Permeable Pavement: A New Chapter

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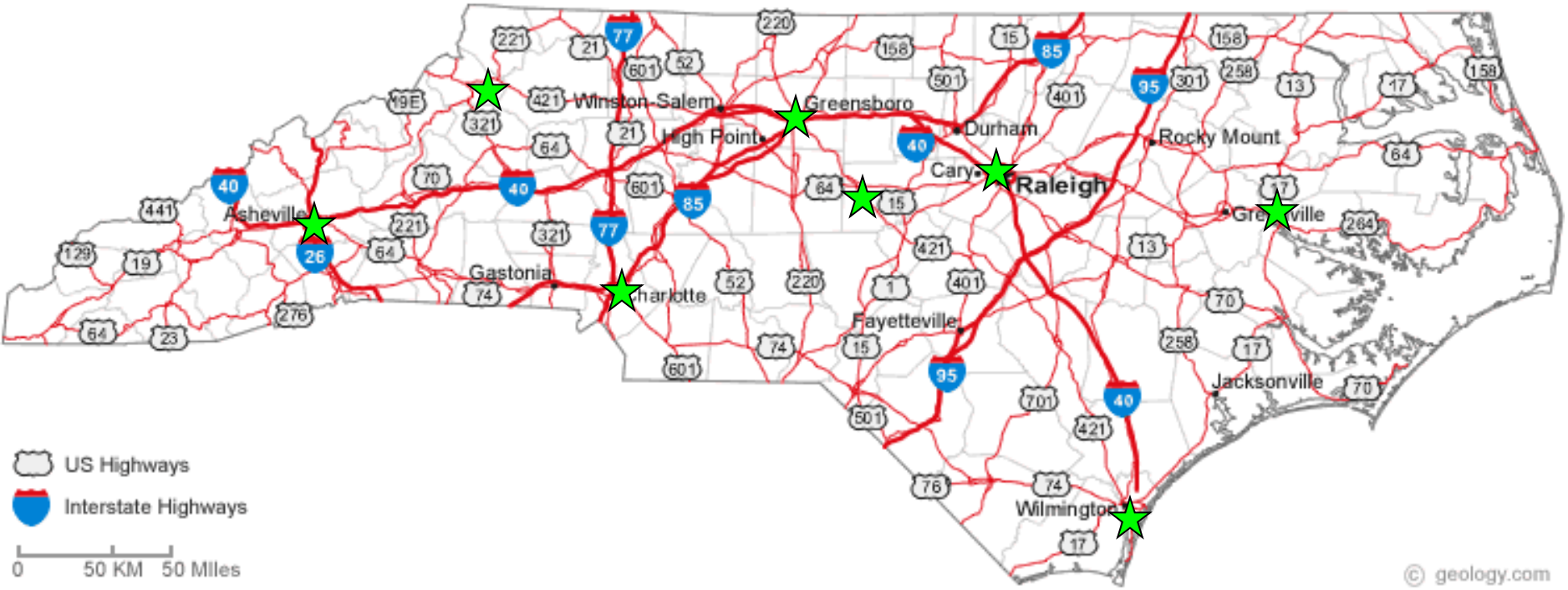
NC Division of Water Quality
Wetlands & Stormwater Branch

Began the revision in January
Public noticed on June 1
Final version Oct. 16

Permeable Pavement: 2012 Tour



This talk will cover:

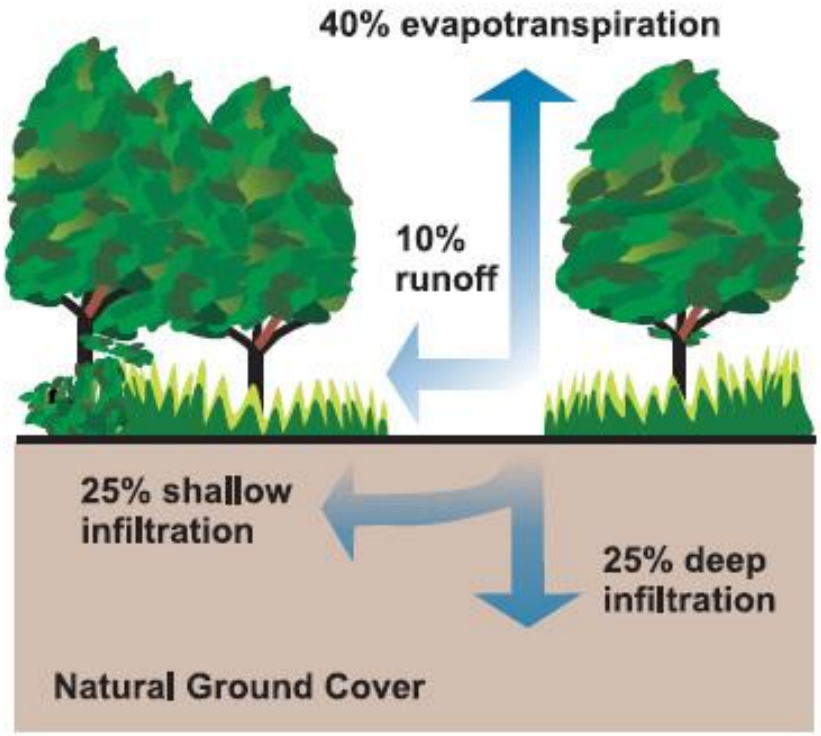
WHY are we revising the chapter?

HOW are we revising the chapter?

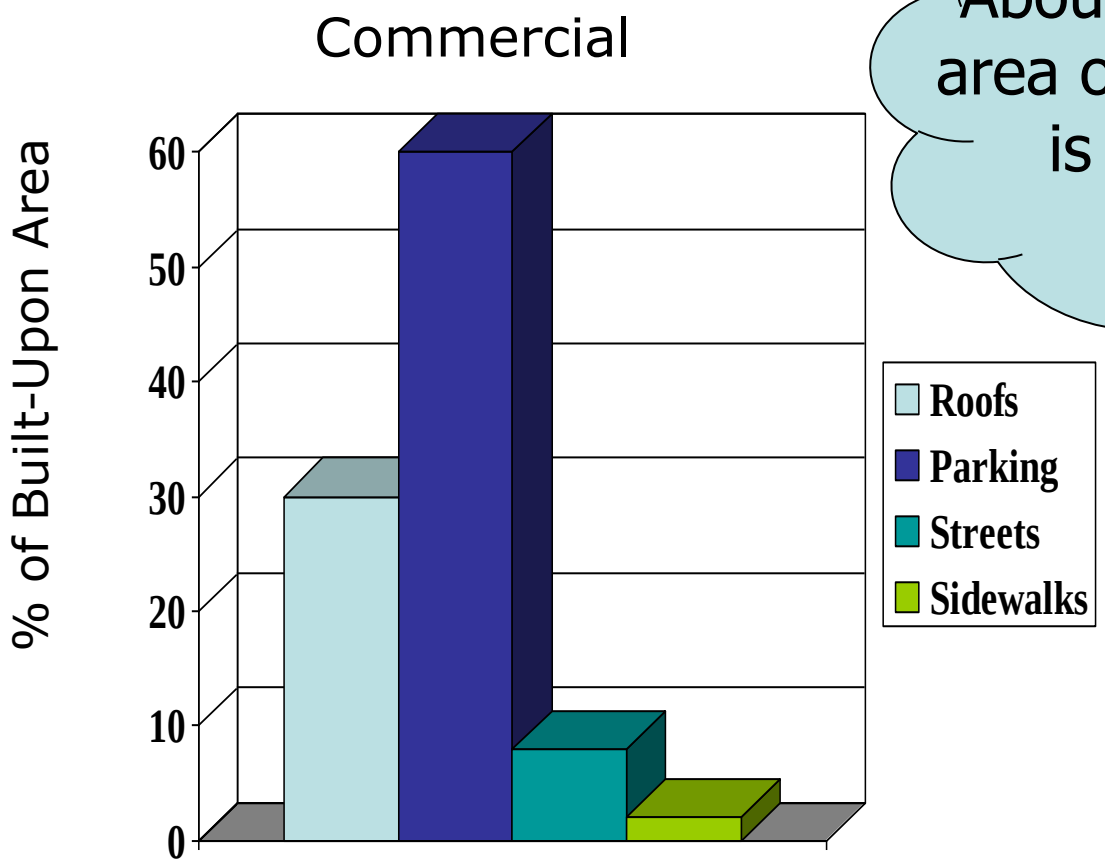
WHY are we revising the Permeable Pavement Chapter?

- Current stormwater practices ARE NOT working
- Permeable Pavement IS working state-wide
- Other benefits for the site besides water quality

Hydrology 101



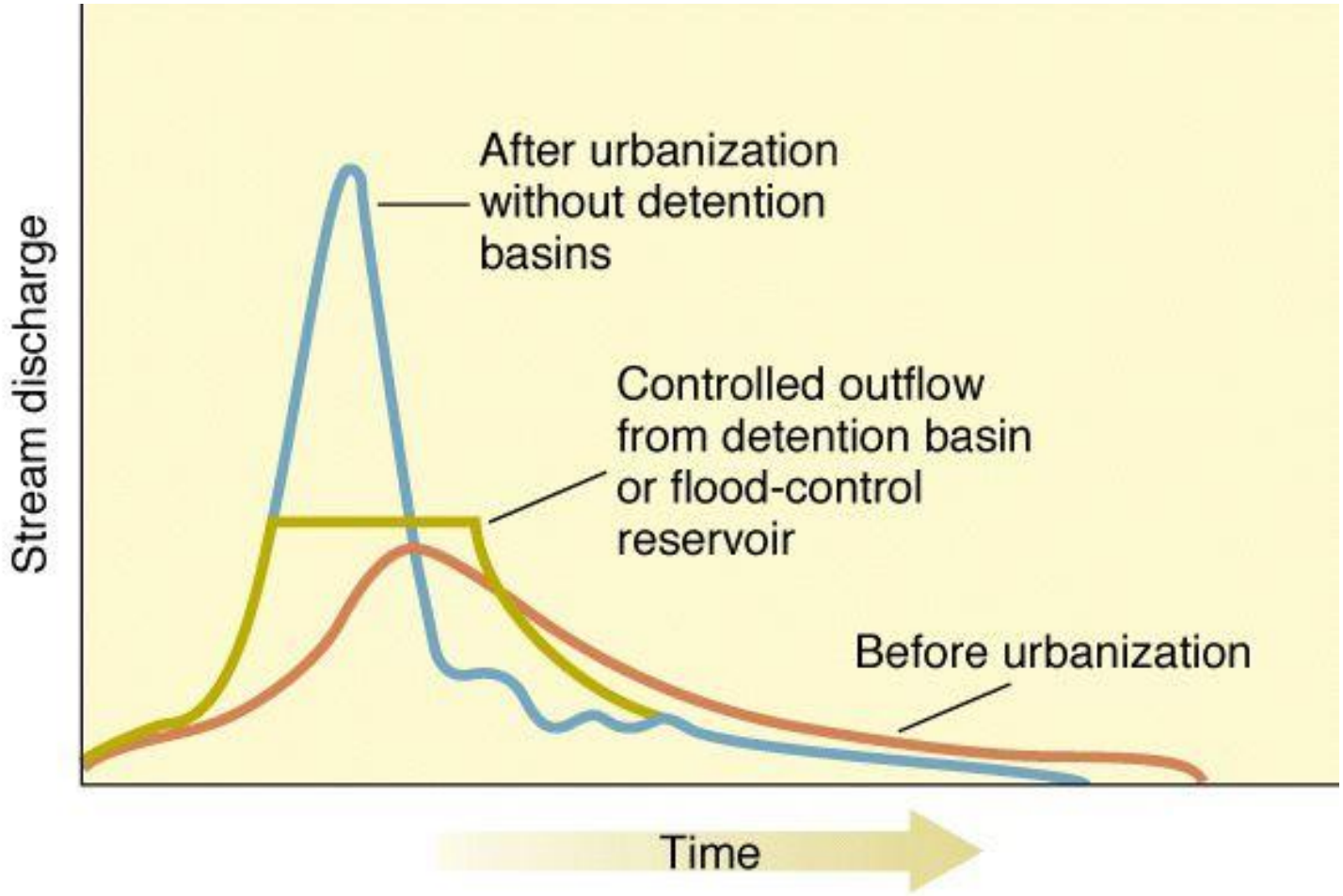
Land Use Planning 101



About 70% of built-upon area on a commercial site is parking, streets and sidewalks.

Most common stormwater BMP

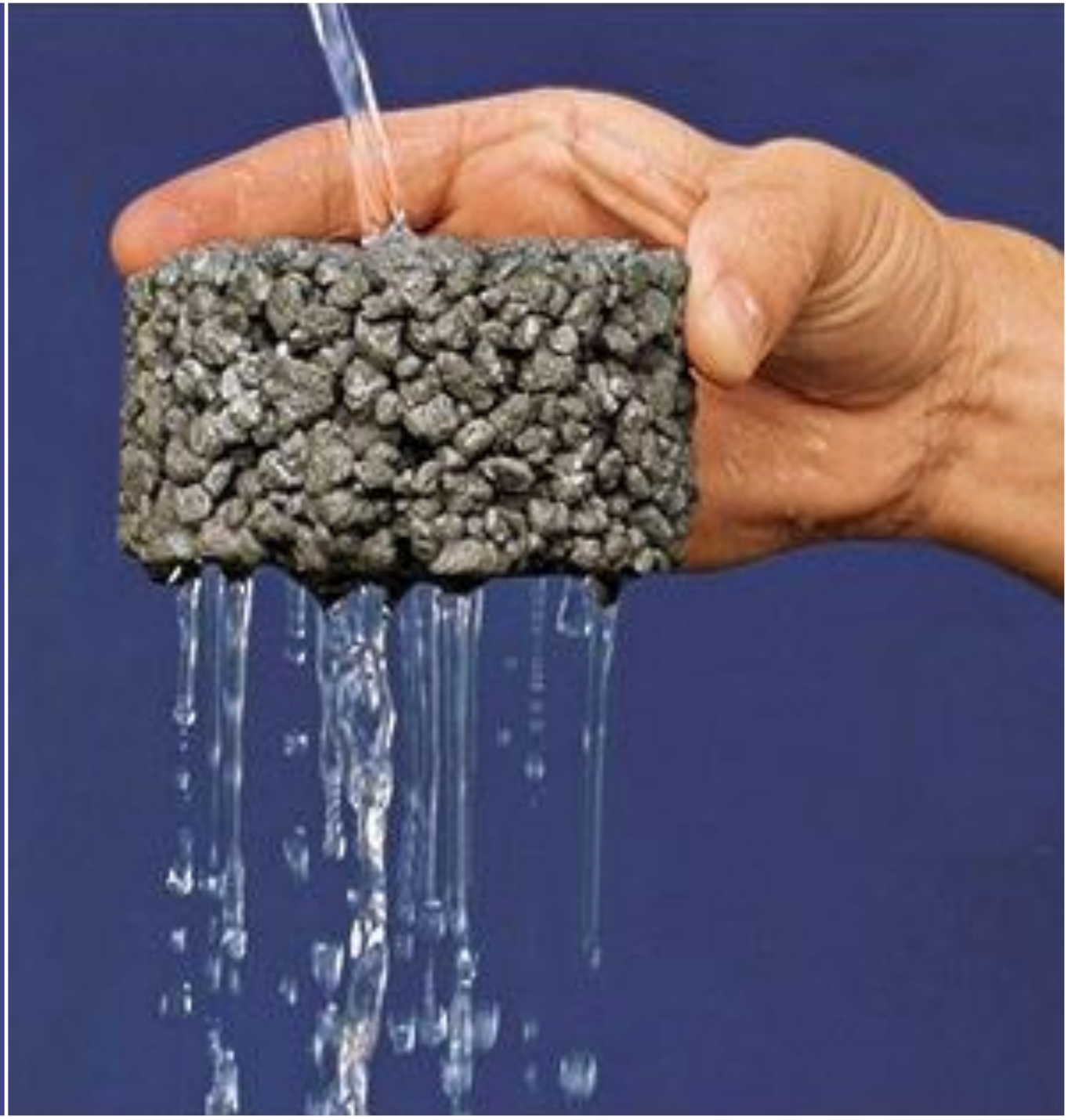
Here's the Hydrograph!




Higher high flows
Lower low flows

Urban stormwater is the #1 cause of stream degradation.

WHAT if we went to the source of the problem?

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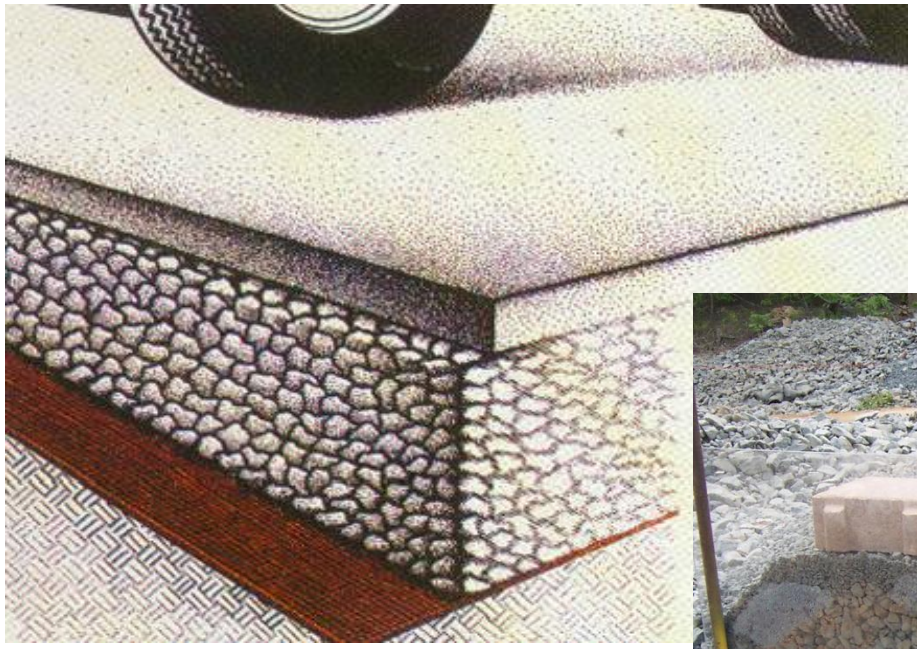
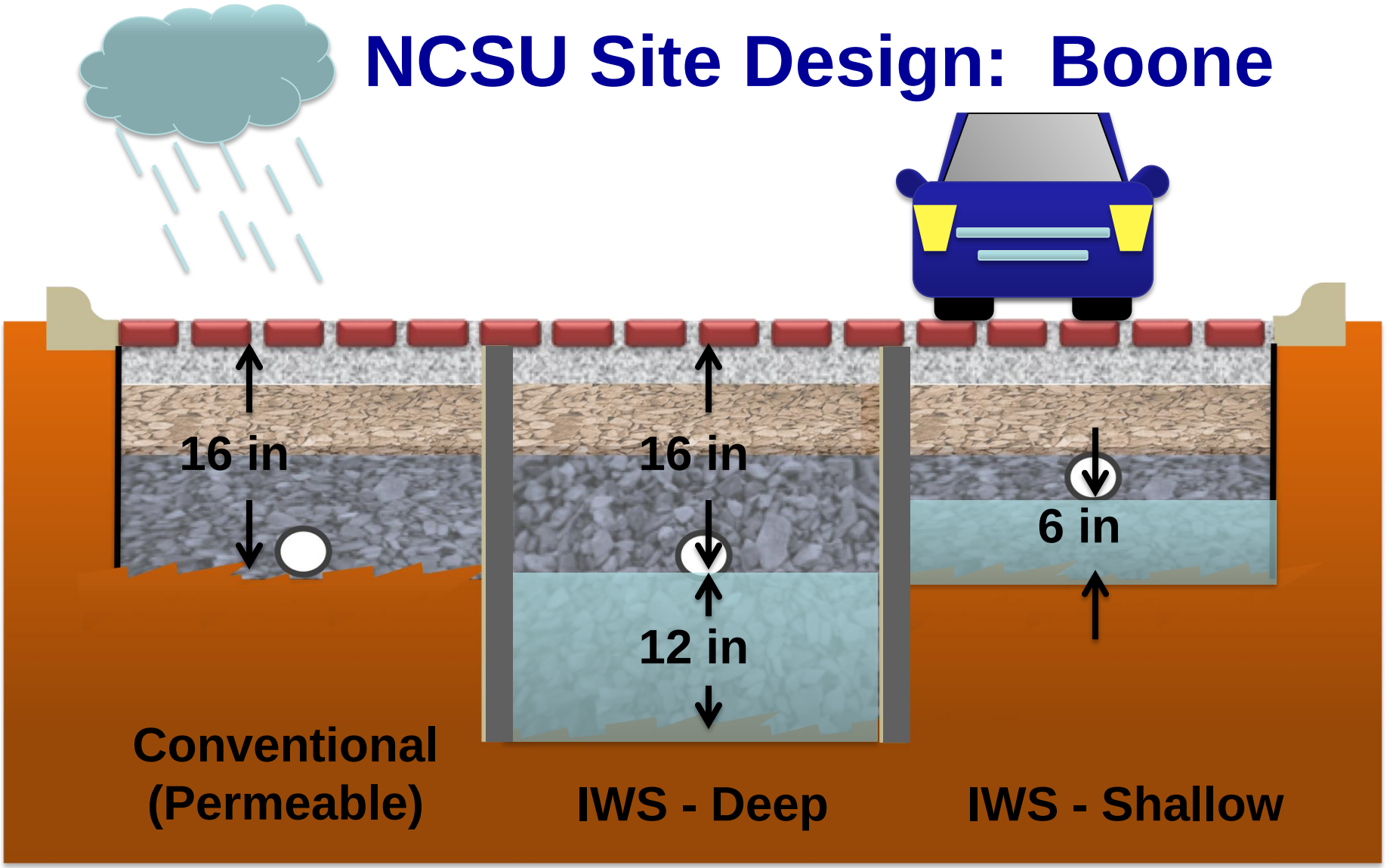
Stores STORMWATER in an aggregate layer to enable infiltration. If water cannot infiltrate, then it can be detained & released.



NCSU Site Design: Boone



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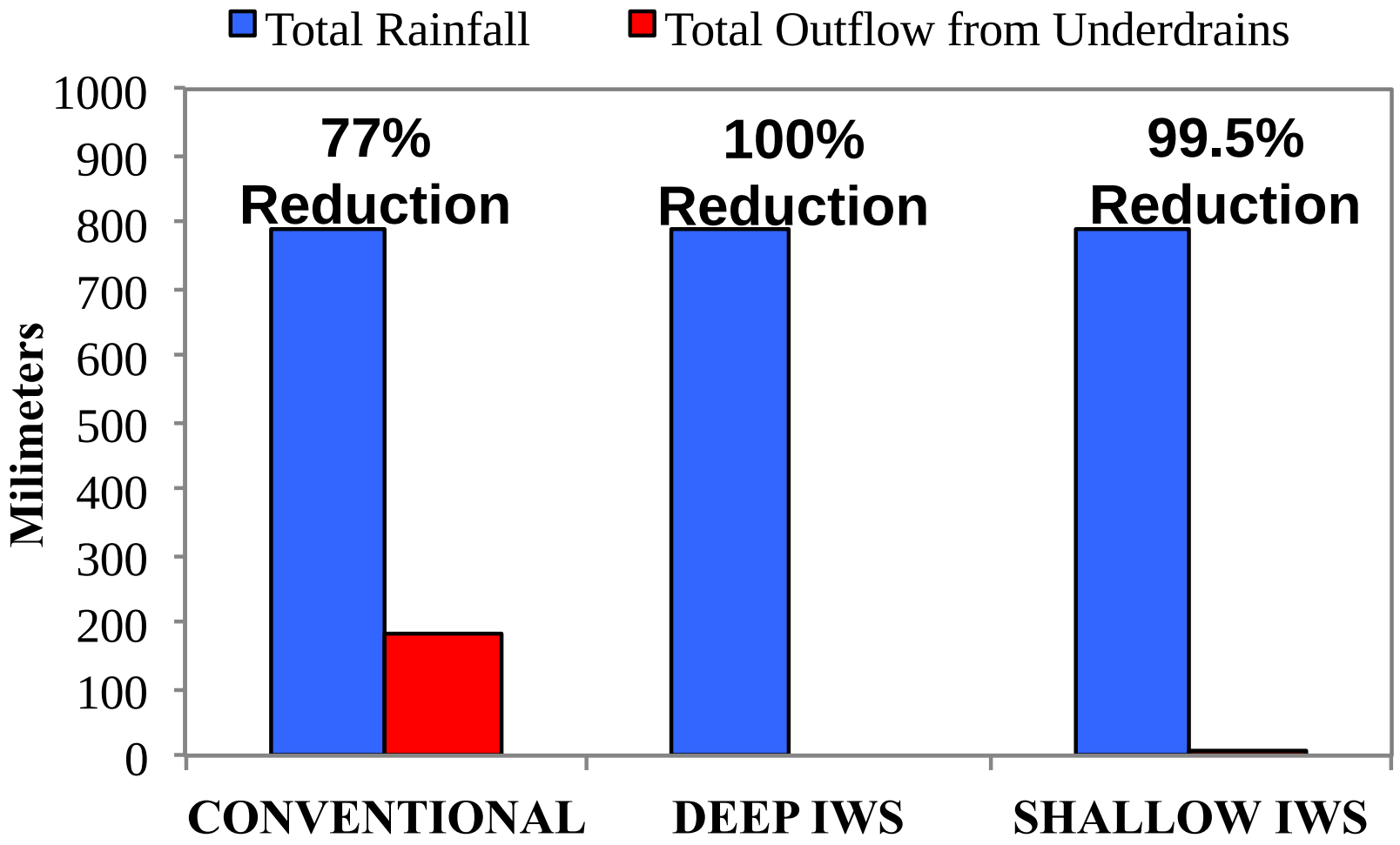
www.bae.ncsu.edu/stormwater

Results of Boone Study



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Other Benefits besides water quality!

Dry streets
Dry shoes
Safety

Permeable Pavement costs more per sq ft than conventional pavement, but it allows developers to avoid other costs.

Protecting streams is also an economic issue!

How did DWQ Decide on the New Design?

- **Research by NCSU & others**
- **Advice from local experts** (Ready Mixed Concrete Assoc, Fred Adams Paving Co, UNC-CH, Estes Design Group)
- **Design standards from other states** (OH, MD, DE, PA)
- **Data gathered during our field trip**

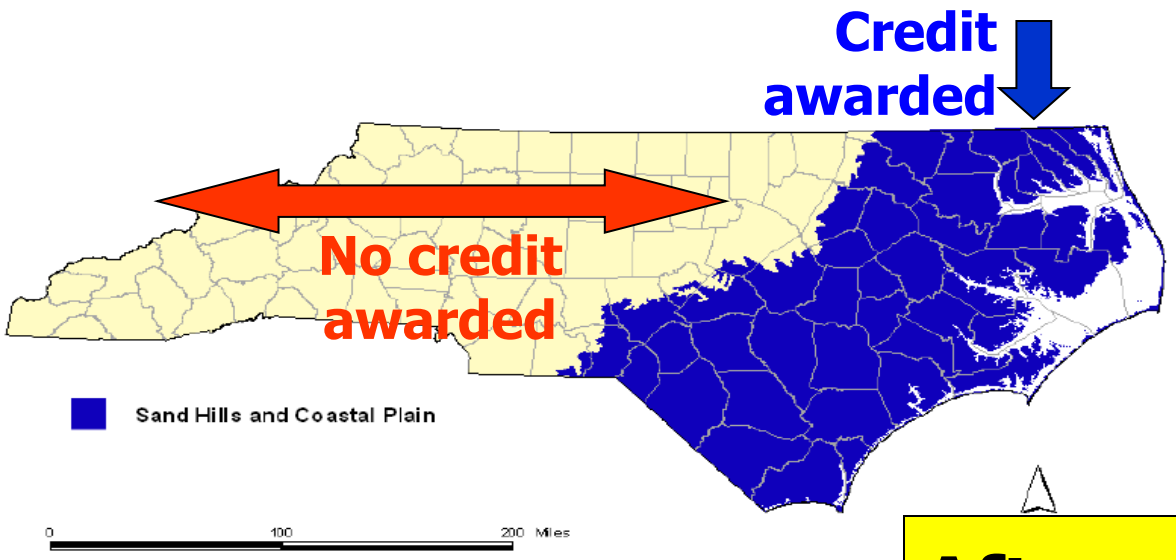
New Permeable Pavement Chapter: DWQ Goal

Provide design standards that will insure both short and long term excellent performance of permeable pavement for both water quality and structural goals.


HOW are we revising
the Permeable Pavement Chapter?

#1: Statewide Use and Credit

Before:



+ 0.52 in/hr soil infiltration

After: Credit awarded state-wide but design allowances must be made for differing soil permeabilities.

Approximate Soil Infiltration Rates (Ferguson 2006)

Texture	Infiltration Rate (inch/hour)
Sand	**8.27**
Loamy sand	**2.41**
Sandy loam	**1.02**
Loam	**0.52**
Silt loam	0.27
Sandy clay loam	0.17
Clay loam	0.09
Silty clay loam	0.06
Sandy clay	0.05
Silty clay	0.04
Clay	0.02

Note: 0.52 in/hr = 13 in/day, more than one quarter of the annual rainfall expected in Raleigh(45 in) or Charlotte (44 in).

Why?
Research has shown that these limitations are not necessary.

#2: More Credit Awarded

Before: Permeable pavement received a BUA credit as 60% or 40% pervious depending on the type of pavement and the depth of the aggregate.

After: Permeable pavement will receive BUA credit based on the soils, not the location of the pavement.

Why?
This is a more accurate way to estimate the effectiveness of permeable pavement.

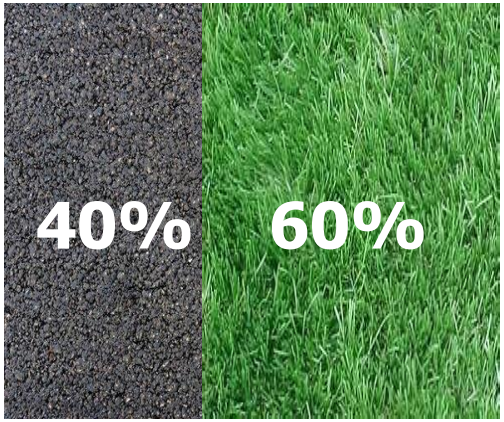
Credit ≠

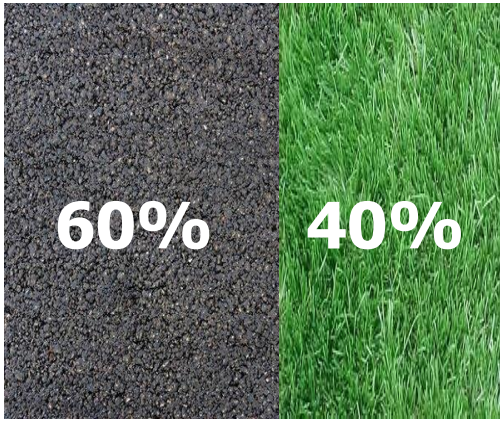
or

The BUA credit is used to determine whether the site is high or low density. After that the BUA credit does not affect the design of the site or the pavement.

BEFORE:

Coastal Plain →





Permeable pavement

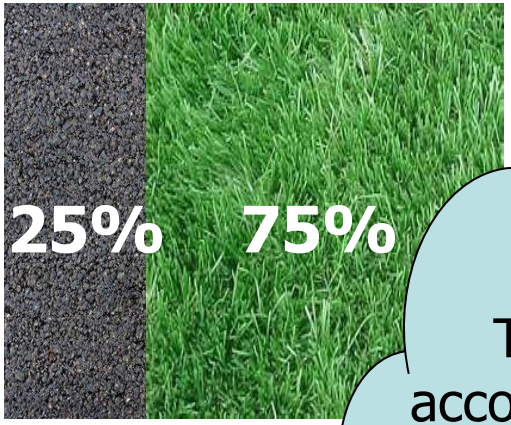
Rest of state →

No credit

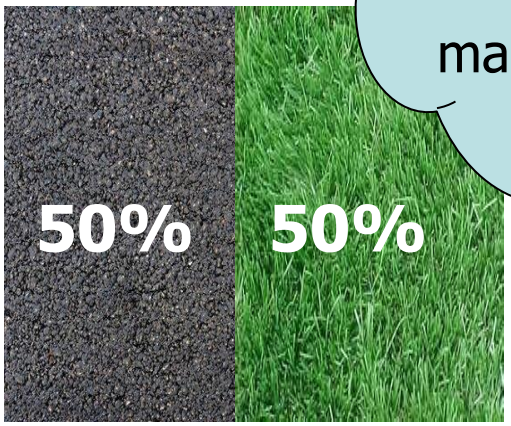
AFTER:

Permeable pavement

A & B soils →



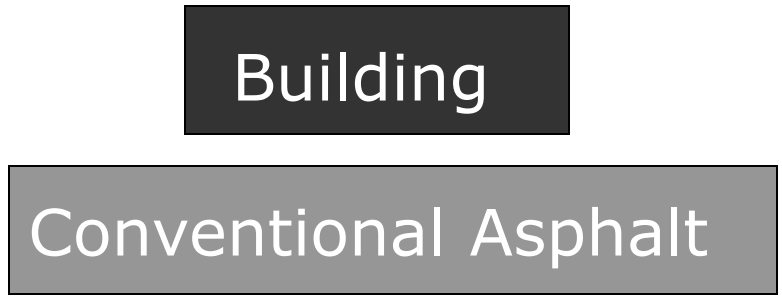
C & D soils →



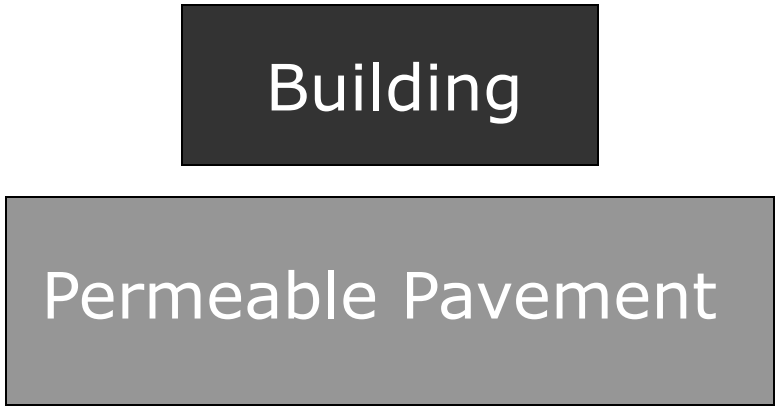
Why?
These numbers account for permeable pavement's performance while also accounting for potential maintenance issues.

How BUA Credit Can Affect a Site

Need this size lot to be low density for Phase 2.



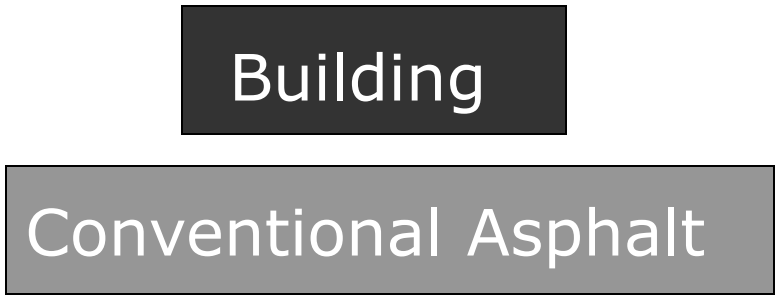
Low density for Phase 2 – C and D soils.



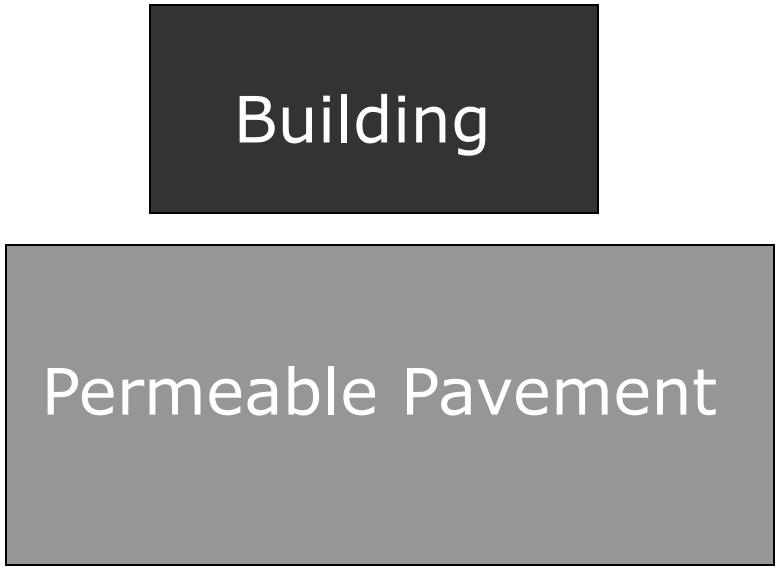
No piped conveyances.

How BUA Credit Can Affect a Site

Need this size lot to be low density for Phase 2.



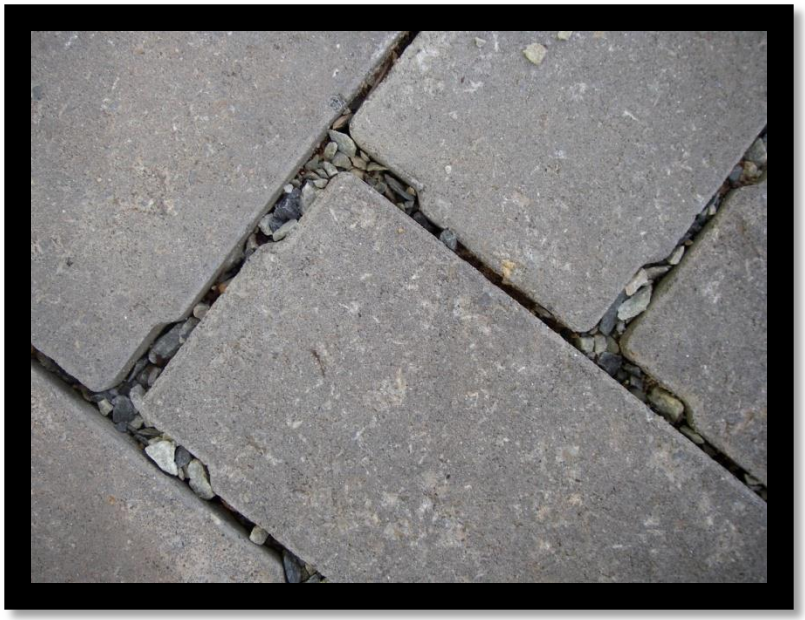
Low density for Phase 2 – A and B soils.



No piped conveyances.

#2: More Credit Awarded, Continued

Before: Permeable pavement did not receive credit for removing pollutants.



After: Significant pollutant removal credit is awarded to permeable pavement based on the design of the system.

Pollutant Removal Credits

Infiltrating systems:

- 85% TSS
- 30% Total Nitrogen
- 35% Total Phosphorus

Why?
The research data supports pollutant removal credit.

Detention systems (explained in a minute):

- 70% TSS with an impermeable liner
- 85% TSS with no liner
- 10% Total Nitrogen
- 10% Total Phosphorus

Permeable Pavement is Joining a New Club

85% TSS Removal:
- Wet detention pond
- Stormwater wetland
- Bioretention cell
- Sand Filter
- Infiltration basin/trench
- Permeable pavement *

<85% TSS Removal:
- Dry detention pond
- Grassed swale
- Vegetated filter strip

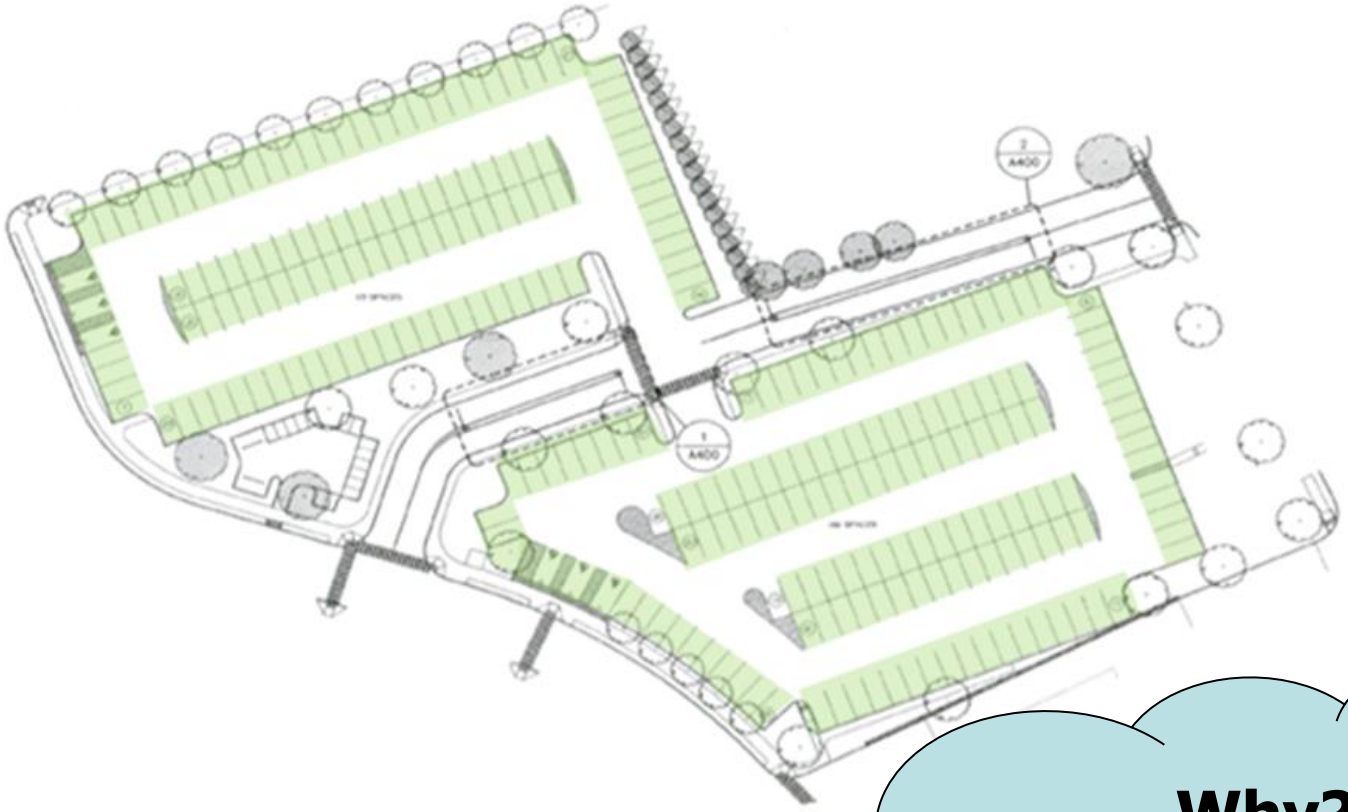
BUA Credit Only:
- Permeable pavement

* This is the only device in the 85% club that also gets BUA credit.

#3: Adjacent BUA can be Treated by Permeable Pavement

Before: Permeable pavement may not have any adjacent areas on the site discharging to it.

After: Runoff from site BUA can be directed to the pavement to receive pollutant removal credit.



Why?

This has worked in other states and if designed correctly, can work in NC too.

#4: Requiring Soil Testing

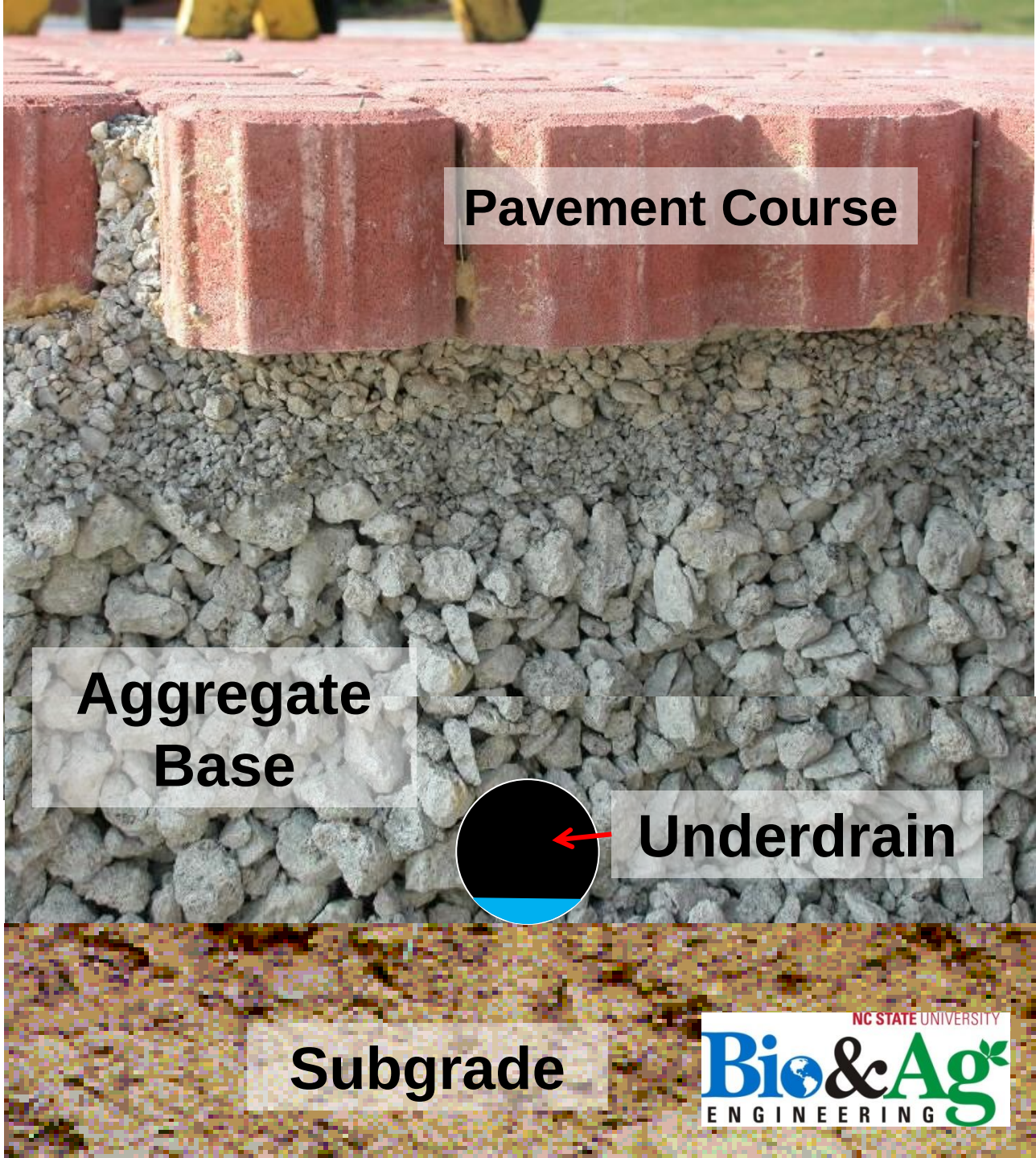
Before: A high soil infiltration rate was assumed and there was a "cookie cutter" design.

After: Soil testing must be done and used as the basis for the pavement design.

Why?

The design of the permeable pavement must be customized to the soils, particularly when used in areas with lower permeability.

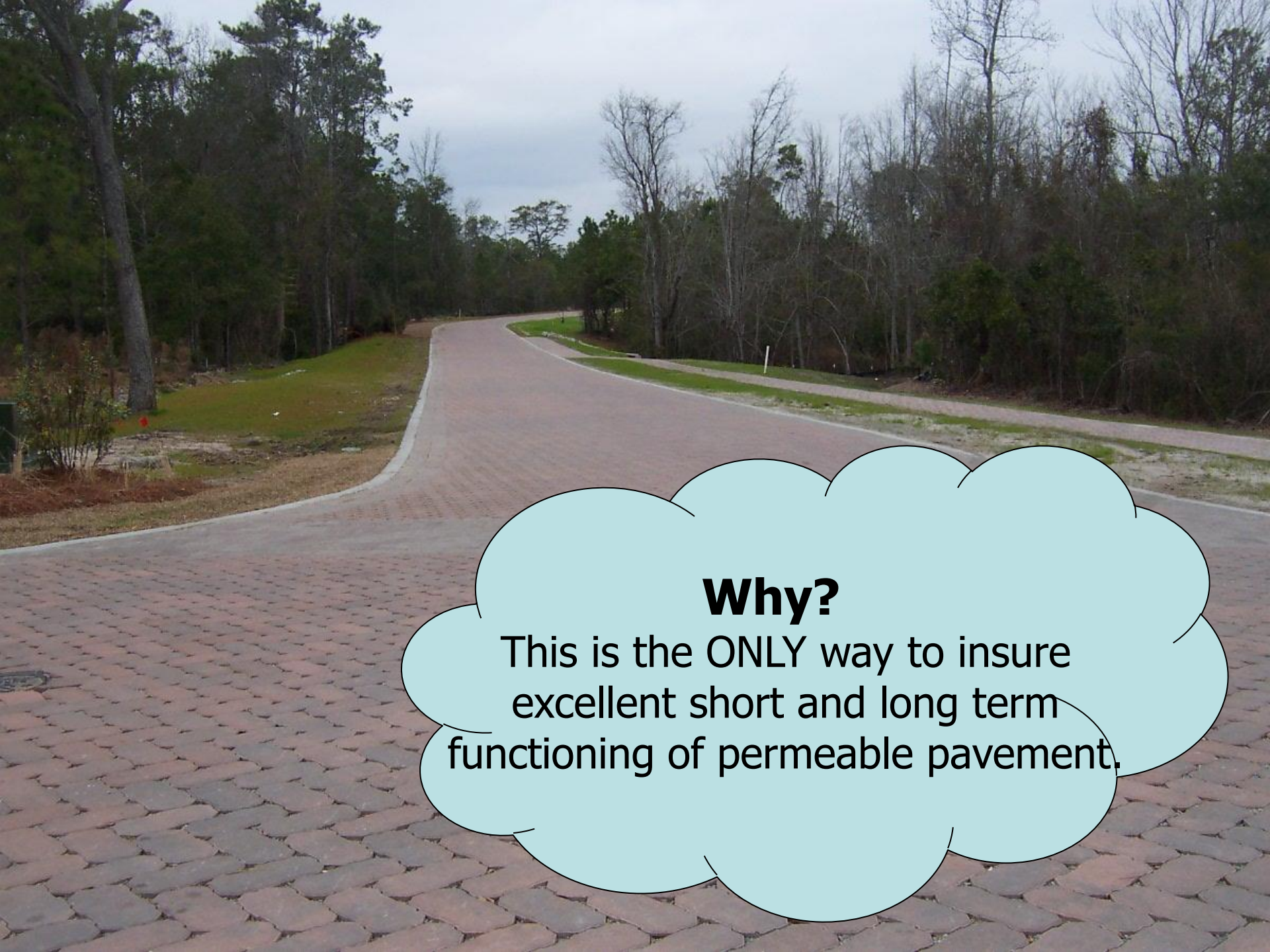
Standard permeable pavement cross section



#5: Higher Bar for Construction & Maintenance

Before: Very little mention of construction techniques. Maintenance requirements were not comprehensive.

After: Clear, comprehensive construction and maintenance requirements.


Why?
This is the ONLY way to insure excellent short and long term functioning of permeable pavement.

Before: No signs required.

After: Signs are required to inform users and managers about the care of permeable pavement.

Why?

Lots of effort and $ can be wasted with one uninformed action on permeable pavement.

Stormwater Unit Homepage

BMP Manual Errata Sheet

BMP Manual Chapters

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5 - Common BMP Elements r. 7/16/09
6 - Landscape & Soil Specs. r. 6/17/09
7 - BMP Maintenance r. 9/28/07
8 - Level Spreader & Veg. Filter Strip r. 3/9/10
9 - Stormwater Wetland r. 7/10/09
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11 - Sand Filter r. 9/20/09
12 - Bioretention r. 7/24/09
13 - Reserved
14 - Grassed Swale r. 6/8/09
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DWQ Stormwater BMP Manual & BMP Forms

Select from the menu on the left the BMP Chapter, BMP Supplement Form, or O&M Agreement that you want to view.

All other forms and documents related to State Stormwater and Post-Construction can be found HERE.

Sign-up for the listserv to receive BMP updates: CLICK HERE

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COMMENT ON THE BMP MANUAL & RELATED FORMS

North Carolina
Division of Water Quality

Stormwater Best Management Practices Manual

July 2007*

NCDENR

*Individual chapters of the BMP Manual will be updated periodically. Individual chapters may be more recent than July 2007.