

# Benthic Habitat Enhancement + Relocation = Impairment Delisting



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Senior Project Manager



13 October 2017

# Benthic Habitat Enhancement: Smith Creek

- Introduction
- Smith Creek Plan
- Why Benthos?
- NC Standards
- Year 1 & 2 Results
- Reference Reach
- Public Education
- Habitat Enhancement
- “Bug Seeding”
- Year 3 Results
- Delisting



# Town of Wake Forest Smith Creek Watershed

# Smith Creek Watershed



➤ Population Explosion: 2000 (10,000)      2010 (40,000+)

➤ Increased Development

➤ **2008: 303d Impaired Waters List:**

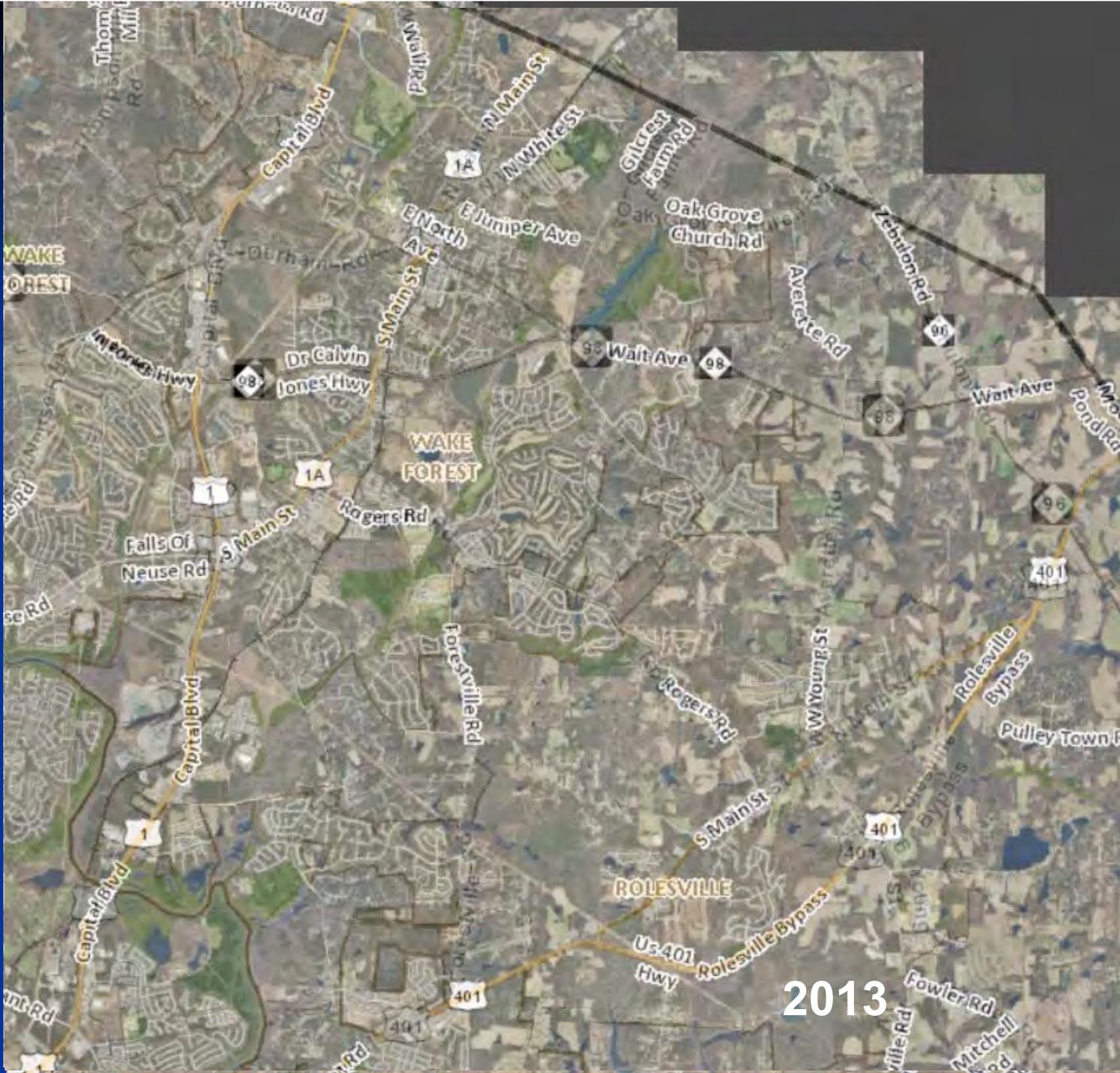
## **Fair Benthic Macroinvertebrates**

- Faced with a potential TMDL
  - Limits on development?
  - Increased riparian buffers?
  - Increased water quality testing?

# Smith Creek Watershed



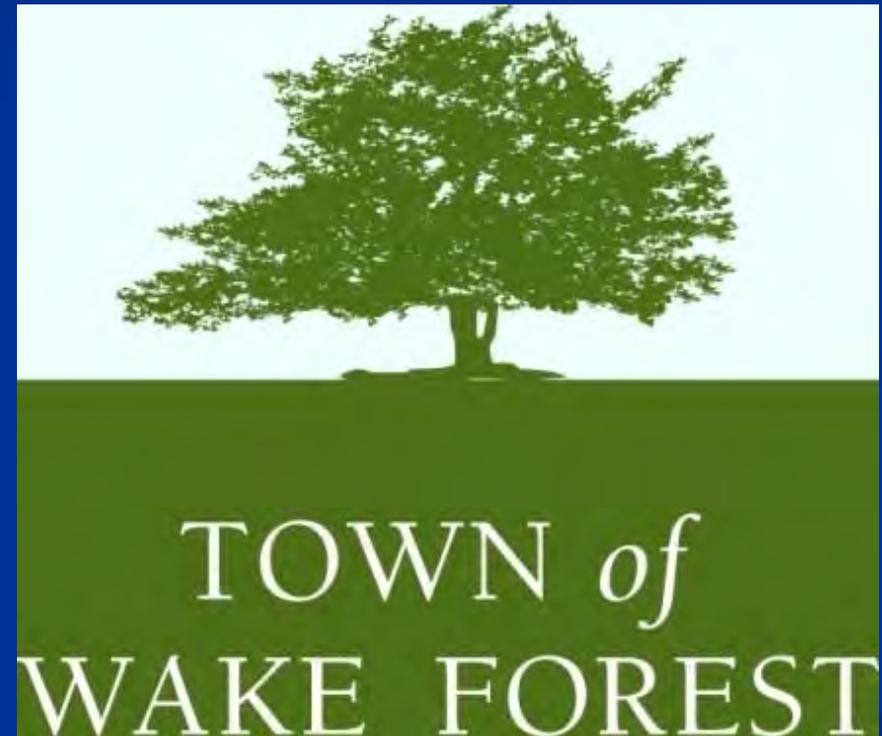
**Goal: Category 4B or delist without  
developing a TMDL**



2013

# 319 (h) Grant

December 2012



# Smith Creek Watershed Restoration Plan

Wake and Franklin Counties  
North Carolina

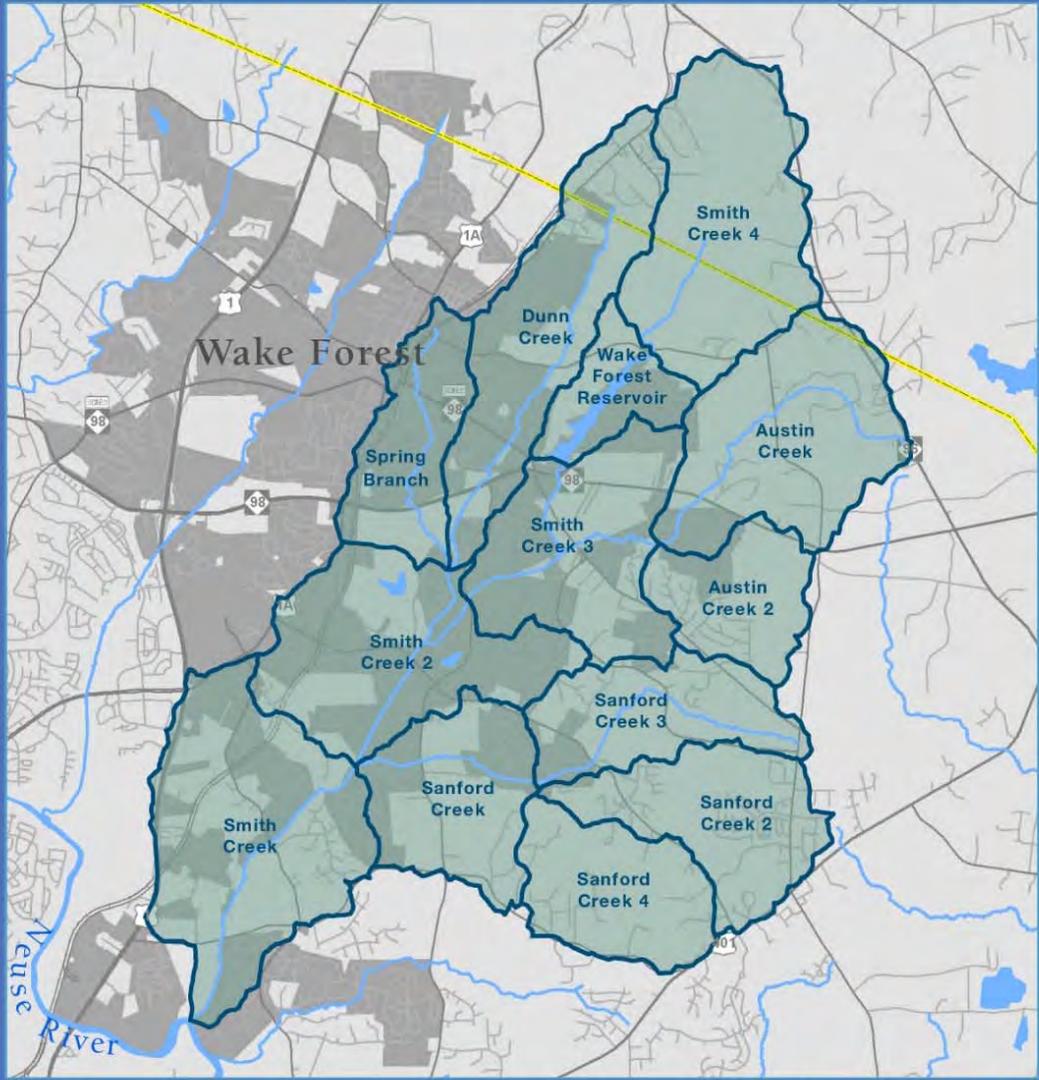


Prepared for the Town of Wake Forest  
301 S. Brooks St.  
Wake Forest, NC 27587

Prepared by WK Dickson & Co., Inc.  
616 Colonnade Dr.  
Charlotte, NC 28205

December 2015

# Smith Creek Watershed



## 13 Subwatersheds:

1. Smith
2. Smith 2
3. Smith 3
4. Smith 4
5. Reservoir
6. Spring Branch
7. Dunn Creek
8. Austin
9. Austin 2
10. Sanford
11. Sanford 2
12. Sanford 3
13. Sanford 4

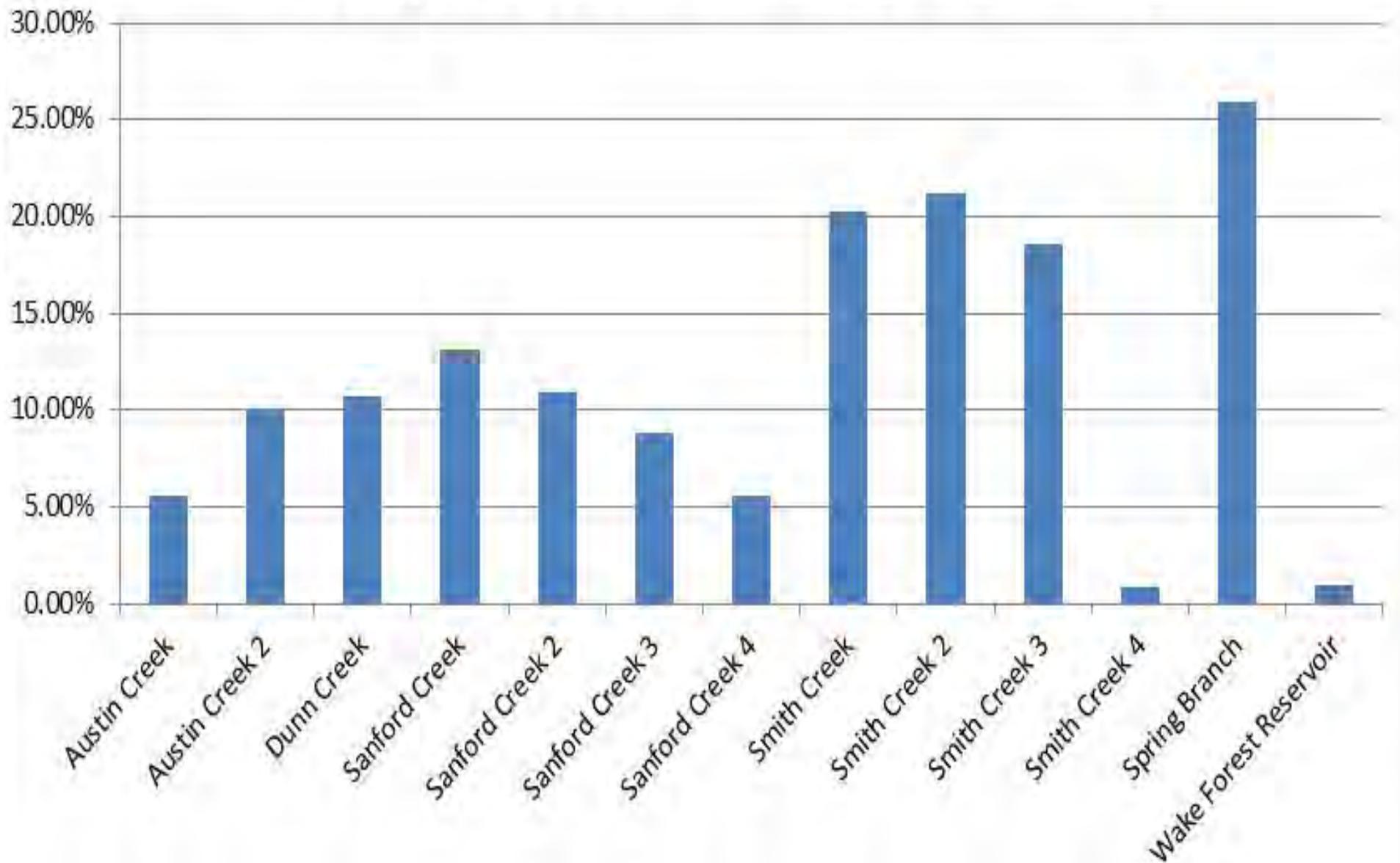
**Legend**

- Major Streams
- Major Water Bodies
- Streets
- Town Limits
- County Boundary



Please note that this map is intended for illustrative purposes only. For specific inquiries regarding data displayed here, contact the Wake Forest Engineering Department at 919-435-9443.

# % Impervious/Subwatershed





Benthic Macroinvertebrates

# Use Support

# Use Support

303(d)

# Use Support

~~303(d)~~

# Use Support



Ephemeroptera



Plecoptera



Tricoptera

# Use Support



Ephemeroptera



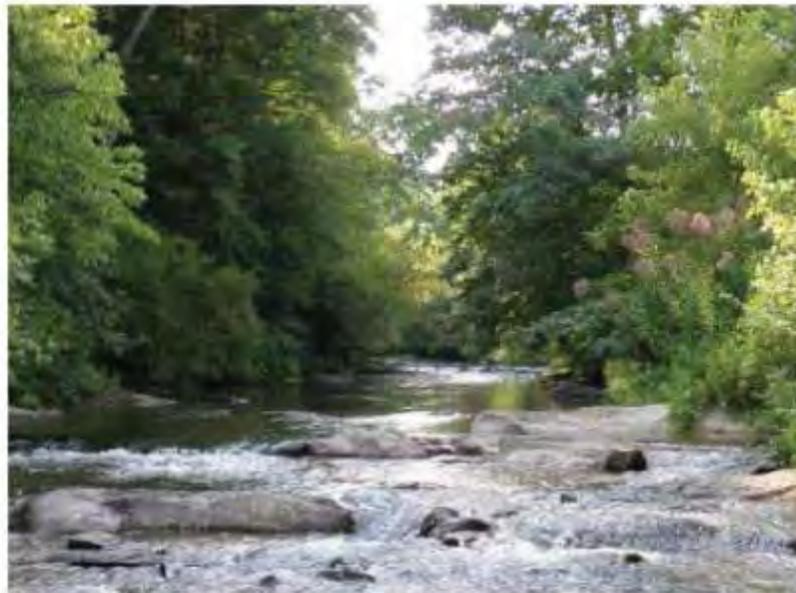
Plecoptera



Tricoptera

## Biological Classification

**STANDARD OPERATING PROCEDURES  
FOR  
BENTHIC MACROINVERTEBRATES  
BIOLOGICAL ASSESSMENT UNIT  
OCTOBER 2012**



NORTH CAROLINA  
DEPARTMENT OF ENVIRONMENT  
and NATURAL RESOURCES  
Division of Water Quality  
Environmental Sciences Section



October 1, 2012

# Bio Classification

Excellent

Good

Good-Fair

=

~~303(d)~~

# Bio Classification

Fair  
Poor = 303(d)

# Bio Class =

$\bar{X}$

EPT Score &  
Biotic Index

# EPT Score

Taxa Richness  
Abundance

# Biotic Index

$$\text{Biotic Index (BI)} = \frac{\text{Sum}(TV_j)(n_j)}{N}$$

$TV_j$  = ith taxa's tolerance value

$n_j$  = ith taxa's abundance value (1, 3 or 10)

$N$  = sum of all abundance values

# Biotic Index

Tolerance Value 1-10

# Biotic Index

Tolerance Value 1-10

 = More Tolerant of  
Poor Conditions

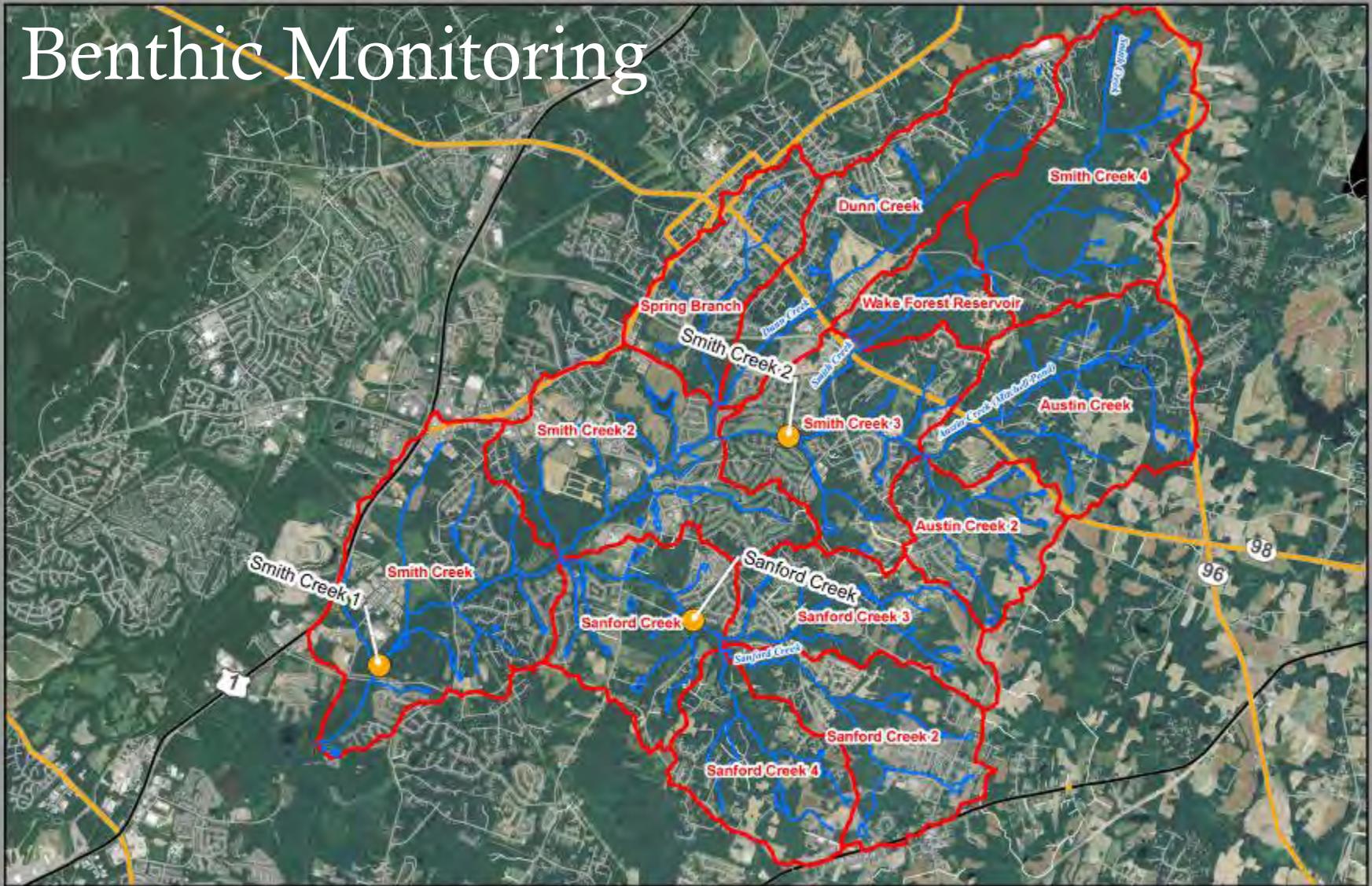
# Biotic Index

Tolerance Value 1-10



= Less Tolerant of  
Poor Conditions

# Benthic Monitoring

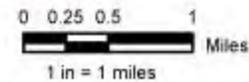


## Legend

-  Permanent Benthic Locations
-  Streams
-  Sub-Watershed Boundary



**Figure 10**  
**Smith Creek Watershed Restoration**  
**Plan and Implementation Project**  
**Permanent Benthic Monitoring Locations Map**









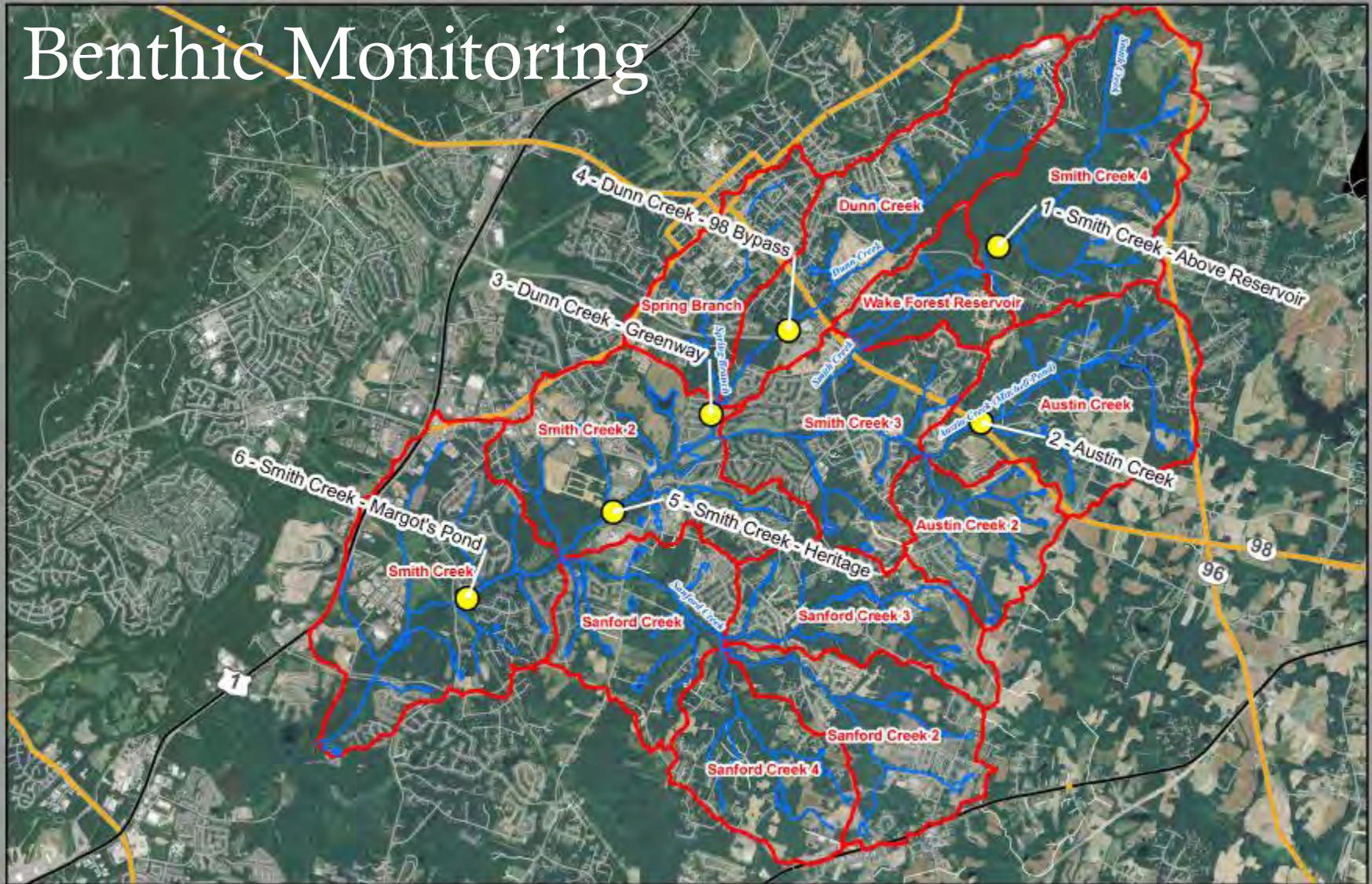
# Benthic Monitoring

**Table 9. Benthic Macroinvertebrate Sampling Results – Permanent Locations – July Sampling**

Site	2013			2014			2015		
	SA	S1	S2	SA	S1	S2	SA	S1	S2
Total Taxa Richness	39	30	45	42	37	49	42	51	38
EPT Taxa Richness	12	8	13	15	14	15	12	16	13
EPT Abundance	59	46	90	62	60	61	65	64	69
NC Biotic Index	6.0	5.8	5.5	5.7	5.9	6.0	5.8	6.1	5.7
EPT score	2	1.6	2	2.4	2.4	2.4	2	2.6	2
BI Score	3	3.4	4	4	3	3	3.4	3	4
Site Score	2.5	2.5	3	3.2	2.7	2.7	2.7	2.8	3
<b>Rating</b>	<b>Fair/GF*</b>	<b>G-F</b>		<b>G-F</b>	<b>G-F</b>	<b>G-F</b>	<b>G-F</b>	<b>G-F</b>	<b>G-F</b>

\*Rounds down to Fair, based on EPT Abundance criteria (<71). Under estimation of EPT taxa richness in 2013, however, suggests that these would more likely be Good Fair. Compare to the 2014 collections.

# Benthic Monitoring

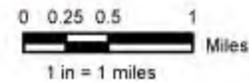


## Legend

-  Spring 2014 Benthic Locations
-  Streams
-  Sub-Watershed Boundary



**Figure 11**  
**Smith Creek Watershed Restoration**  
**Plan and Implementation Project**  
**Spring 2014 Benthic Monitoring Locations Map**



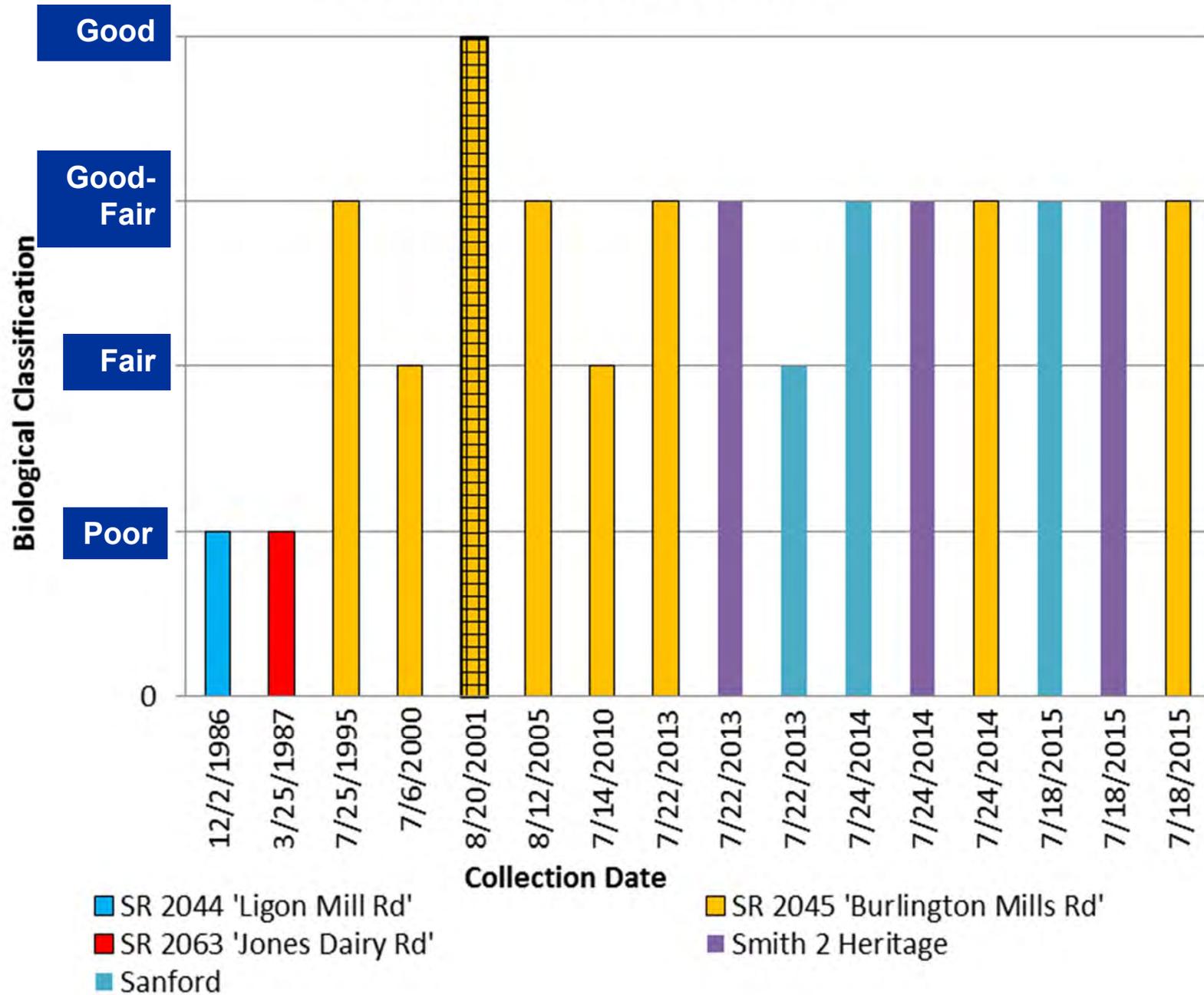
# Benthic Monitoring

**Table 10. Benthic Sampling Results – 2014 Locations April Sampling**

Site:	1S12A13D1	4D2	5S2	6S3
Total Taxa Richness	37 34 25	31	25	30
EPT Taxa Richness	19 19 11	14	10	15
NC Biotic Index	4.4 5.0 6.4	5.3	5.8	5.6
<b>Rating (Small Stream Criteria)</b>	<b>G* G F</b>	<b>GF</b>	<b>GF</b>	<b>GF</b>

\*Almost Excellent

# Smith Creek Benthic Results





# Public Education



# Public Education



# Habitat Enhancement



# Habitat Enhancement







# Relocation “Bug Seeding”



# Tolerance Value

11 New Species

*Neophylax oligius*: 2.4

*Eccoptura xanthenes*: 4.7

*Anchytarsus bicolor*: 2.4

# Delisting



**Benthic Community Table**

Stream	SMITH CR	SMITH CR	SMITH CR	SMITH CR
Site Location	SR 2044	SR 2063	SR 2063	SR 1942
County	Wake	Wake	Wake	Wake
Site ID	JB233	JB234	JB234	JB343
Collection date	12/2/1986	3/25/1987	7/1/2014	7/1/2014
BAU sample number	3935	4033	11884	11882
Sample method	EPT	EPT	Full Scale	Full Scale
Criteria	Winter/ Piedmont	Spring/ Piedmont	Summer/ Piedmont	Summer/ Piedmont

Richness				
Ephemeroptera	0	2	5	7
Plecoptera	0	0	0	3
Trichoptera	2	0	5	5
Odonata			6	7
Megaloptera			0	3
Coleoptera			3	8
Chironomidae			27	25
non-Chironomidae Diptera			4	9
Oligochaeta			4	3
Mollusca			2	0
Other taxa			1	1
Total taxa richness			57	71

Other biological metrics				
Total EPT	2	2	10	15
Seasonal EPT	0	0		
Corrected EPT	2	2		
EPT abundance	13	6	50	104
EPT Biotic Index	6.90	4.85	5.85	4.79
NCBI	---	---	6.51	5.53
Seasonal Correction				
Corrected NCBI				
Bioclassification	Poor	Poor	Fair	Good-Fair

# Delisting



**Benthic Community Table**

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Trichoptera	2	0	5
Odonata			6
Megaloptera			0
Coleoptera			3
Chironomidae			27
non-Chironomidae Diptera			4
Oligochaeta			4
Mollusca			2
Other taxa			1
Total taxa richness			57

Other biological metrics			
Total EPT	2	2	10
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# Delisting



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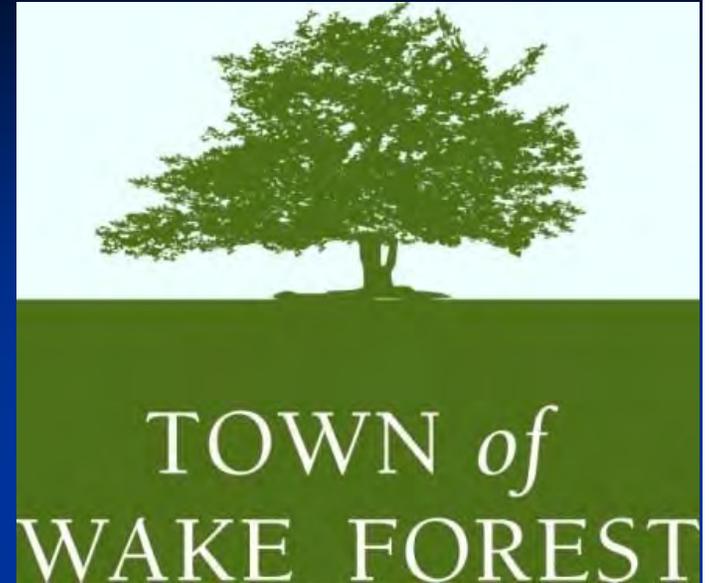
~~303(d)~~

Good-Fair

# ACEC Engineering Excellence Award 2015



# Partners







**KEEP IT SIMPLE STUPID**

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 **WK  
DICKSON**  
community infrastructure consultants

WARNING!  
SHAMELESS PLUG

