Post-Development Water Quality

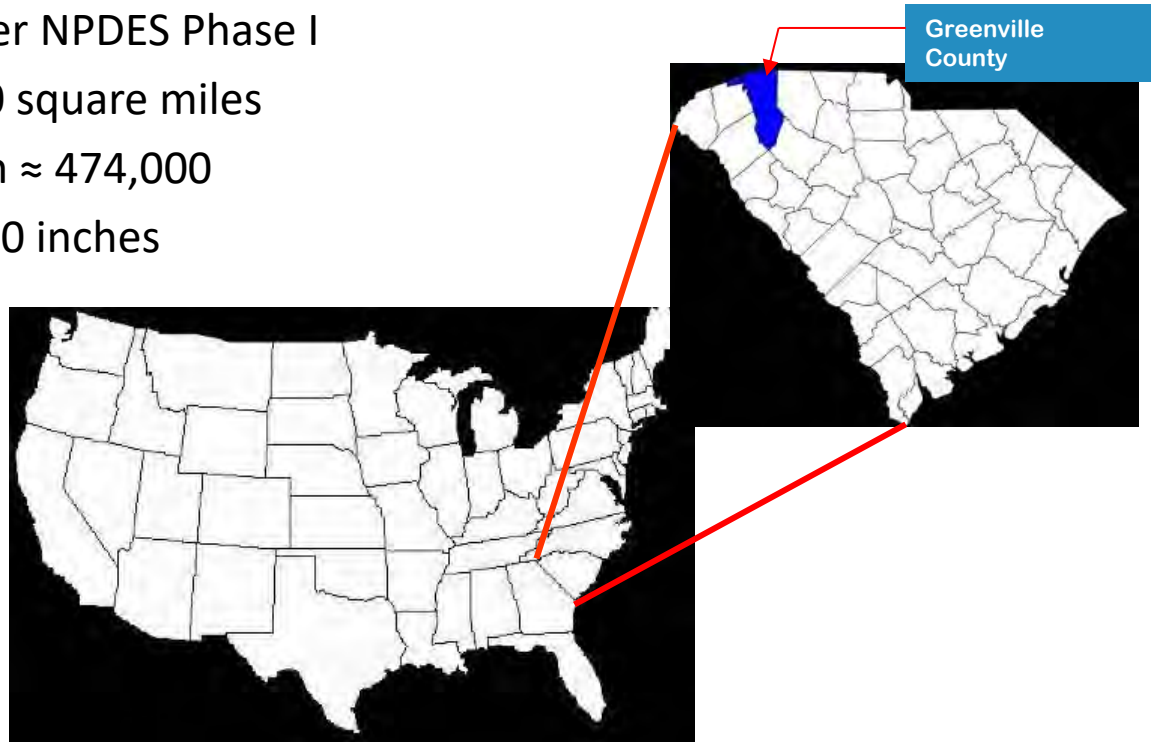
Who are we to question nature?

WOOLPERT
ARCHITECTURE | ENGINEERING | GEOSPATIAL

SESWA Conference October 5, 2018

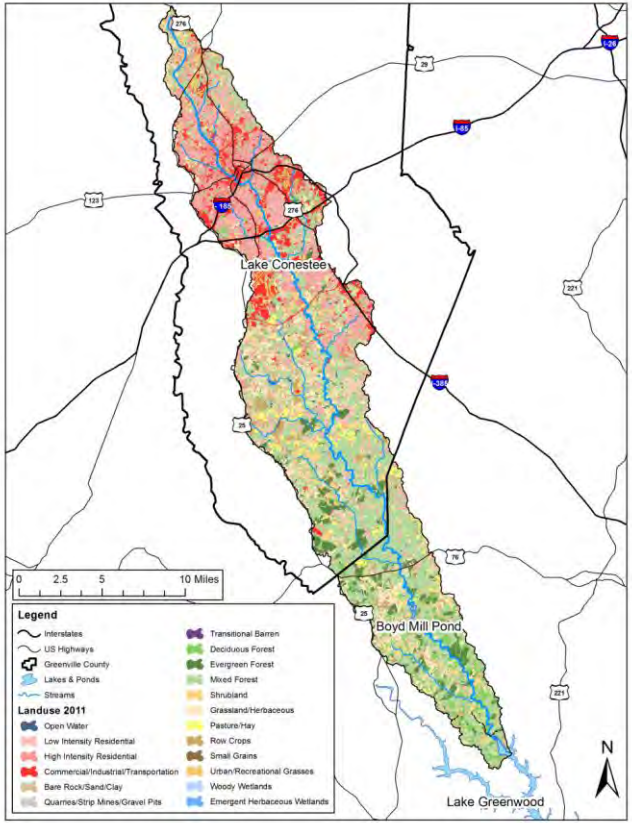
Greenville County, South Carolina

- Located in foothills of Appalachian Mountains
- Medium MS4 under NPDES Phase I
- Approximately 800 square miles
- Current Population ≈ 474,000
- Annual Rainfall ≈ 50 inches



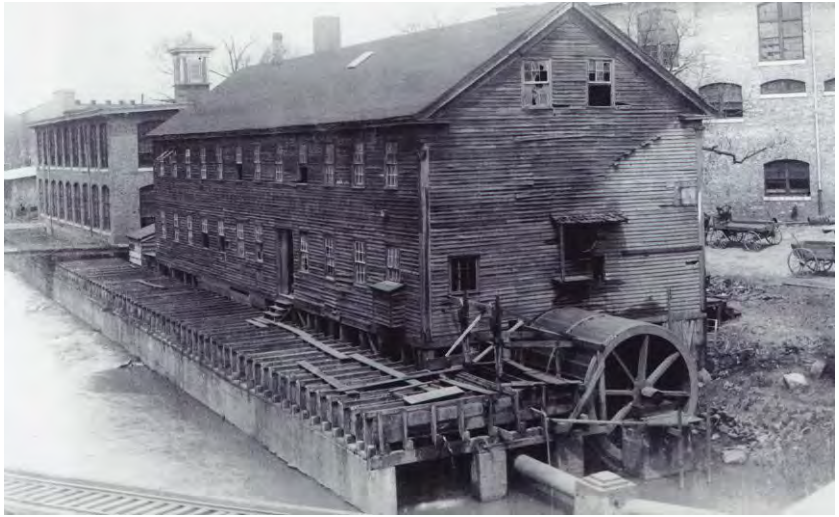
The Reedy River Watershed

- Headwaters contained within County boundaries
- Approximately 200 square miles
- Various MS4s, wastewater treatment facilities, sub-sewer districts, agriculture
- Large portions undeveloped



History Lesson

- 1815 – McBee Mills
  - Grist Mill, Saw Mill, Carriage Factory



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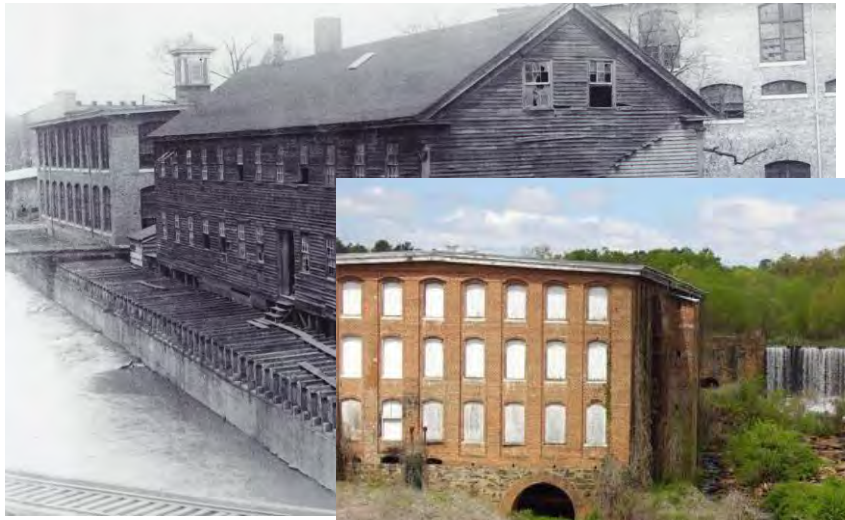
- 1870 – Conestee Mill
- 1900 –Textile Mill Boom
  - Wash away the unwanted
  - International Center of Textiles
- 1928 – City WWTP built



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  - Donaldson Air Base
  - I-85

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- 1948 – 1.3 MIL SC residents worked in Textile Industry
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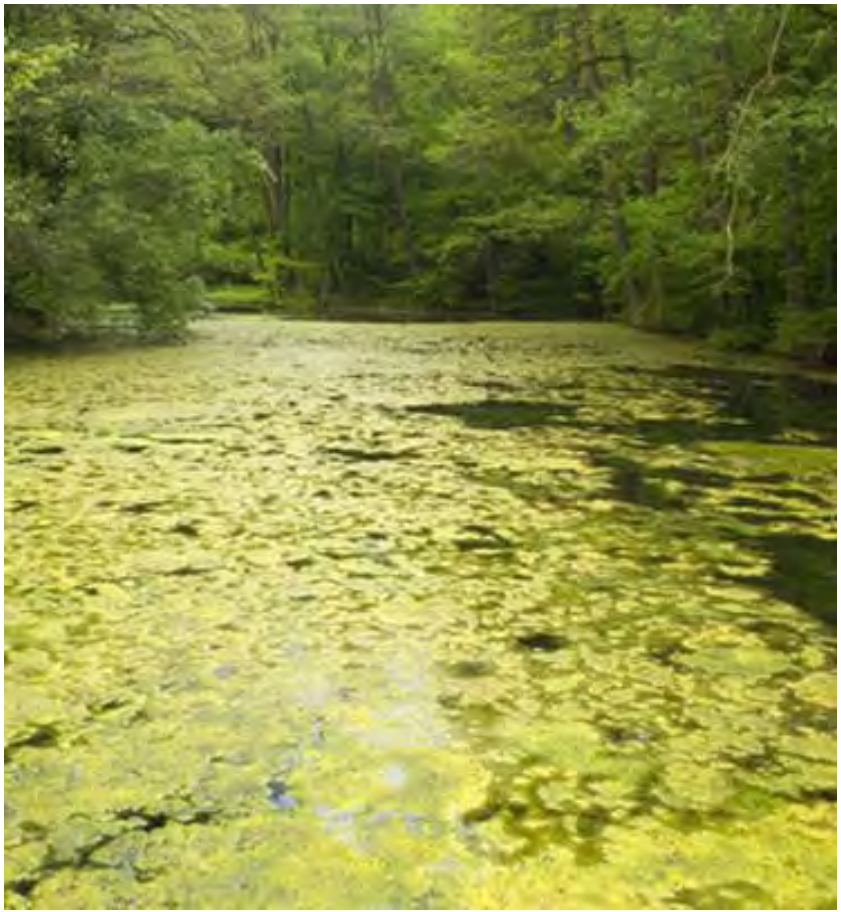
  - Donaldson Air Base
  - I-85
- 1960
  - Conestee Mill Closed
  - Camperdown Bridge constructed

History Lesson

- 1972 – Clean Water Act
- 1990's
  - Decline of Textiles in US
  - Friends of the Reedy
  - Upstate Forever
- 1996 – Colonial Pipeline
  - 1 MIL gallons of Diesel Fuel
  - Killed 23-miles of river
- 2000 – Colonial Pipeline Settlement
  - $34 MIL in EPA fines
  - $1.2 MIL set aside for Clean Water Trust Fund
- 2002 – Camperdown Bridge removed

History Lesson

- 2000 – Algal Bloom in Lake Greenwood
  - Controlling TP and TN could control chlorophyll-a
- 2012 – TMDL for TP and TN released
  - To maintain the proper level of chlorophyll-a in Lake Greenwood
  - TP and TN Load reductions for MS4s and POTWs
  - Model had major flaws
- 2015 – 5R , Reedy River Water Quality Group
  - Stakeholders wanted to improve the model
  - Joined the USEPA's 5R program



History Lesson

- The 5R program
  - Stakeholder-driven
  - Involved in every aspect of the model development
  - Data collection 90% Complete
  - Model set-up 90% Complete
    - LSPC, WRDB and WASP
  - Watershed Based Plans - 2020

- Greenville County
  - What can we do in the meantime?
  - Use **Regulatory Authority** to halt increase of P
    - New Development
    - Significant Redevelopment

Regulatory Options

- Sediment as a Surrogate
  - % Reduction of TSS

Strengths	Weaknesses
Relatively simple to calculate	No direct connection to pollutant of concern (P)
Current County Standard	BMPs that trap TSS don't necessary trap P very well
Prescriptive design standards are not needed	
Facilitates LID and use of MTDs	

Regulatory Options

- Volume as a Surrogate
  - Infiltrate a design storm (95 percentile)

Strengths	Weaknesses
Relatively simple to calculate	MS4 must dictate BMP design criteria
Incentivizes reduction of impervious area	No direct connection to pollutant of concern (P)
Incentivizes LID	No accounting of pollutant removal
	Volume is not a pollutant - MTDs
	Assumes infiltration of pollutants is best
	Assumes the 95th percentile storm infiltrates in pre-developed conditions for all sites

Regulatory Options

- Average Annual Loading
  - Example – Virginia Chesapeake Bay Standard
    - .41 lb/ac/yr (P)

Strengths	Weaknesses
Direct connection to pollutant of concern	Restricts design alternatives
Relatively simple to calculate (spreadsheet)	Requires MS4 to provide calculator
	Doesn't take BMP aspects into account
	Can't be used for complex sites
	Requires extensive design criteria by MS4
	One size does not fit all

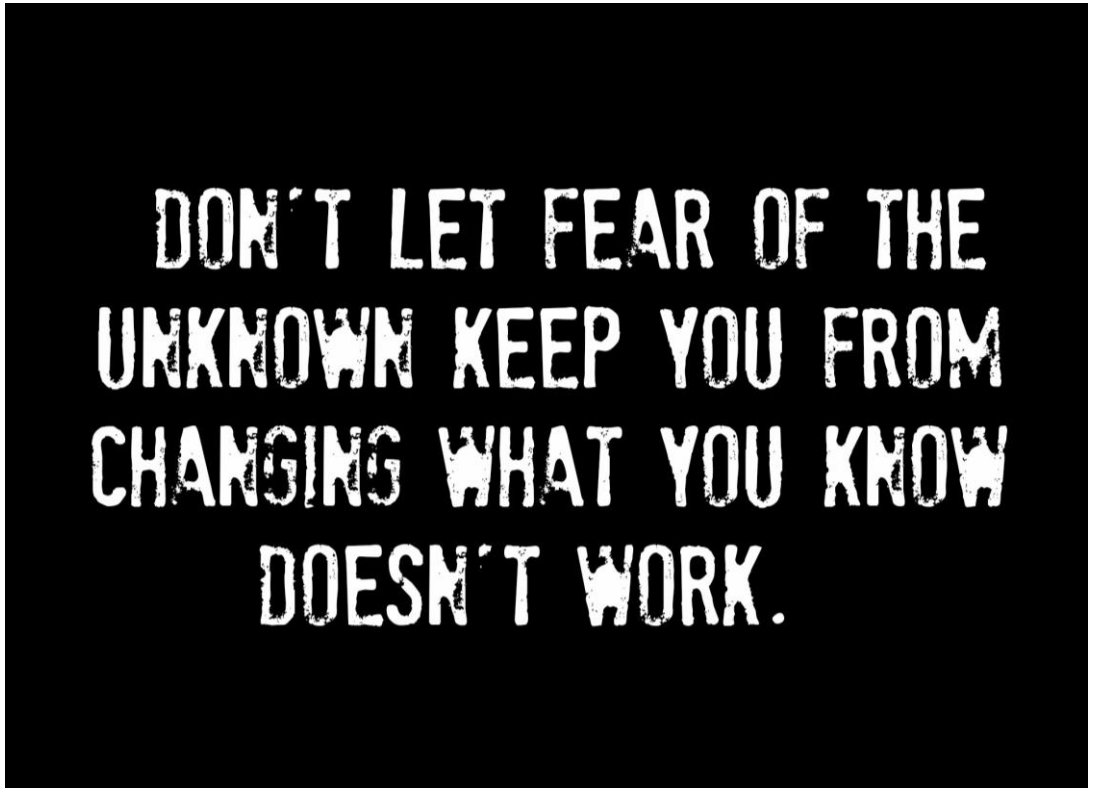
Regulatory Options

- Post-development loading ≤ pre-development loading
  - "…post-construction annual pollutant loads are not allowed to exceed pre-development levels for pollutants of concern…"
- Example:
  - OCRM and SCDHEC **Anti-degradation** restrictions for Developments >25-ac

Strengths	Weaknesses
Direct connection to pollutants of concern	Requires more complex calculations
Allows for site specific conditions to be taken into account	Requires design community to think
Less controversial (policy driven)	Requires a higher level of understanding by plan reviewers
Allows characteristics of BMPs to be taken into account	
Overly prescriptive design standards are not needed	

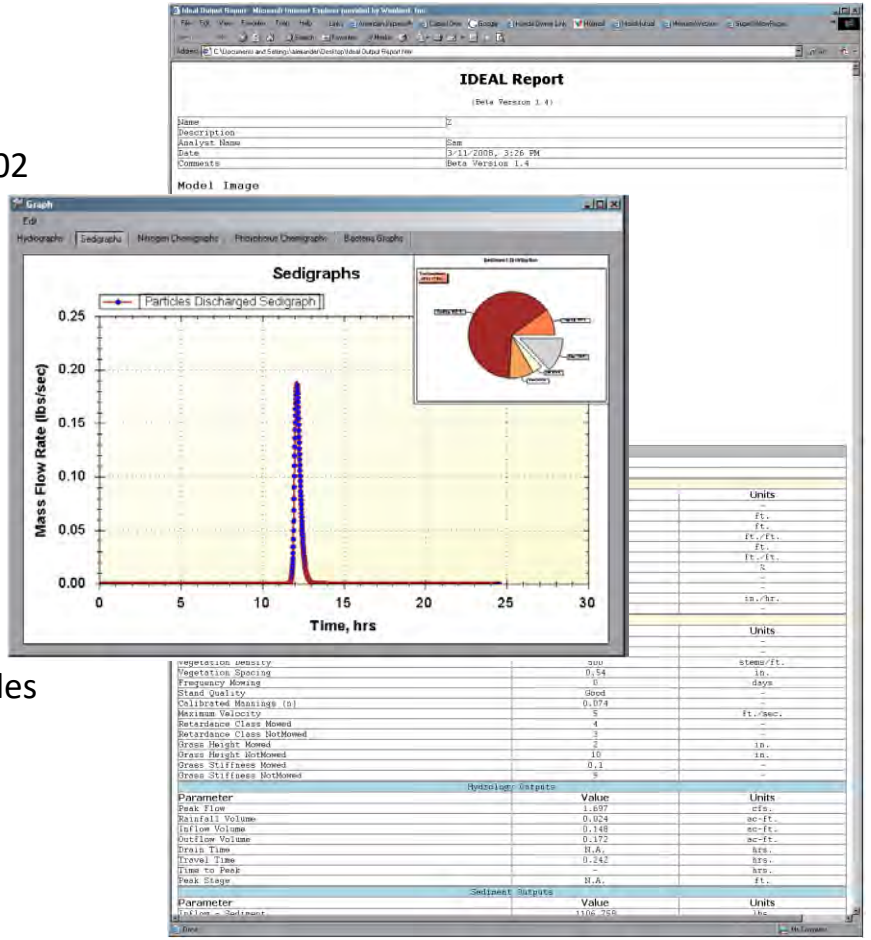
Proof of Concept

- Practicality Analysis
  - Calculations
  - Complexity
  - Permitablity
  - Constructability
  - Costs



IDEAL Model

- Developed by Woolpert with J.C. Hayes and Associates in 2002
  - Drs. Bill Barfield and John Hayes
- Response to antidegradation restrictions for Coastal SC
  - User group – site design engineers
- Process based
  - Annual simulation or single storm
  - Takes design details into account
    - NRCS Hydrology
    - MUSLE Sedimentology
    - EMCs for Pollutant Washoff
    - Calculates settling and trapping of discrete particles
    - Bacteria growth and mortality calculations
- Greenville County adopted
  - Upgraded to VB.net program



C:\Program Files\stormOps\IDEAL Coastal\ExampleFiles\Example_3B\Example_3B.iar - IDEAL

File Run View Reports Options Help

Object Library

Watershed Objects

- Subwatershed
  - Pervious Area
  - Impervious Area
  - Combined Area

Best Management Practices

- BMP
  - Vegetative Filter Strip
  - Bioswale
  - Dry Detention Pond
  - Wet Detention Pond
  - Sand Filter
  - Bioretention Cell

Logical Objects

- Logical Objects
  - Junction
  - Diversion
  - Outlet

Miscellaneous Objects

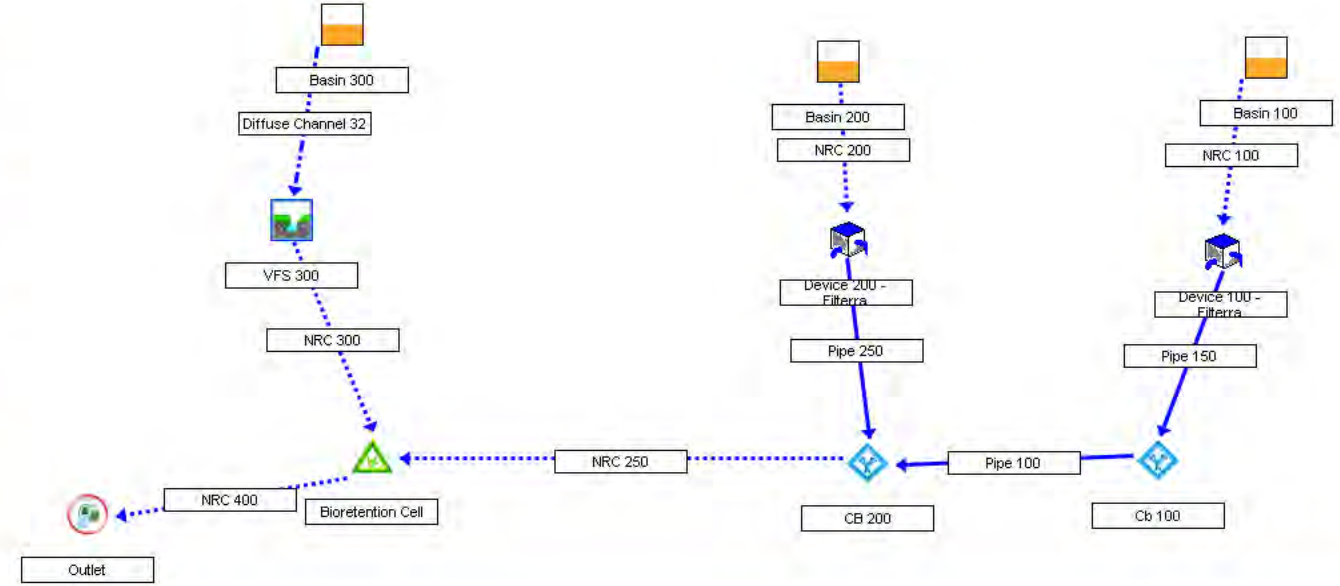
- Misc. Objects
  - User Defined BMP

Conveyances

- Conveyances
  - Circular Conduit
  - Open Channel
  - Diffuse Channel
  - Non-Routed Connector

Object Library | User Library

IDEAL Workspace



Error List

0 Errors | 0 Warnings

Object	Error ID	Description

Ready

Ready

Summary of versions

	OCRM Spreadsheet (2002)	Greenville Co. IDEAL (2018)
Pollutants	Sediments, Nutrients, Bacteria	
Watersheds	1	200+
BMPs	Wet/Dry Ponds, VFS	▪ Wet/Dry Ponds, ▪ VFS, ▪ Bioretention cells, ▪ Sand filters, ▪ Bioswales, ▪ Porous pavement, ▪ Cisterns, ▪ Infiltration trenches, ▪ Engineered devices
Conveyances	None	Pipes, channels, and simple translation

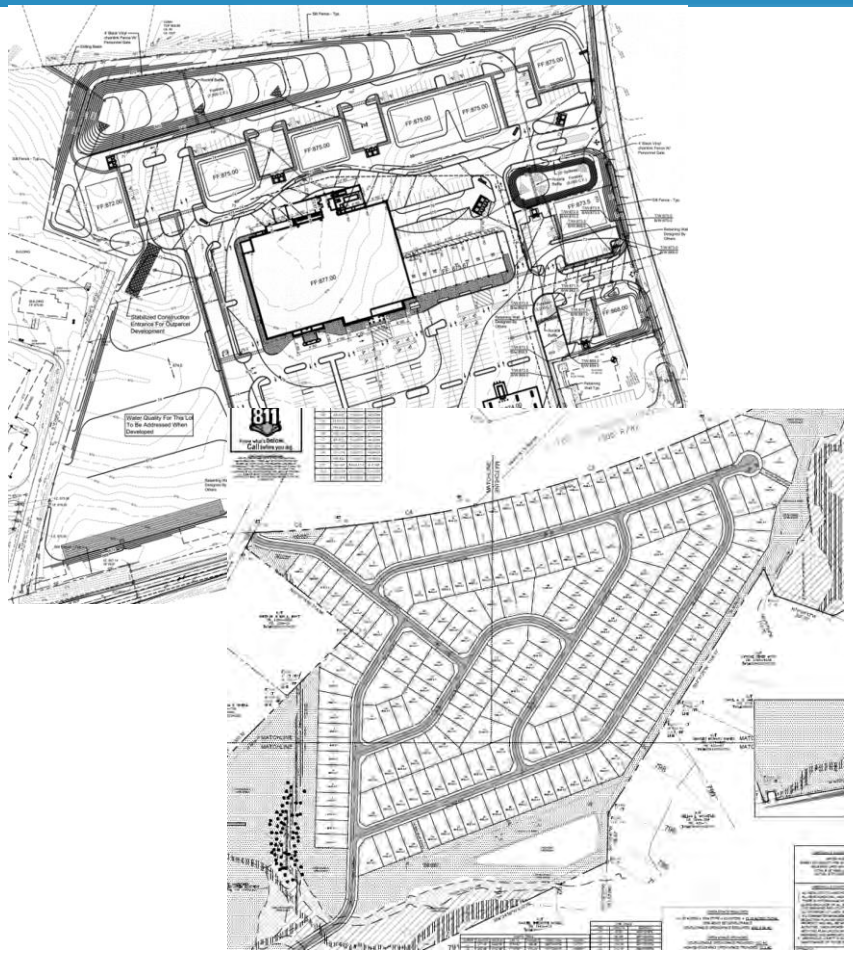
Study Method

10 randomly-chosen project sites that were permitted meeting the 85% TSS Trapping Standard or Alternative TSS Standard

Development Type	Greenville County Project Number	Area Disturbed	Area Modeled
Commercial	1307	1.4	1.4
	1218	1.6	1.6
	1229	1.3	1.3
	1276	17.4	17.4
Residential	1296	46.9	81.2
	1264	7.9	7.9
	1261	47.7	196.5
	1288	23.4	23.4
	1294	6.2	6.2
Institutional	1231	3.3	3.3

Study Method

- Proposed Standard: No net increase in TP loading from predevelopment conditions
- Built pre-development and post-development IDEAL models based on original design submittals
- Used incremental modifications, but did not try everything possible. A skilled designer may be able to improve on proposed design modifications



Level of Difficulty	Description	Number of Sites
No Modifications Required	The site met the proposed TP standard as permitted	2 / 10
Minimal Modifications	The existing BMPs were modified by expanding surface area up to 25% or converting to a more effective BMP	2 / 10
Moderate Modifications	At least one additional BMP was required, but that BMP fit within the site footprint and was relatively small	5 / 10
Major Modifications	More than one additional BMP was required, and/or the additional BMP(s) were relatively large and costly	1 / 10

Development/ Redevelopment Location	Development/ Redevelopment Characteristics*	Water Quality Requirement
Any Development in Greenville County < 10,000 sf		None**
Sites 10,000 square feet – 0.99 acres OR other sites meeting criteria for Alternative TSS Standard (as described in Section 9.1.4)		Ensure annual TSS load is ≤ 600 pounds per acre
Not within the Reedy River watershed	1 – 25 acres OR ≥ 25 acres and NOT discharging to impaired waterbody (TMDL or 303d)	Trap 85% of annual Total Suspended Solids (TSS) load
	≥ 25 acres AND Discharging to impaired waterbody	Trap 85% of annual TSS load AND Anti-degradation Rules for Pollutant of Concern (POC)
Within the Reedy River watershed	1 - 25 acres OR ≥ 25 acres and NOT discharging to impaired waterbody	Trap 85% of annual TSS load AND No Increase in Annual Loading for Total Phosphorus (TP)
	≥ 25 acres AND Discharging to impaired waterbody	Trap 85% of annual TSS load AND Anti-degradation Rules for TP and POC

Fallout?

- Standards Introduced December 2017
  - County provided Training Class
  - Implemented January 2018
- Development in Greenville County robust
- IDEAL support
  - ≈ 20% Increase in Calls
  - ≈ 15% Increase in Emails
- Results Mirror Proof of Concept Study Results
  - 90% can meet standard in same SW management footprint
  - 50% needed a better mousetrap
  - No failure to meet standard to date

Questions?