

Stormwater Workshops – Ohio – Nov/Dec-11

Applied Research, Informed Regulators Better Decisions

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www.bae.ncsu.edu/stormwater

Sub-theme: “Life is a Big Communications Problem.”

- 90% of conflicts could have been thwarted with better communication



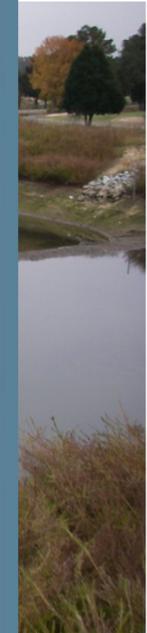


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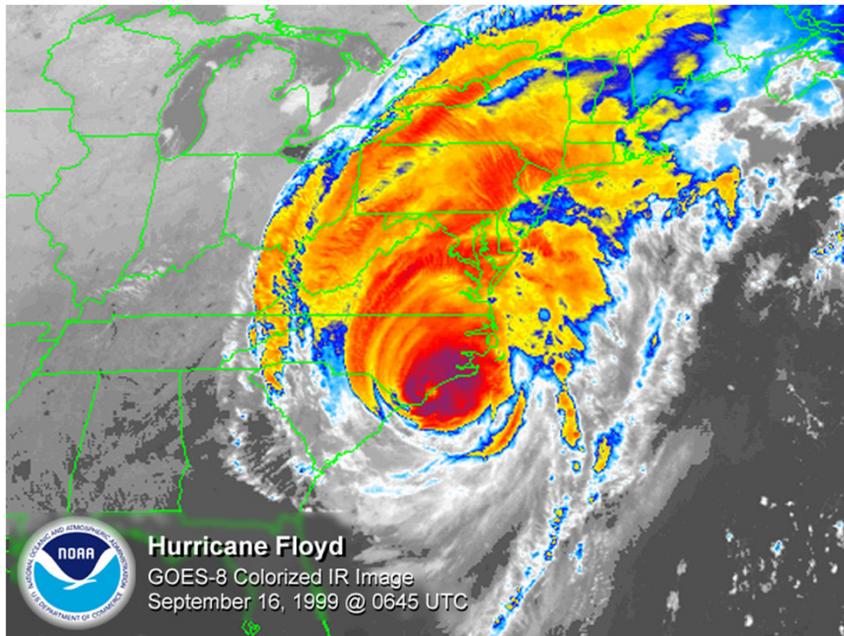
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Our stormwater practices couldn't

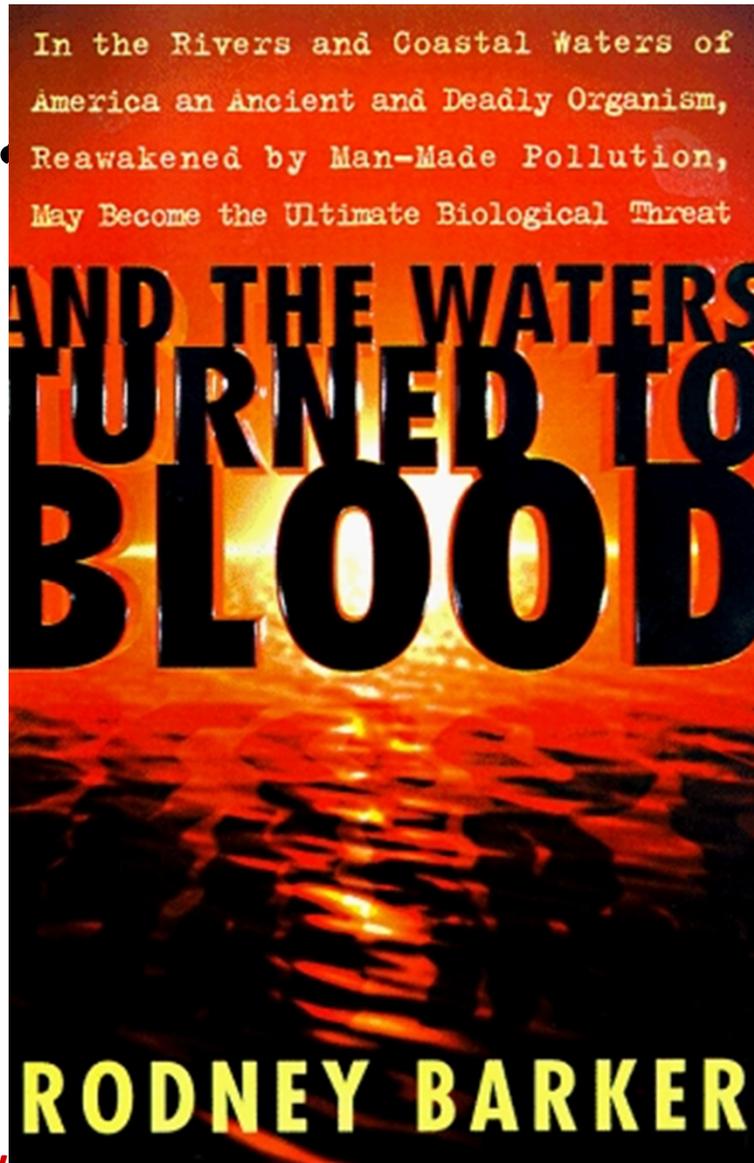
- Infiltrate
 - Soils too clayey
- Reduce volumes of water
- Be anything but *Typha* (Cattail) jungles
- Be located next to people
- Be driven on?!



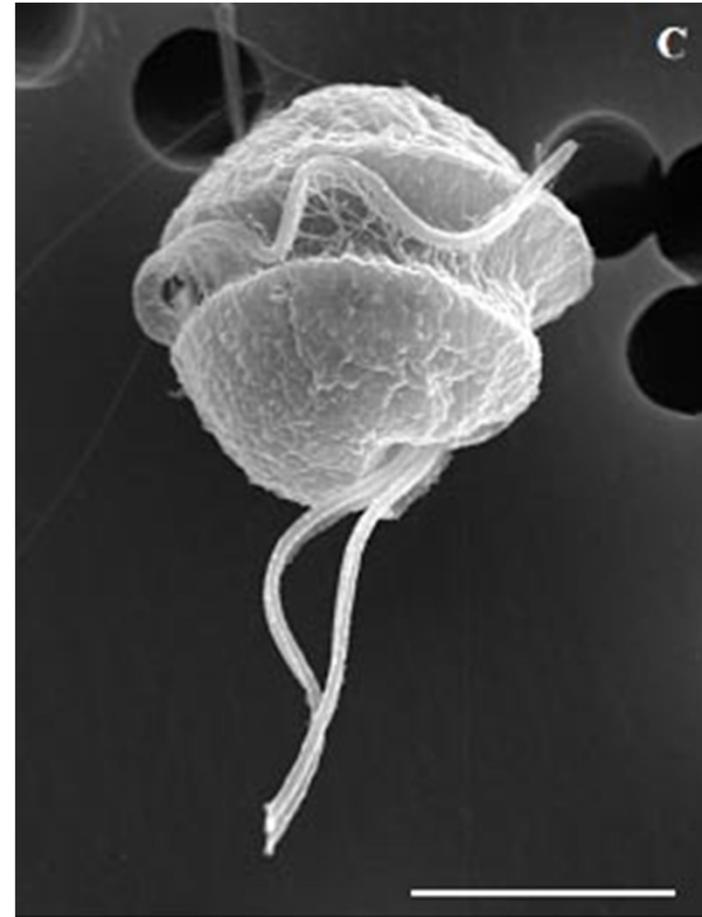
But then came the Hurricanes...



And then the fish kills...



And politicians reacted and told regulators: thou must remove nutrients



Images: NCSU CAAE

Why? Our Tourism Industry



WRAL.com

coverage you can count on
RALEIGH • DURHAM • FAYETTEVILLE

Obituaries

Because Every Life
Has a Story...

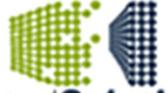
View local tributes >

Triangle 411 : Autos : Classifieds : Jobs : Real Estate : Shop WRAL : WRAL-TV

Home : News : Traffic : Weather : Sports : **Business** : 5 On Your Side : Health

Local Tech Wire : Market Summary : Local Stocks : My Watchlist : Tax Guide : Calculators

Business

Presented by

Hosted**Solutions**

Visitor spending hits record \$17.1B in N.C.

Posted: Aug. 5, 2008

RALEIGH, N.C. — Visitor spending increased 7.4 percent across North Carolina last year, to a record \$17.1 billion, according to [information](#) released Tuesday by the state Division of Tourism, Film and Sports Development.

Wake County was one of six counties to register double-digit growth in visitor spending, with a 10.7 percent increase to almost \$1.5 billion. Nash County saw the largest jump statewide at 12.7 percent, to \$218 million.

All Triangle-area counties saw increased tourism spending, except for Lee County, which registered



 Video

- [OBC rides tide of troubled economy](#)

 Documents

- [2007 N.C. visitor spending](#)

Now Government Officials had reason to be open to change

- But, rightfully, were very cautious
- And the Dialogue began...

**A Hoping to
be Happy
Regulator**



Who's at the Table?

- Designers wanted tools
- Environmentalists wanted protection
- Regulators wanted to be careful
- Dr. Hunt wanted solutions
 - And work



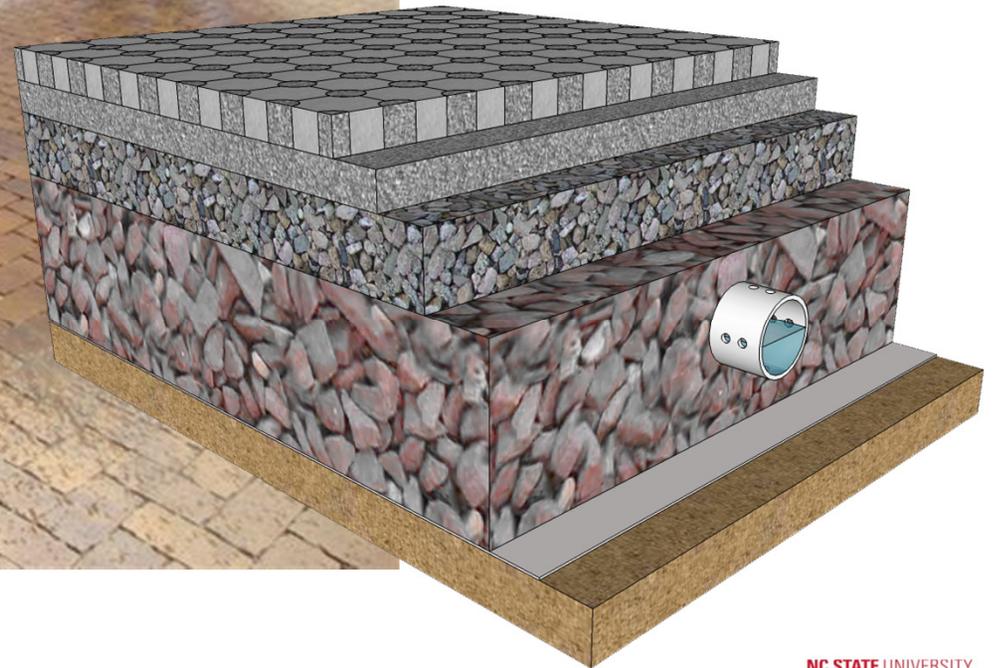
Criticism #1 – You won't let us use permeable pavement (2000)



Response: Because they don't work!



Permeable Pavement?

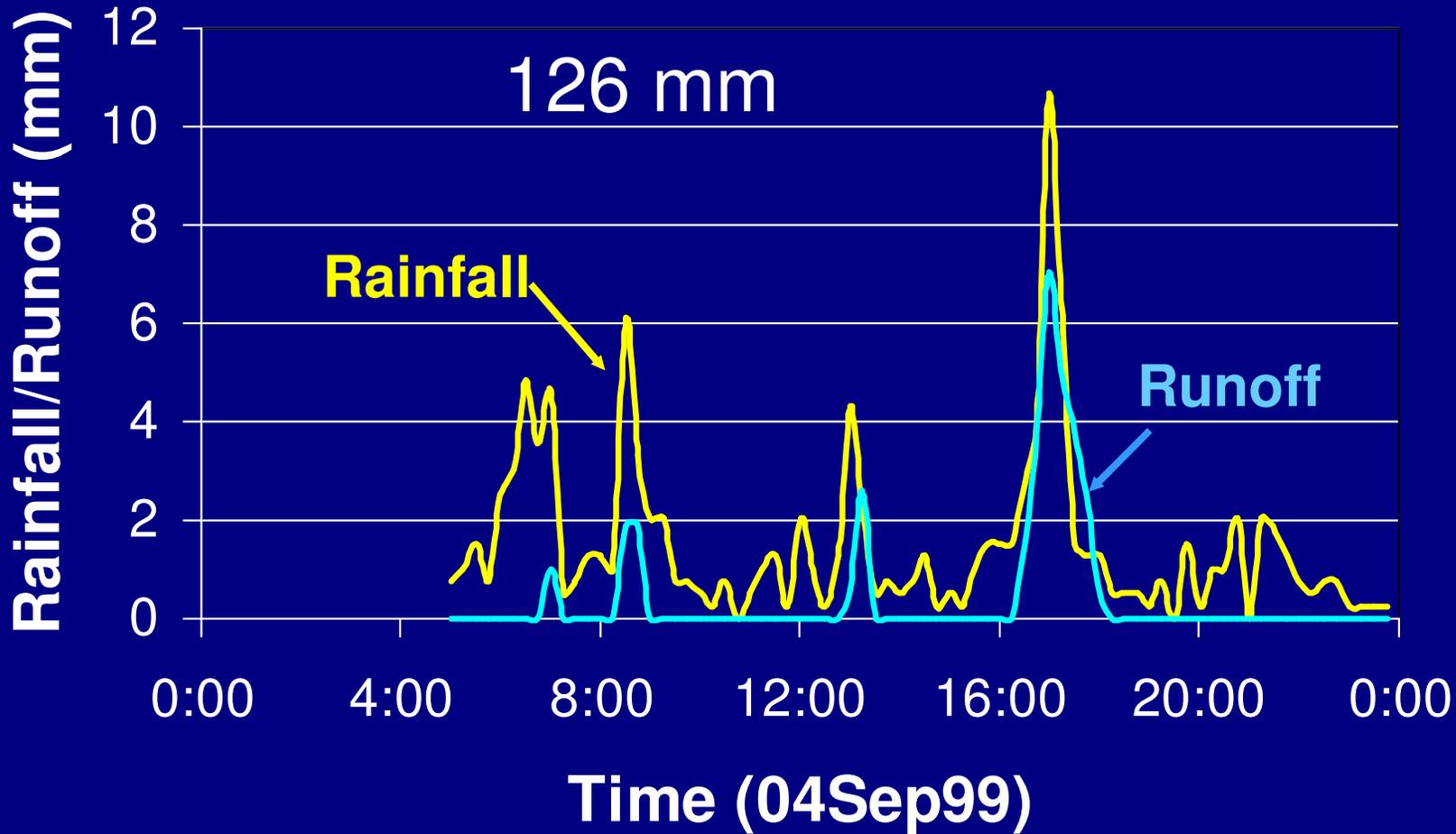
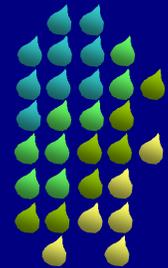


Kinston, NC, Block Paver Study

- Sandy Soil ($K > 8$ in/hr or 0.056 mm/sec)
- Seasonal High Water Table > 2 m from surface
- Employee Parking Lot (ADT = 30)
- Average Slope = 0.5%



Hurricane Dennis Hyetograph & Hydrograph – 15 min intervals



Wilmington, NC, Permeable Concrete Study

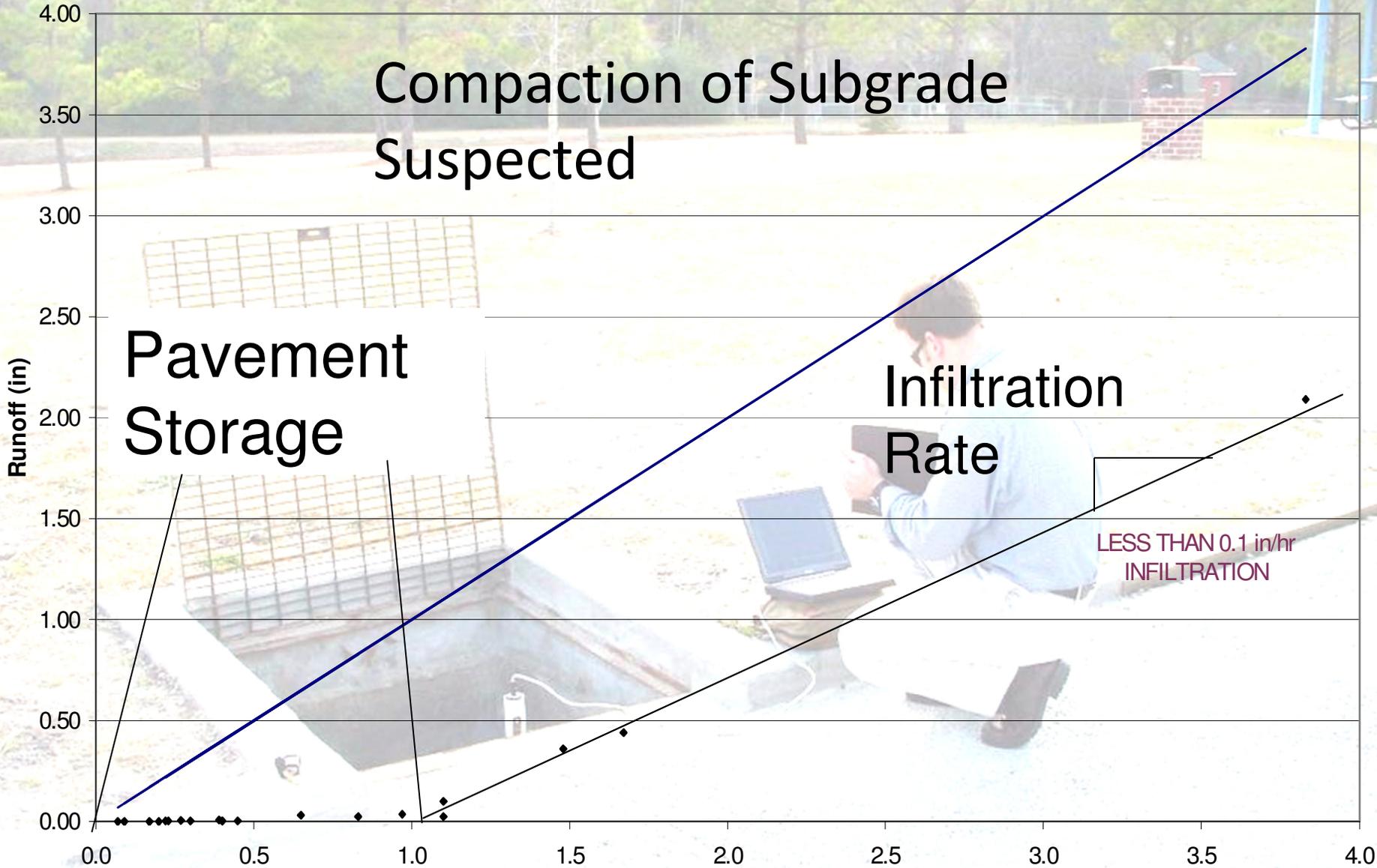
Loamy Sand Soil—
Coastal NC

- Water table > 1 m from surface
- Day Use Recreation (40 ADT)



Permeable Concrete Wilmington NC

Compaction of Subgrade Suspected



Pavement Storage

Infiltration Rate

LESS THAN 0.1 in/hr INFILTRATION

— Runoff from an Impermeable Lot

• Runoff from Permeable Concrete Lot

Swansboro PICP study



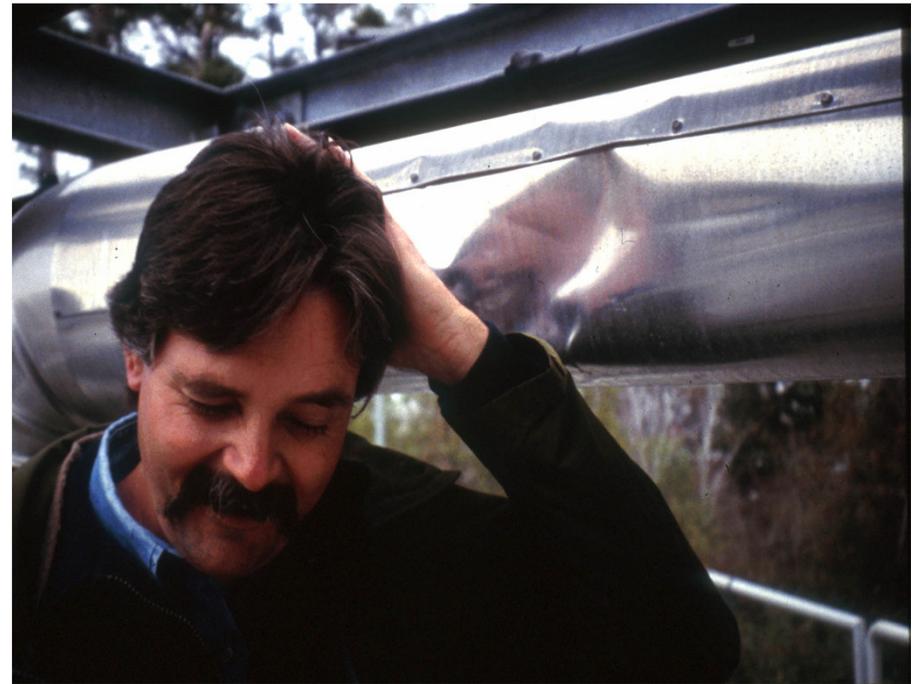
~50 cm
of
Gravel
Storage
Layer

Swansboro Data

- No Runoff from March to December 2004
 - Five events > 50mm (2 in)
 - Largest Event: 88mm (3.5 in)
 - 90 events (>0.25 mm)
- Average NRCS Curve Number: 44
 - Limited by rainfall total
- Rational Coefficient (for Q_{peak}): 0

Still not satisfied?

- All of the pavements you studied were young
- Won't they still clog with time?



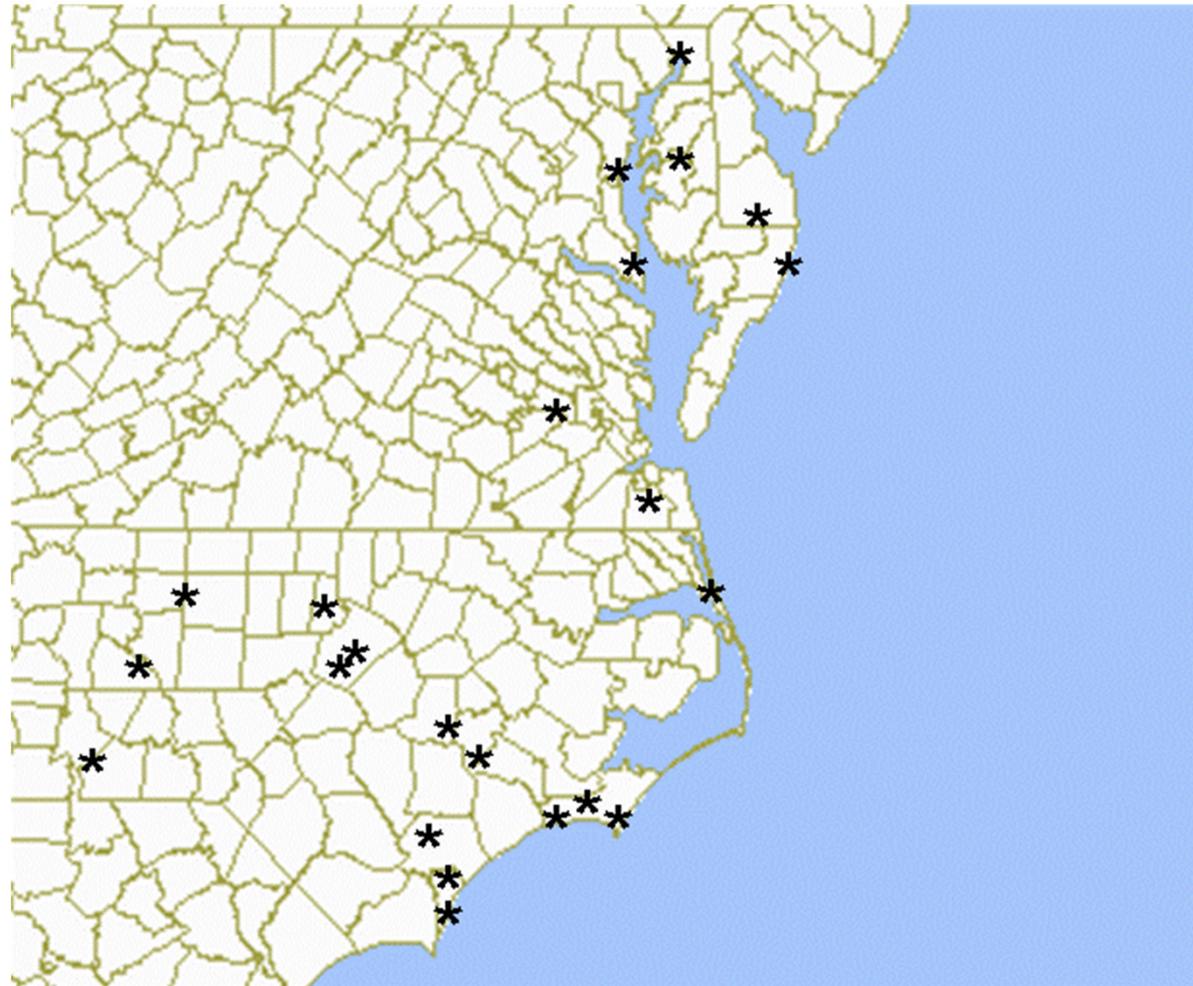
Study on Surface Infiltration Rates



Surface Infiltration Rates

- 48 sites
 - CGP (17)
 - PICP (14)
 - PC (11)
 - PA (5)
 - PG (1)
- 2 to 21 yrs old

Funded by ICPI



Procedure

- Modified Soil Infiltration Rate Procedure
 - ASTM D3385-03
 - Falling Head; Sealed
- Double Ring
 - Inner and Outer Rings filled to 125 – 175 mm (5 – 7 in)
 - Depth measured every 5 - 10 min

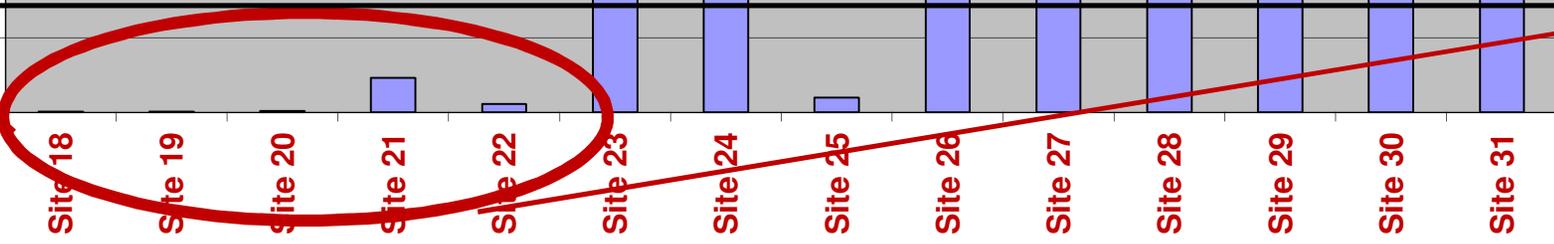
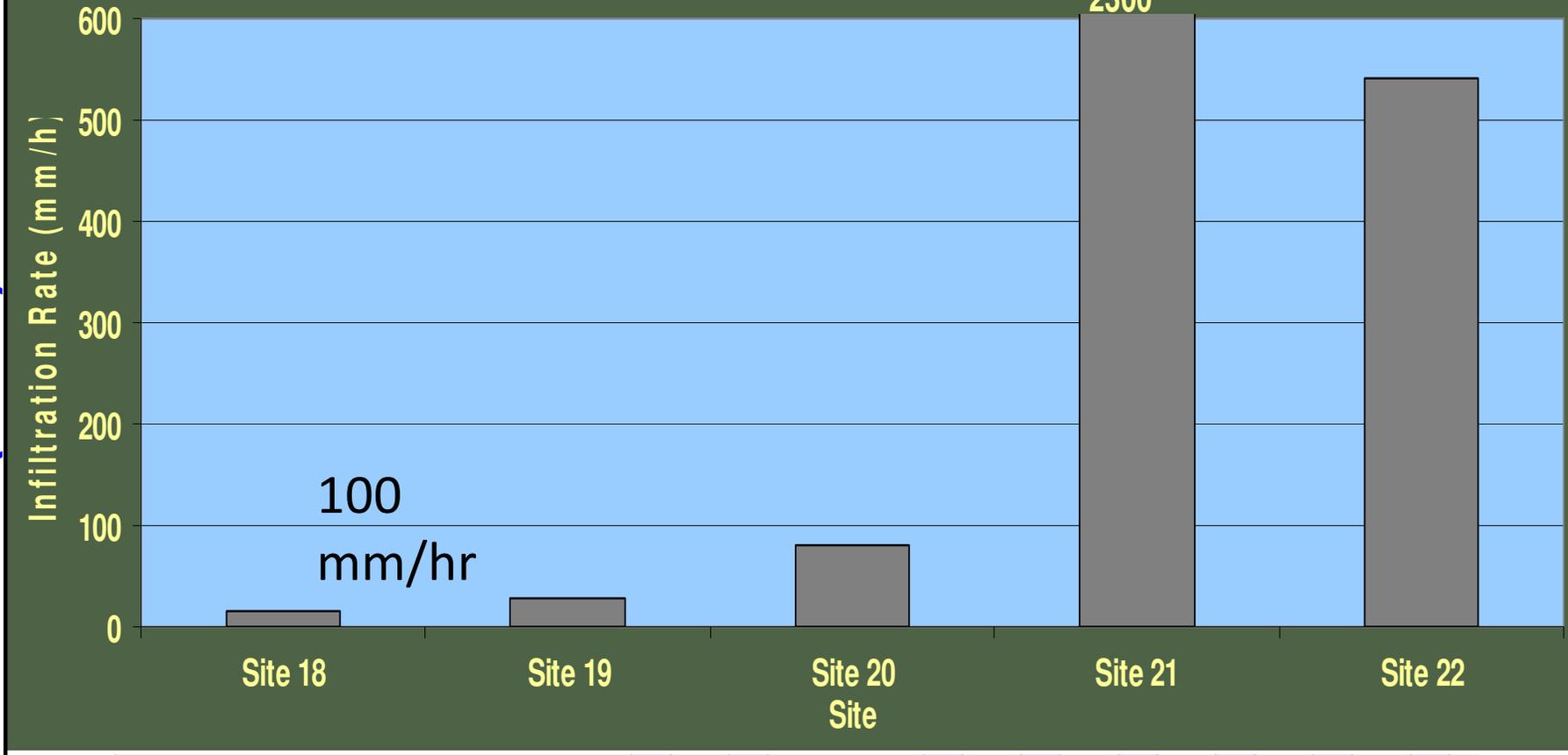


PICP: Surface Infiltration



Permeable Interlocking Concrete Pavers

Infiltration Rate (mm/h)



Site

PICP Results

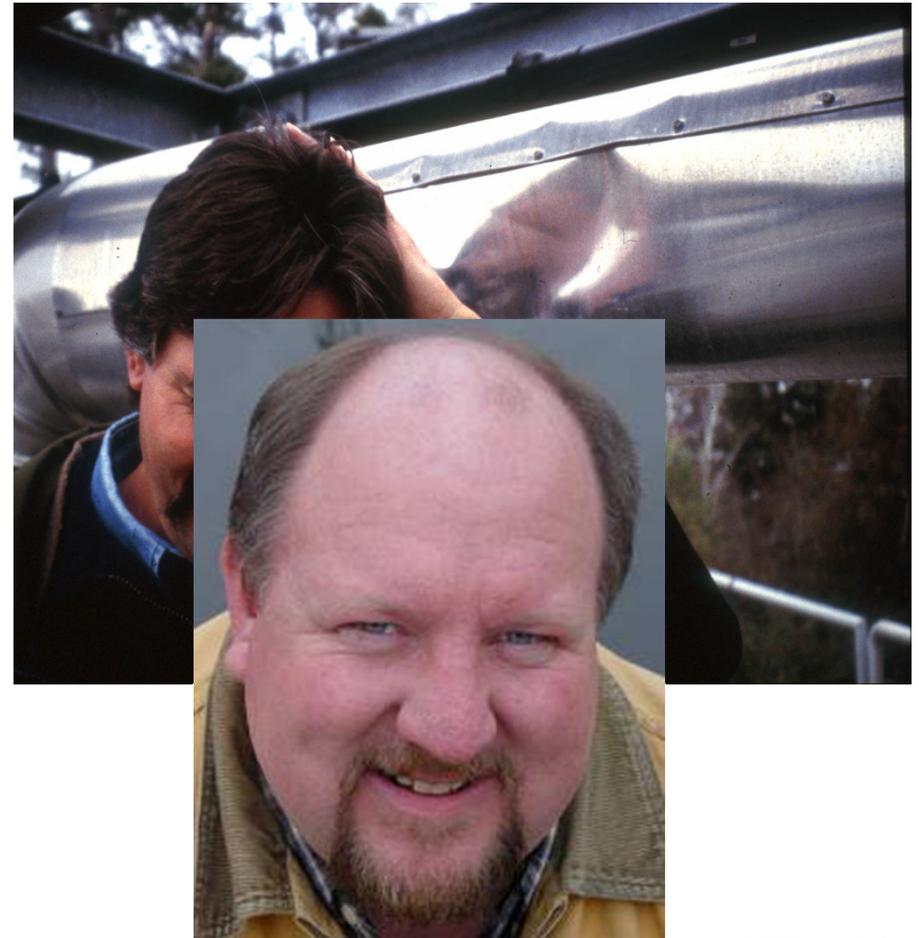


Clogged Sites' Infiltration Rate Reflected that of Nearby Soil

- PICP Exposed to Fines:
SIR = **80 mm/h**
- PICP not Exposed to Fines:
SIR = **20000 mm/h**
- **99%** confidence statistically significant difference

2005 – State of NC Regulators: The Moment of Truth

- Permeable Pavement \neq Impermeable Pavement!
- Incentives Given for Developers to use Permeable Pavement
- But amount of incentive somewhat conservative



Bringing Findings to the Design Community

- Workshop Series held across North Carolina in 2006 & 2007
- 100's of designers attended
- Several Muni's updated codes
- Permeable Pavement is among the most popular practices in some cities



The Importance and Conduct of Workshops

- Tentative Design Standards Presented
- NCSU leads
- NC DENR (regulators) always a part
- Attendees ask/ make recommendations
- Design Standards finalized 3-6 months later



Sample BRC Questions Answered for the Design Community and/or NCDENR

- Minimum Media Depth
- Fill Media Type & Composition
- Runoff Volume Reduction Potential
- IWS Sizing
- Regional Performance (Coastal Plain Sands and Loamy Sands)
- Proportional Sizing



Other Practices Revised in NC



The Communication + Design Protocol

- And Every 6 months...
- We meet with our regulatory officials
 - Provide updates and research direction
- And Every 2 years...
 - A new design standard has emerged for bioretention
- And immediately post 1st Draft Design Standard
 - A (well attended) workshop series was offered

Summary

- Sometimes it takes a crisis
- Communication is key
- Design Standards need not be static
 - Informed / Defendable Design Standards are appreciated
- Regulators, Researchers, and Designers should cooperate



Thank you and Questions

