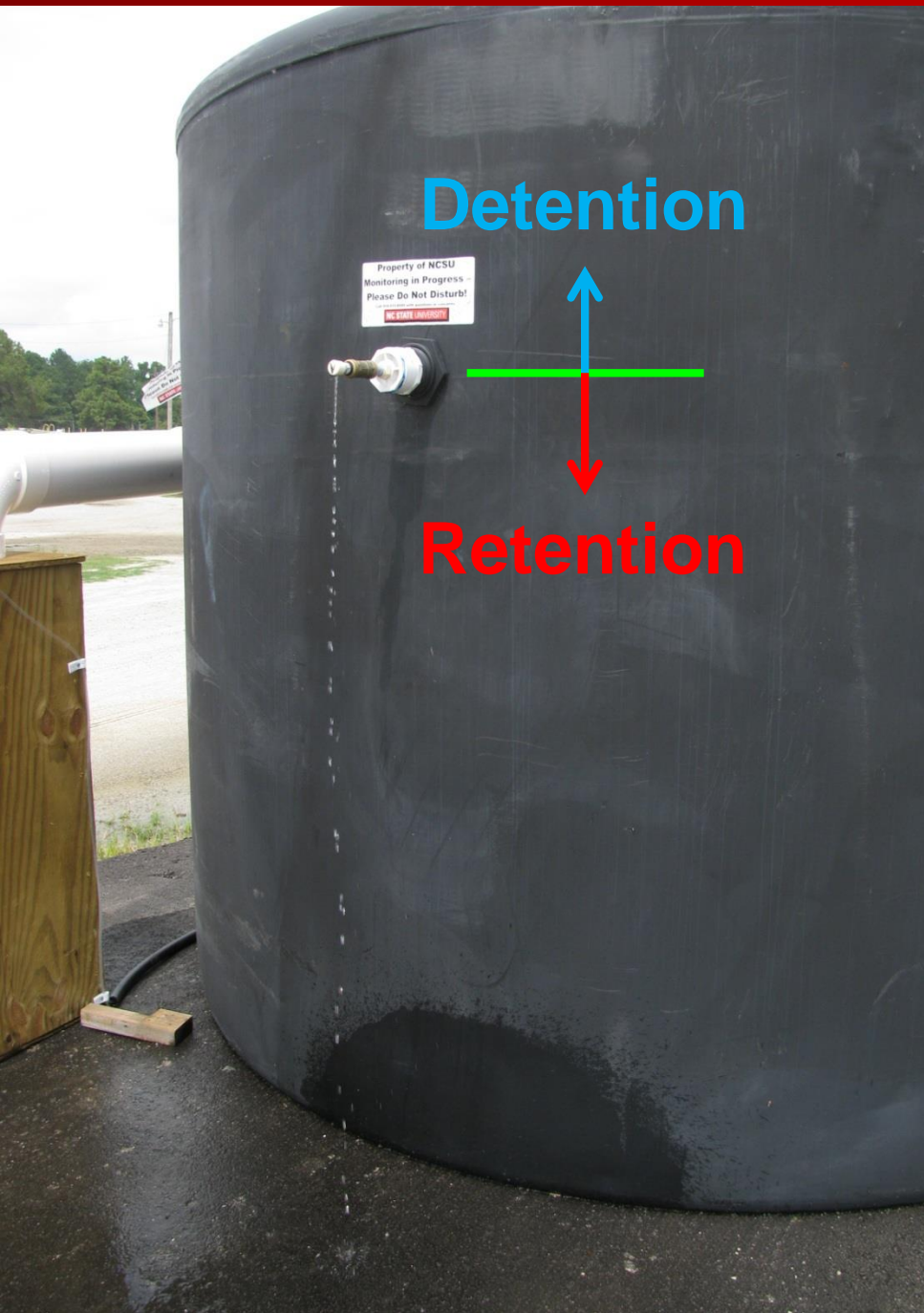


Terminology

- Detention / Active or Passive Release
 - Used to mitigate peak flow and provide non-potable water
- Single-Purpose
 - Used to provide non-potable water

Passive Release Concept





- Detention volume = 600 gal (~1.1")
- Retention volume = 6,000 gal
- Drawdown time = 3 days



Passive Release Conclusions: Function

- Significant potential for meeting stormwater management regulations
- Easy to **retrofit** existing systems
- Very Low Maintenance free
- Coincides well with existing North Carolina stormwater regulations

Infiltration Devices



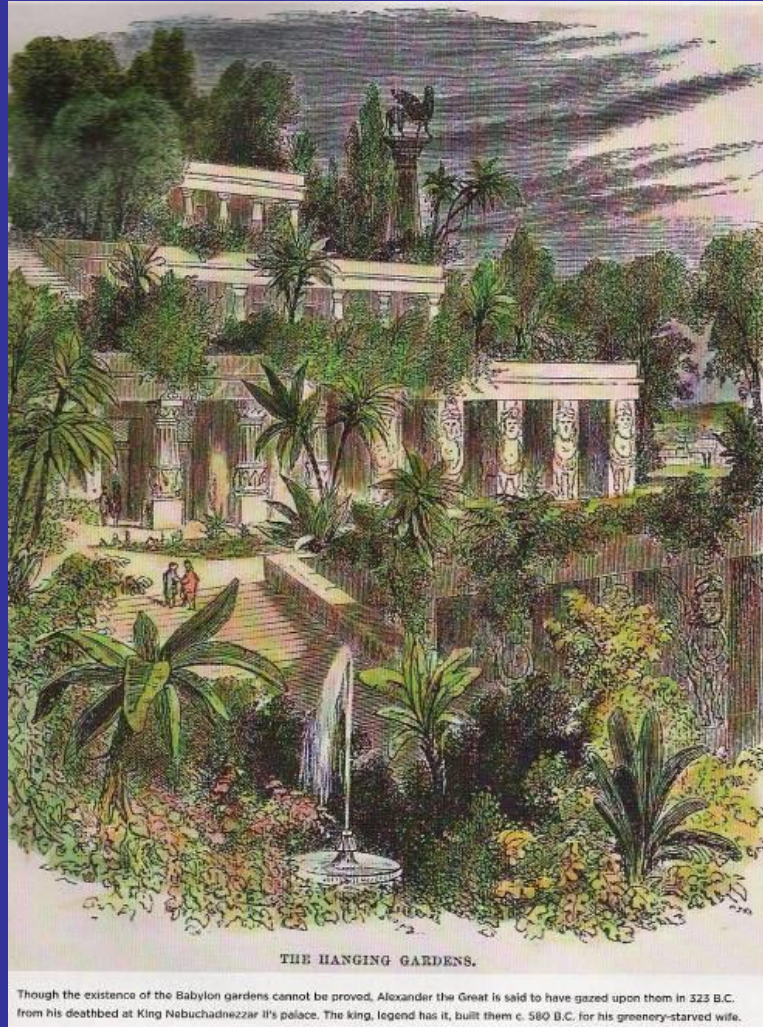
Green Roofs



Are green roofs common?



Are Green Roofs Old?



Green Roofs: Southern Style



Cleveland Clinic Green Roof Module System



Cleveland Clinic Green Roof Weeds – White Clover Colony



'Green Gutters'



Green Walls?



Green Walls Durham North Carolina



Cameron Village Raleigh NC



Residence Time

- Length of time water is stored in the BMP
 - Bioretention bowl should hold water for 12 hours
 - Residence time for water quality volume in a pond or wetland is 2 – 5 days

Bioretention residence time



Retention Pond Function

- Designed to store and slowly release stormwater
- Limited removal of sediment, TSS, nutrients
- Landscape feature - Waterfront property??



Stormwater Wetland Functions

- Reduce flooding
- Recharge groundwater
- Improve water quality
- Should not serve as mosquito habitat
- Attractive landscape features
- Add biodiversity
- Multiple uses
(educational, regulatory requirements, aesthetics)



Wetland Mosquito Control

- What makes plants “bad?”
- Cattails
- Willows and other trees
- Algae
- Phragmites
- The create habitat....



Mosquitoes can vector numerous diseases

Spray V. Wipe

- Wipe – Spotty, but growing areas of cattails
- Spray – The entire pond / wetland is covered up in Cattails



Selective Control of Unwanted Trees and Shrubs: Roundup in Shoe polish bottle



Cut and Treat Method of Tree Removal

- Cut trees and shrubs with pruner or saw
- Treat immediately with 2% Glyphosate solution
- Kills shoots and root system – systemic herbicide



Cut & Spray: Woody Vegetation Removal



Spray V. Wipe



Outlets Need Regular Maintenance



Outlet Cleaning



Wetland residence time



Bioretention Functions

- Infiltrate runoff
- Slow runoff
- Pollutant removal
 - Absorption
 - Adsorption
 - Plant uptake
 - Microbial action
 - Filtration
 - Sedimentation
 - Sunlight



Permeable Pavement Functions

- Infiltration
- Pollutant removal through filtration



Sand Filter Functions

- Filtration
- Collection of oil and grease
- Pollutant filtration



Large Scale Sand Filter



Grassed Swale Functions

- Slow and spread water flow to facilitate filtration, infiltration, and limited nutrient uptake



Level Spreader Functions

- Designed to slow and spread runoff to facilitate:
 - Infiltration
 - Filtration
 - Sedimentation



Pollutant Removal Mechanisms

- Sedimentation
- Filtration
- Adsorption
- Infiltration
- Microbial Action
- Plant Uptake
- Sunlight
- Collection
- Heat removal
- Fixation



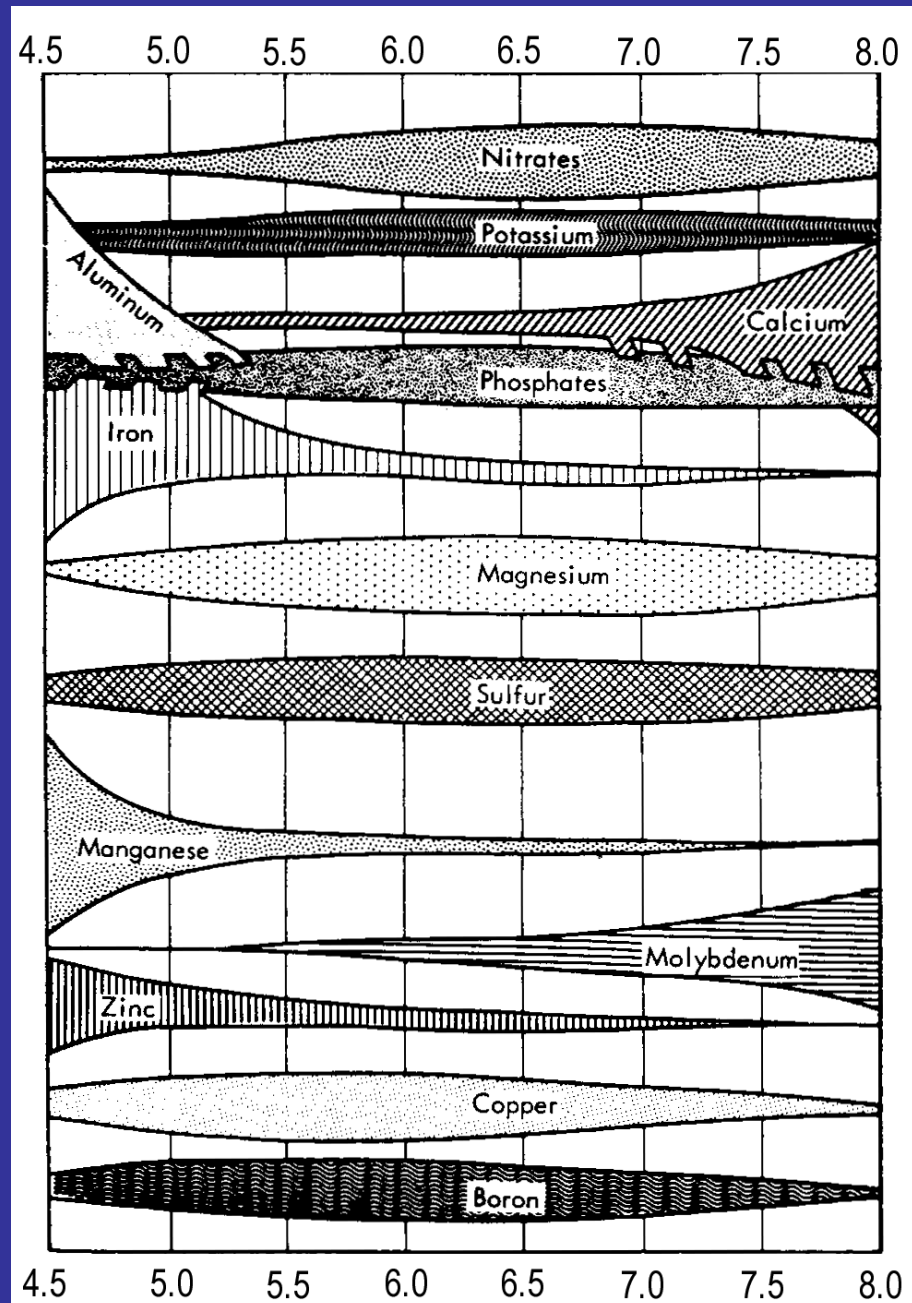
Pollutant Removal Mechanisms

- Sedimentation – metals and P are attached to soil and sediment
- P is adsorbed by low P soils and is tied up by Fe, Al, and Ca
- In adsorption molecules stick to solids



Soil pH

- Changes in pH affect nutrient availability
- Can limit root growth under extremely acidic conditions
- Can affect the microbial population in the soil



Pollution Removal Mechanisms

- Fixation
- P fixed by iron and aluminum in soil – in clay fraction and fines
- CEC increases with clay, fines, and OM
- Metals fixed by CEC
 - >CEC attracts Zn and Cu



Infiltration

- Infiltration and absorption
- In absorption the BMP acts like a sponge



+ 4 Hours

+18 Hours

Pollutant Removal Mechanisms

- Infiltration
- Pollutant removal through filtration



Pollutant Removal Mechanisms

Day of planting



- Plant uptake
- Plants 'fix' nutrients
- Should plants be harvested??

3 Years After



Pollutant Removal Mechanisms

- Sunlight
- Needed to kill pathogens and to encourage oxidation of organic matter



Pollutant Removal Mechanisms

- Collection



Pollutant Removal Mechanisms

- Filtration
- Infiltration



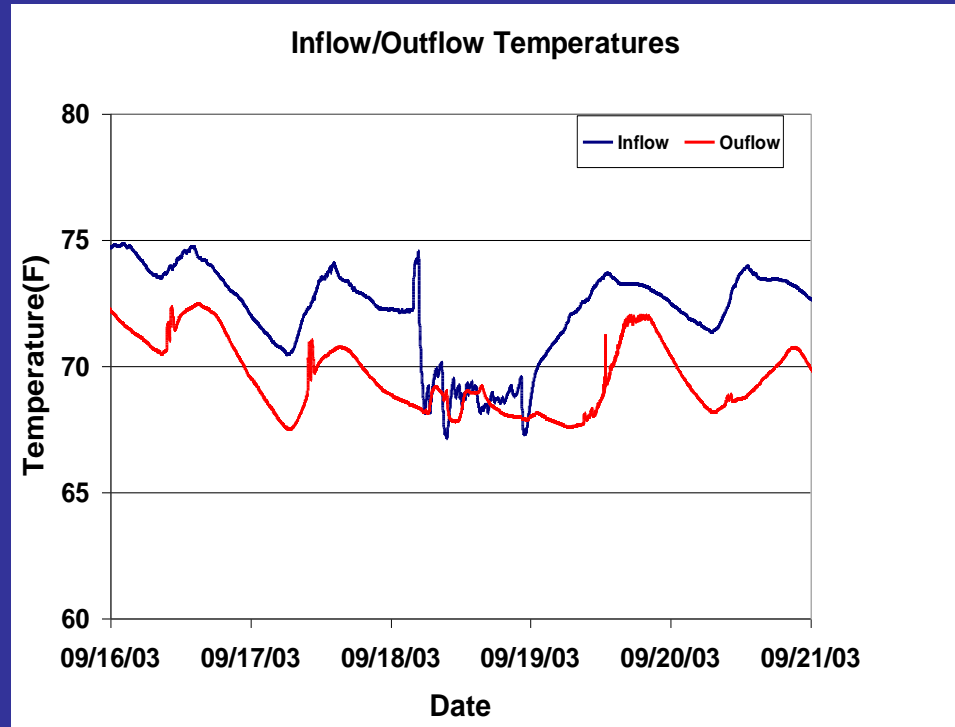
Pollutant Removal Mechanisms

- Gross Filtration



Pollution Removal Mechanisms

- Heat Removal / Temperature Reduction



SSSHS Stormwater
Wetland
Stormwater BMP Maintenance & Inspection

Temperature Effects?



Brevard



Asheville.

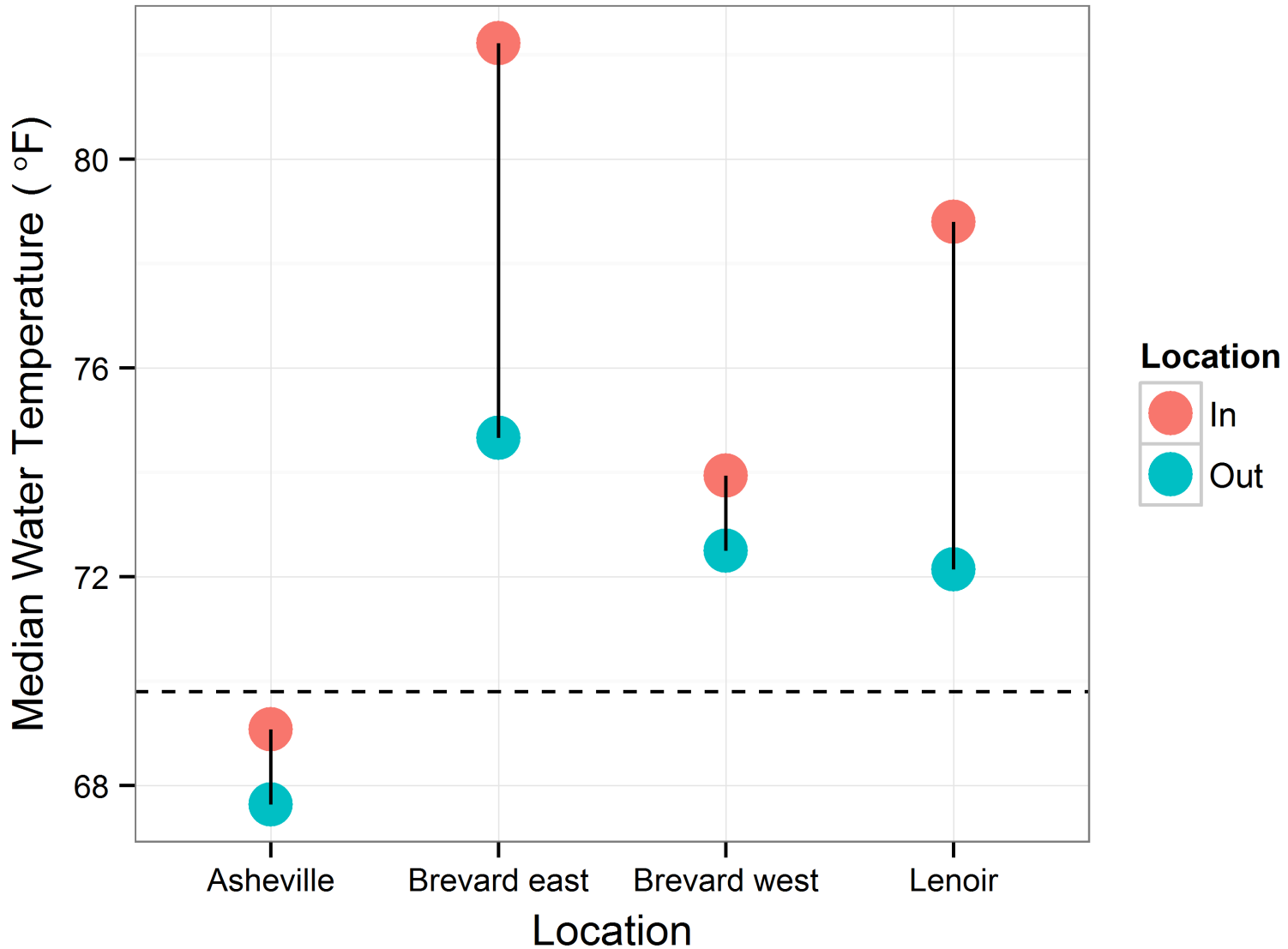


Asheville.



Lenoir.

Temperature Effects?



When do you need to replace the soil or media?



Question: What's the Ideal Media?

Ideal "Mix"

- 85-88% washed Sand
- 8-12% Fines (Clay+Silt passing # 200 sieve)
- 3-5% Organics – eg: aged pine bark fines



NCSU recommends commonly available components

- Concrete sand
- Fines from baseball infield mix
- Pine bark fines

Concrete Sand

- Coarse sand is described in ASTM D2487-10 as that retained by a No. 10 sieve.
- Also known as concrete sand or 'non-spec' sand



Ball Field Mix

- Contains approximately 60% coarse sand and 40% red or orange clay.
- Fe and Al in the soil are fixing the P in the stormwater



Cut ball field mix with coarse sand

- 4:1 sand to ball field mix yields 8% clay
- 3:1 sand to ball field mix yields 10% clay



Pine Bark Fines

- Commonly available
- Use pine or hardwood bark mulch if not available
- Smaller sizes of mulch are better to get better distribution through mix



Will Plants Grow in Bark and Sand?



Standard Nursery Mix

5 parts bark, 1 part sand



Replacement Soil Examples

- 'Ball field' mix
 - 85% sand, 10% fines, 2-5% OM
 - \$16.20/cu.yd or \$12/ton
 - wgt 2700 lbs/cy
 - (2012 quote)
- Permatil mix
 - 80% Permatil, 10% approved compost, 10% pine bark fines
 - \$32.50/cu.yd. or \$42/ton FOB
 - wgt 1565 lbs/cy
 - 2012 quote

The Role of Good Housekeeping

- Prevention of problems is always best
- Dirty watersheds = dirty BMPs



Storm drains lead to streams *and* BMPs





BMP Maintenance Falls Into 3 Main Categories

- Function
 - Hydrologic (Water)
 - Water Quality
- Aesthetics
- Safety



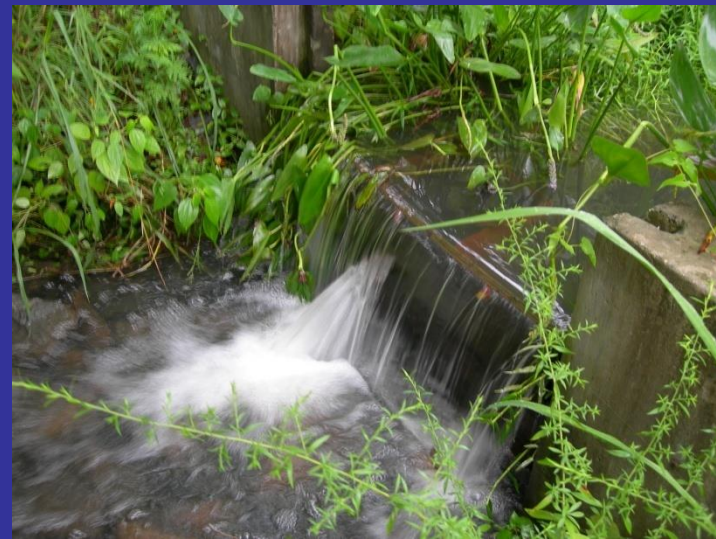
BMPs need

- Access
- According to one BMP contractor the biggest expense in maintaining BMPs is creating access...
- They need 6-8 ft wide access road and pad



BMPs need

- Regular inspection of components



BMPs need

- Specialized mowing –
not scalping



BMPs need

- Specialized pruning



BMPs need

- Plant management



BMPs need

- Water level management



BMPs need

- Protection from sediment



BMPs need

- Regular trash cleaning



BMPs can be damaged by...

- Fertilizer
- Sediment from traffic or outparcels
- Poor grass or mulch maintenance
- Roundup and other herbicides
- Excessive or too low mowing
- Compaction

BMPs can be damaged by...

- Fertilizer



BMPs can be damaged by...

- Sediment from traffic or outparcels



BMPs can be damaged by...

- Excessive Sediment from upstream



BMPs can be damaged by...

- Poor grass or mulch maintenance



BMPs can be damaged by...

- Poor vegetation management
- (Roundup)



BMPs can be damaged by...

- Excessive mowing or mowing too low





Register Here!



Why is Stormwater BMP Inspection and Maintenance Needed?

Communities across the State of North Carolina must manage rainfall that runs off roads, streets and parking lots. This runoff is called stormwater. To manage stormwater, many treatment devices, called BMPs, have been built. These devices include: wet retention ponds, bioretention areas, swales, stormwater wetlands, permeable pavement, rainwater harvesting systems,



Opportunities in Stormwater

BMP Inspection and Maintenance also presents a business opportunity for inspection by licensed professionals such as engineers and landscape architects, and maintenance by landscape and other green industry professionals. Designers will learn to design SCMs/BMPs with maintenance in mind; landscapers can diversify their business to ensure year-round work in a recession proof area of work; and suppliers of materials and technology to the stormwater industry can learn about new and existing opportunities to support the stormwater industry.



Who Should Attend

Commercial Landscapers
Property Managers
Owners
Homeowners Associations
Professionals with Licensure (PE's, PLS's, RLA's)
Regulators
Municipal and County Landscape Personnel



Certification Goals:

- Understand stormwater, how it affects water quality, and regulations associated with it.
- Understand stormwater management devices used in North Carolina and how they function.
- Understand inspection and maintenance requirements of each stormwater practice.

Recertification

UPDATE classes are available to renew certificates. When registering, please have your certificate number ready. This class will be 5 hours of lecture with no exam. Upon completion, receive an updated