Nothing Compares
NORTH CAROLINA

Nutrient Criteria Development
SAC Update – June 15, 2016

SAC Update – June 15, 2016

1. Staff changes in DWR NCDP team
2. Identify alternates
3. Travel Authorizations
4. Nutrient Management -- HB 1030 Section 14.13
5. EPA Nutrient Criteria Webinar -- Lakes and Reservoirs
6. Compiling Literature – EndNote
7. High Rock Lake - Technical Support Document
    - Extensions to other lakes and reservoirs
8. Where we left off in April

HOUSE BILL 1030 - 2016 Appropriations Act

DEVELOPMENT OF NEW COMPREHENSIVE NUTRIENT MANAGEMENT REGULATORY FRAMEWORK

SECTION 14.13.(a) The General Assembly finds all of the following:

(1) It is necessary for the State to have a comprehensive management strategy to protect and improve water quality.

(2) Over the last 20 years, watershed nutrient management strategies and buffer rules have been implemented throughout North Carolina.

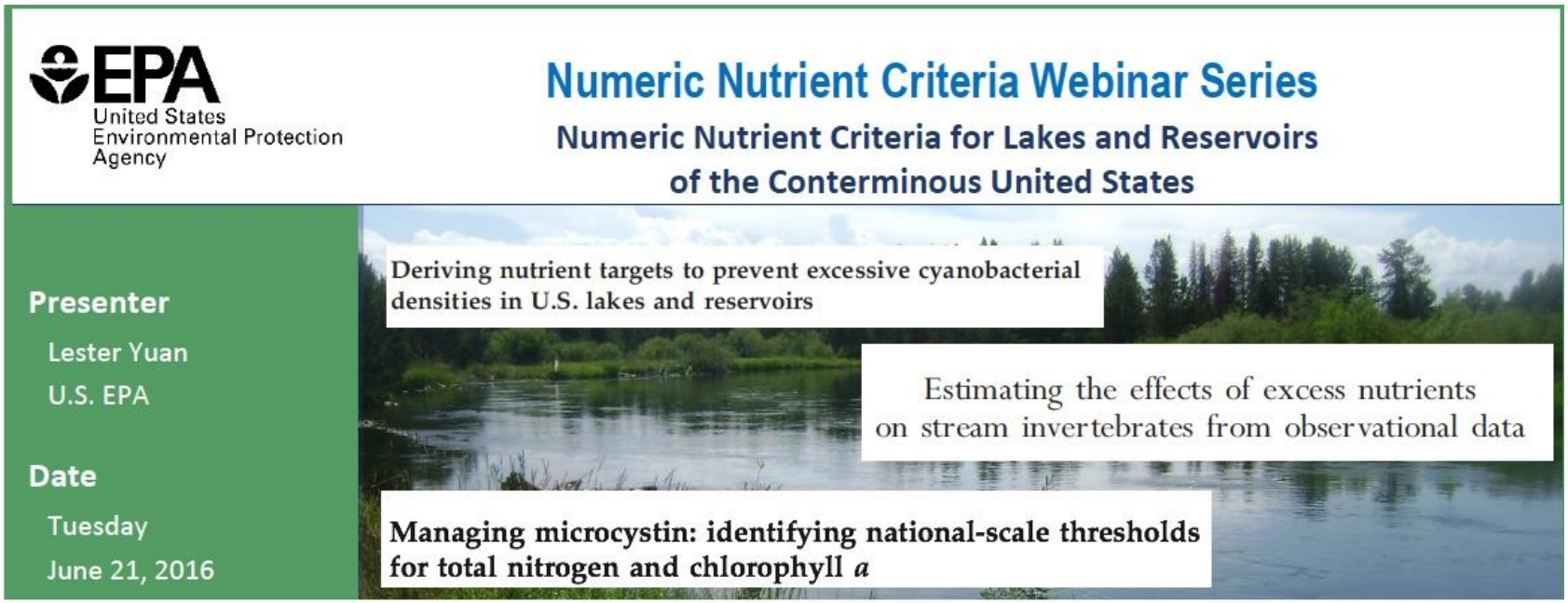
(3) Existing nutrient management strategies in many cases have shown little to no improvement in water quality, have created an increased regulatory and economic burden in the billions of dollars to the State, its municipalities, and its citizens, and have limited, and in some cases significantly limited, land use options for thousands of public and private properties.

(4) Instead of continuing regulatory frameworks that may not improve water quality in all watersheds now or in the future, new comprehensive management strategies that include in situ treatment of impaired water bodies must be developed.

(5) These new strategies should incorporate proven measures already shown to be effective and recognize investments in water quality already implemented by stakeholders.

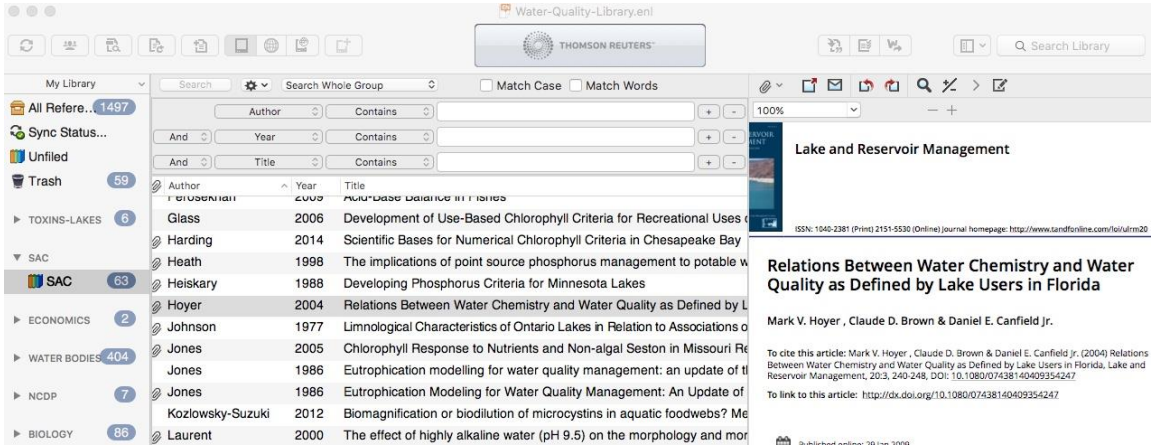
SECTION 14.13.(b) For the reasons set forth in subsection (a) of this section,

Nutrient Webinar – June 21, 2016



Literature Compilations -- EndNote

- Albemarle
- SAC



Summarizing HRL Discussions

Ohio Environmental Protection Agency

Technical Support Document: Nutrient Criteria for Inland Lakes in Ohio

Houston Engineering

Development of Nutrient Criteria for Lakes and Reservoirs for North Dakota and Plain States in Region 8.

United States Environmental Protection Agency

NUTRIENT ASSESSMENTS SUPPORTING DEVELOPMENT OF NUTRIENT CRITERIA FOR MISSISSIPPI LAKES AND RESERVOIRS

Final Project Report: Grant Number X974454-06

NC

Where we left off in April

- pH *(Clifton Bell)*
- Algae and toxins *(Nathan Hall and Astrid Schnetzer)*
  - Water supply
  - Recreation
  - Toxins
- Dissolved Oxygen *(Martin Lebo)*
- Aesthetics / Taste and Odor *(Jim Bowen)*
- Turbidity *(Mike O'Driscoll)*
- Fisheries *(Marcelo Ardon)*
- Chlorophyll-a *(Bill Hall and Clifton Bell)*

Indicator Short List

Parameters for Numeric Ranges	No. of Votes
Chlorophyll-a	11
pH	10
Dissolved Oxygen	10
Clarity (Secchi depth or turbidity)	9
Algal toxins	8
Nitrogen and Phosphorus (needs discussion)	6

Parameters for Narrative Ranges	No. of Votes
Algal Community Structure	2
Fishery	2

Possible TN and TP Ranges for High Rock Lake

Lauren Petter, EPA Region 4

June 15, 2016

SAC Meeting

TP & TN Overview

- EPA's February 2015 "***Preventing Eutrophication: Scientific Support for Dual Nutrient Criteria***" and associated references provide support for adopting both TP and TN criteria.
- There are pros and cons with adopting *Loading Format Criteria* or *Concentration Based Criteria*.
- Duration and Frequency components of the criteria are important too (more on this later).

Tools for Nutrient Criteria Development

- Reference condition approach
  - Ability to demonstrate minimally impacted waters
  - Sufficient nutrient data
- Stressor-response analysis
  - Paired stressor-response data
  - Sufficient data across all classes (each cofactor requires more data)
- Mechanistic modeling
  - Any water condition (doesn't require minimally impacted waters)
  - Ambient trend data (doesn't require paired data)
  - Models "borrow" information from neighboring segments

*Slide from Tiffany Crawford's June 2015 SAC presentation

Selecting a Defensible Percentile

- Based on statistical reasoning
- For a small data set with greater heterogeneity, choose a lower percentile; for a large data set with greater homogeneity, choose a higher percentile
- Ties into assessment endpoint selection
  - Support your percentile choice with scientific literature and other available information

*Slide from Tiffany Crawford's June 2015 SAC presentation

Lessons Learned

- Definition of *reference condition* varies; however in all cases:
  - Reference conditions should support designated uses
  - It need not mean pristine
  - High quality data are developed through application of data quality objectives
  - Objective data screens are used to define reference and arrive at a final data set for deriving criteria
- States have concerns with applying the reference condition approach when there are not many uncompromised sites. There are solutions for regions with heavily impacted sites.
- Selecting the percentile of the reference condition data set is dependent upon the data, and the amount of uncertainty one has that it accurately reflects the reference condition.
- The reference condition approach is scientifically defensible when supported with appropriate rationales and data.

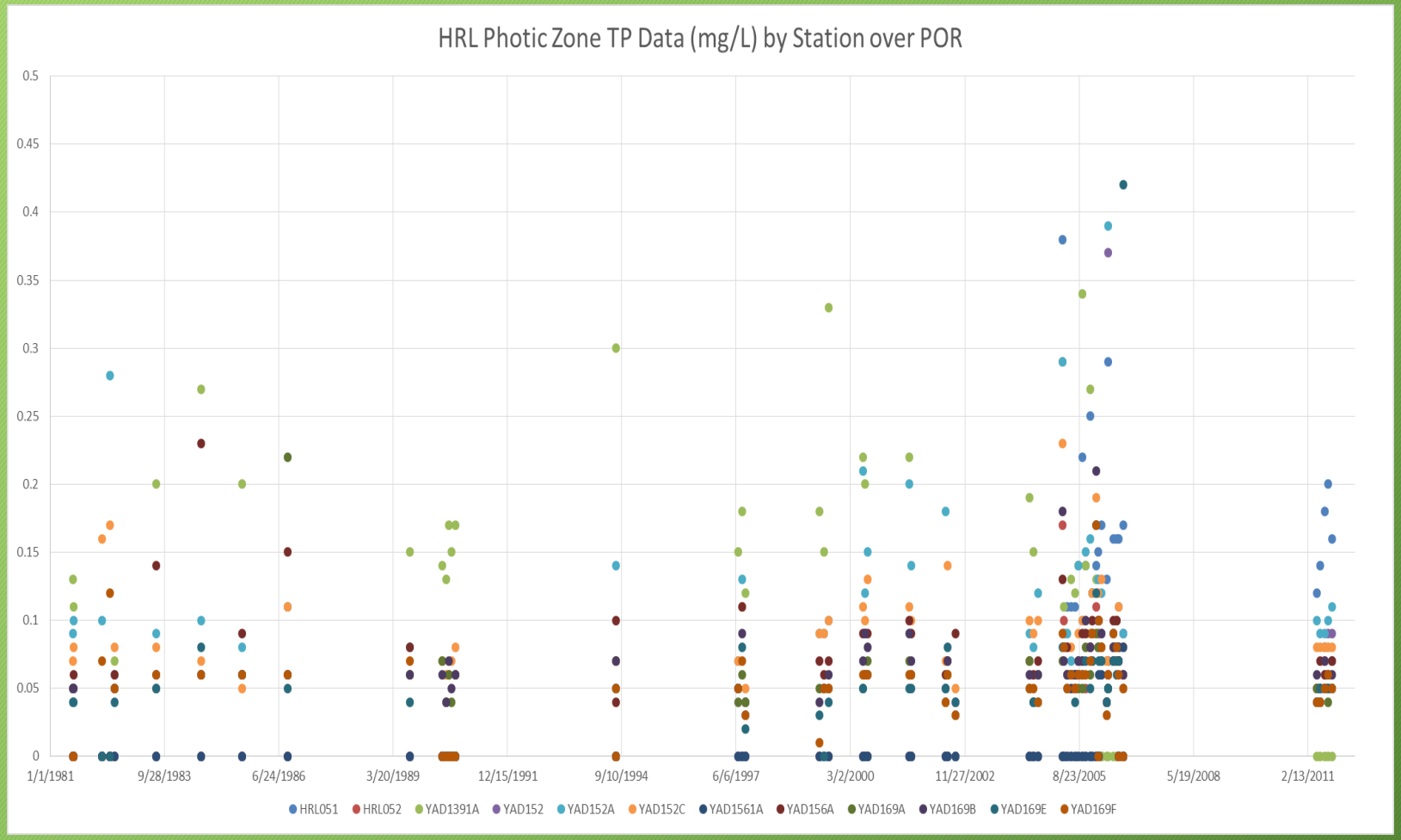
*Slide from Tiffany Crawford's June 2015 SAC presentation

NC DEQ's High Rock Lake Data Spreadsheet

- Plotted 477 photic zone TP samples from 12 stations over ~30 years
- YAD139C, YAD146A, and YAD139 not included because small sample size (≤2 samples)
- Basic statistics for 477 TP photic zone samples:

TP Summary Statistics		
AVG	0.091509	mg/l
MAX	0.96	mg/l
MIN	0.01	mg/l
10th%tile	0.04	mg/l
25th%tile	0.06	mg/l
75th%tile	0.07	mg/l
90th%tile	0.16	mg/l

HRL TP Summary Statistics 2008-2010		
AVG	0.11	mg/l
MAX	0.76	mg/l
MIN	0.02	mg/l
10th%tile	0.04	mg/l
25th%tile	0.06	mg/l
75th%tile	0.13	mg/l
90th%tile	0.18	mg/l
Count	449	



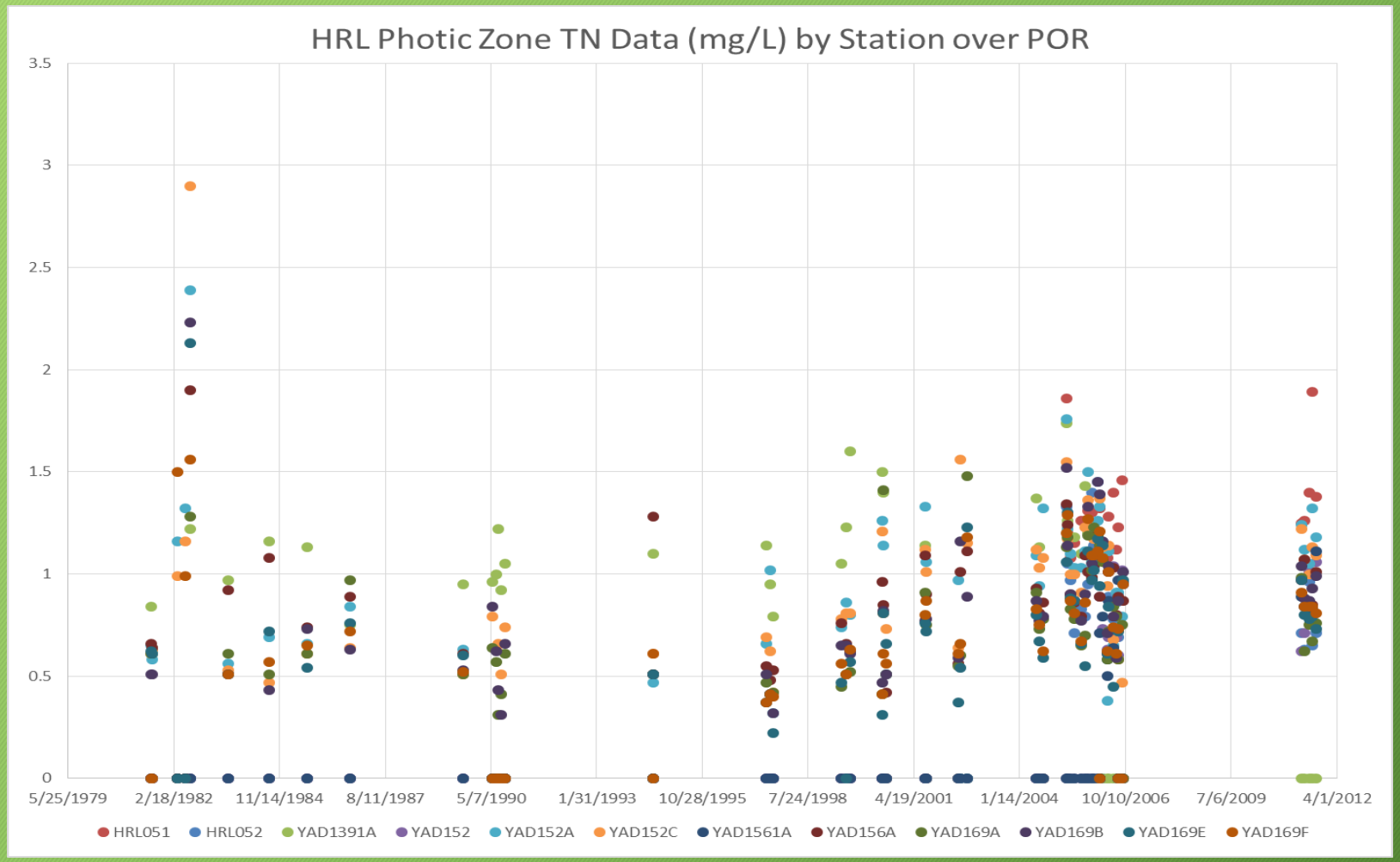
*High data point for YAD152C is 0.96 on 5/2/2006

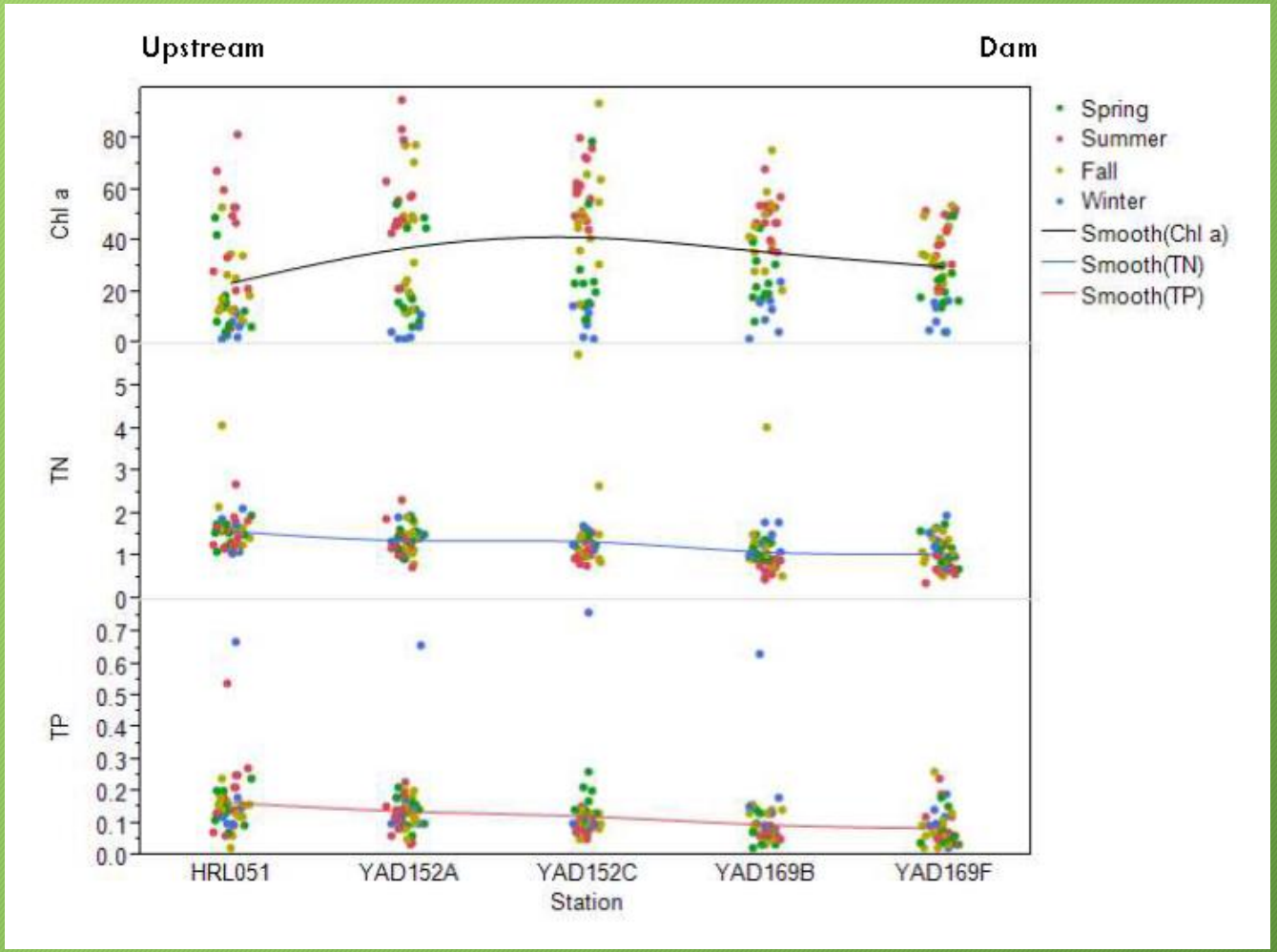
NC DEQ's High Rock Lake Data Spreadsheet

- Plotted 473 TN samples from 12 stations over ~30 years
- YAD139, YAD 139C, and YAD146A not plotted due to ≤2 sample size
- Basic statistics for 473 TN photic zone (calculated and measured) samples:

TN Summary Statistics		
AVG	0.90	mg/l
MAX	2.9	mg/l
MIN	0	mg/l
10th%tile	0.51	mg/l
25th%tile	0.64	mg/l
75th%tile	0.87	mg/l
90th%tile	1.29	mg/l

HRL TN Summary Statistics 2008-2010		
AVG	1.15	mg/l
MAX	5.77	mg/l
MIN	0.30	mg/l
10th%tile	0.67	mg/l
25th%tile	0.84	mg/l
75th%tile	1.39	mg/l
90th%tile	1.67	mg/l
Count	449	


HRL Photic Zone TN Data (mg/L) by Station over POR
3.5
3
2.5
2
1.5
1
0.5
0
5/25/1979
2/18/1982
11/14/1984
8/11/1987
5/7/1990
1/31/1993
10/28/1995
7/24/1998
4/19/2001
1/14/2004
10/10/2006
7/6/2009
4/1/2012
HRL051
HRL052
YAD1391A
YAD152
YAD152A
YAD152C
YAD1561A
YAD156A
YAD169A
YAD169B
YAD169E
YAD169F



We will need to discuss seasonality and segment classification when developing the criteria…

*Chl a, TN, and TP patterns from u/s stations to d/s stations from slide 34 of Jing's August 2015 presentation

EPA's Lake Ecoregion Document

- High Rock Lake is in ecoregions 45b and 45c
- EPA's 25th percentile of all seasons data for Ecoregion 45
  - TP = 0.0225 mg/L
- EPA's 25th percentile of all seasons data for Ecoregion 45
  - TN = 0.304 mg/L

All NC Lakes Chemical Data Spreadsheet

- Filtering for all ecoregion 45b and 45c lakes, looking at TP and TN photic zone samples yielded the following basic statistics regarding the data set:
  - TP Count (3970)
    - TP Min (0.005 mg/L), TP Max (1.5 mg/L), TP Average (0.052 mg/L)
  - TN Count (3906)
    - TN Min (0.055 mg/L), TN Max (6.9 mg/L), TN Average (0.650 mg/L)
  - Chl a Count (3208)
    - Chl a Min (0.5 µg/L), Chl a Max (380 µg/L), Chl a Average (25 µg/L)

All NC Lakes Chemical Data Spreadsheet

- Filtering for all ecoregion 45b and 45c lakes, looking at TP (mg/L), TN (mg/L), and chl a (µg/L) photic zone samples yielded the following basic statistics regarding the all lakes data set:

	TP	TN	Chl a
COUNT	3970	3906	3208
10th %tile	0.01	0.305	5.49
25th %tile	0.02	0.405	11
75th %tile	0.06	0.79	33
90th %tile	0.09	1.09	51

Other R4 State Criteria for TP and TN in Lakes

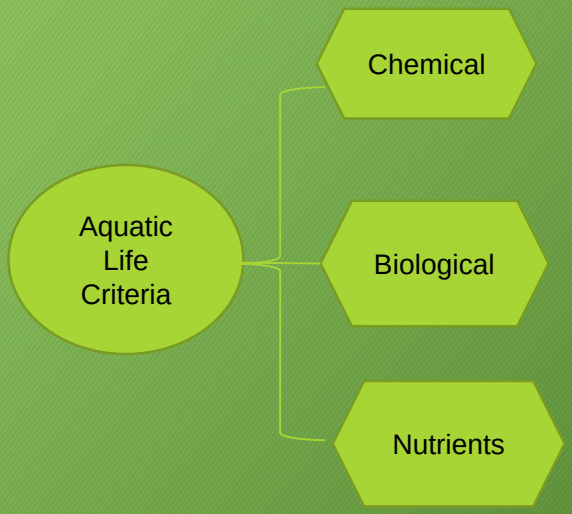
- Florida
  - TP ranges from 0.01 mg/L to 0.05 mg/L when chlorophyll is >20 µg/L
  - TP ranges from 0.03 mg/L to 0.16 mg/L when chlorophyll is <20 µg/L
  - TN ranges from 0.51 mg/L to 1.27 mg/L when chlorophyll is >20 µg/L
  - TN ranges from 0.93 mg/L to 2.23 mg/L when chlorophyll is <20 µg/L
- Georgia
  - TN ranges from 3 – 4 mg/L
  - TP ranges from 0.5 to 5.5 lbs/acre-foot (or 12,500 to 2,000,000 lbs/yr)
  - Chlorophyll a ranges from 5 to 24 µg/L
- South Carolina
  - Piedmont and Southeastern Plains TP 0.06 mg/L
  - Piedmont and Southeastern Plains TN 1.50 mg/L
  - Chlorophyll a of 40 µg/L

Published Ranges of TP and TN Criteria for Lakes

	TP	TN
EPA Ecoregion Document	0.0225 mg/L (25th percentile)	0.304 mg/L (25th percentile)
Other R4 States	0.01 mg/L – 0.16 mg/L	0.51 mg/L- 4.0 mg/L
All NC Ecoregion 45 b&c Data - Photic Zone	0.02 mg/L (25th percentile)	0.405 mg/L (25th percentile)
Existing HRL Data - Photic Zone	0.06 mg/L (25th percentile)	0.66 mg/L (25th percentile)

Establishing Duration and Frequency for Nutrient Criteria

- Short-term exposure may not be easily noticed
  - Waterbody specific
  - Often masked by other pollutants
  - Differ among sensitive species
- Long-term exposure may be irreversible
  - Loss of ecosystem value and aquatic life
  - Regime change in lakes
- Current research on the effects of nutrients on ecosystem health and aquatic life provide a good basis for establishing a criteria magnitude



Making Progress on Duration and Frequency

- Understand and characterize nutrient dynamics.
  - Seasonality of nutrient concentrations, delivery of loads (e.g., spring floods)
  - Seasonality of effects (e.g., summer growing seasons)
  - Ensure there is data to characterize these dynamics (e.g., statistics)

- Match compliance monitoring with analyses used to support criteria development.
  - EPA's guidance recommends using the same or a similar method of data gathering for compliance purposes as used in the analysis to derive the criteria (EPA 2001, Technical Guidance: Lakes and Reservoirs, p. 7-17)

Waterbody-Specific Considerations: Lakes and Reservoirs

- Residence time is waterbody-specific.
- Researchers caution against the application of steady-state assumptions; the effects of spikes in nutrient loading could linger and disrupt the steady state.
- Phytoplankton may respond faster than periphyton.
- Duration may differ for a drinking water designated use and a recreational designated use.

Duration and Frequency

- R4 Info
  - TP and TN values are expressed as annual geometric means not to be exceeded more than once in a 3 year period. (FL)
  - [TN] criteria not to exceed in photic zone. Annual TP loadings criteria not to exceed (in lake or tributary loading values). (GA)
  - TP and TN criteria are shall not exceed and would be interpreted as instantaneous since no other duration is specified. (SC)
- EPA Info
  - One excursion over a three-year period to protect aquatic life against long-term effects of pollutants.
  - Use the same or a similar method of data gathering for compliance purposes
- North Carolina
  - What do we want to use for High Rock Lake and the other lakes in North Carolina?

For future discussions….

2015 Tetra Tech Report on NC Lakes

- Lake chemistry data from 561 North Carolina Ambient Lake Monitoring stations (in 185 total lakes) collected between 1981 and 2014.
- Overall, the report provides good insights regarding the relationships and expectations relative to lake characteristics.

Nothing Compares
NORTH CAROLINA

Indicator Ranges

Scientific Advisory Council
June 15, 2016

Selected Indicators (April 2016)

Parameters for Numeric Ranges	**# Votes**
Chlorophyll-*a*	11
pH	10
DO	10
Clarity (Secchi depth or turbidity)	9
Algal toxins	8
Total nutrients (needs discussion)	6

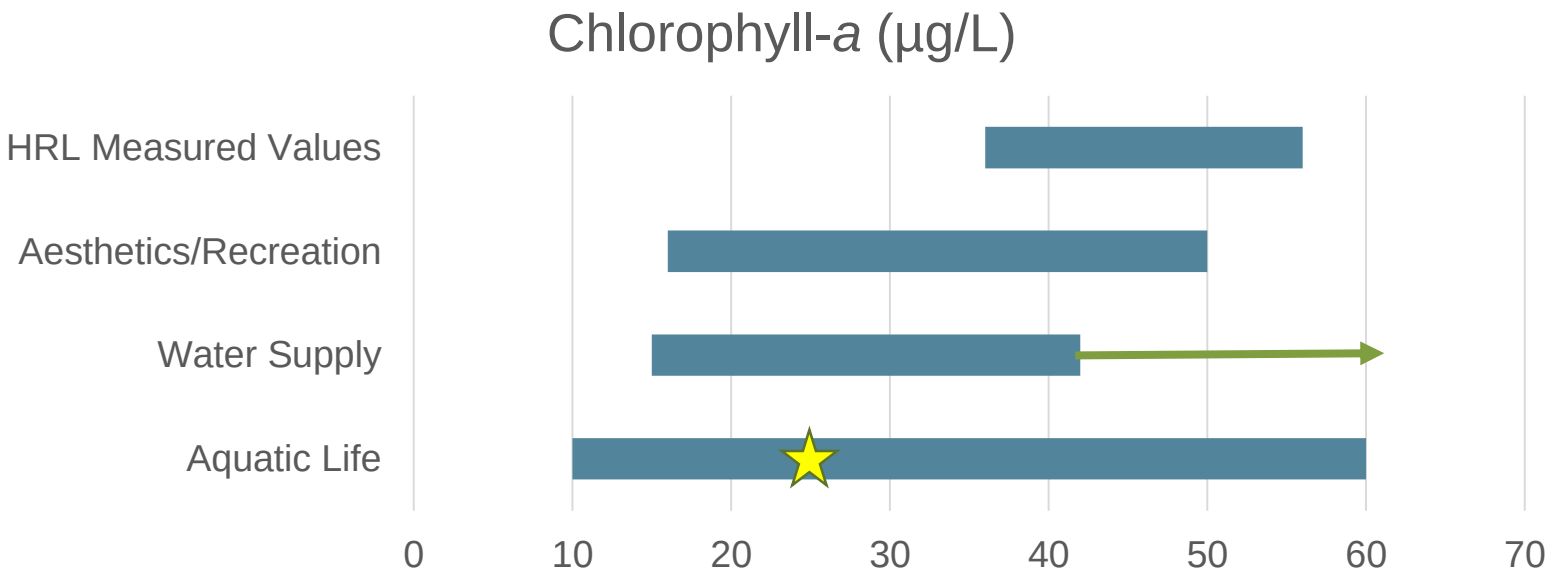
Parameters for Narrative Ranges	**# Votes**
Algal community structure	2
Fishery	2

Chlorophyll-a

WQ Goal	Low	High	Range	Duration	Notes
Aquatic Life	10	60	50		Aquatic life range 10-15 µg/L (literature); 25-60 µg/L (healthy fishery in HRL)
Water Supply	15	42	27		Drinking water max: 15 µg/L (literature); 42 µg/L (HRL data); none (T&O treatable)
Aesthetics/Recreation	16	50	34	Inst. Max	
HRL Measured Values	36	56	20		HRL Measured Values = May-Sept geometric mean

Criteria considerations:

- Apply drinking water standard at station closest to dam
- Use growing season geometric mean
- Determine frequency that is protective of uses
- Criteria may differ between main body and arms of lake



Drinking Water Treatment Considerations

Information from Tom Boyd with the Public Water Supply Section:

"The Town of Denton feeds powdered activated carbon especially during the warm water months for taste and odor control due to algae in the lake. The other problem that the town faces is high turbidity after hard rain events.

The upper Yadkin from Roaring River to Rockford is highly nitrified…Once the Yadkin re-aerates through the shoals at Rockford it seems to be better. All of the plants pulling raw water from the Yadkin during the warm water months have to be alert for algal blooms due to the nutrient levels."

Chlorophyll-a Background (1 of 2)

WQ Goal: Aquatic Life	Low	High	Range	Duration	Frequency	Special Considerations
Healthy fish population	10	15	5			Maceina et al. 1996- Alabama reservoirs [M. Ardon]
Healthy fish population	25	60	35		GS Geomean	Low value based on concerns of adverse impact to recreational fishery; CHLA should not drop below this value. Use attainment status serves as basis for criteria implementation. See evaluation of HRL data for performance-based criteria recommendations and lake zones. [C. Bell]
Main body 1	42.67			see notes	see notes	Sample at HRL051, YAD152A & C, YAD169B & F [B. Hall]
Main body 2	45.59			see notes	see notes	Sample as above, minus HRL051 (due to turbidity) [B. Hall]
Abbotts Creek	37.34			see notes	see notes	Sample at HRL052, YAD169A [B. Hall]
Town Creek	56.28			see notes	see notes	Sample at YAD152 [B. Hall]
Second Creek	55.39			see notes	see notes	Sample at YAD156A, YAD1561A [B. Hall]
Arm	35.95			see notes	see notes	Sample at YAD169E [B. Hall]

Growing season (May-Sept) geomean; ≥ 1 sample/month; allowable exceedance return frequency once/3 years [B. Hall]

WQ Goal: Water Supply	Low	High	Range	Duration	Frequency	Special Considerations
Suitable drinking water source	42*			see notes	see notes	Compliance point: YAD169F (point of lake discharge) [B. Hall]
Suitable drinking water source						Low value derived from reservoirs that experience higher levels of algal toxins. Use attainment status serves as basis for criteria implementation. [C. Bell]
No untreatable taste and odor issues						T&O issues are treatable [C. Bell]
No untreatable taste and odor issues		15				Done to keep geosmin < 5 ng/L (Smith et al., 2002, L&RM) [J. Bowen]

Growing season (May-Sept) geomean; ≥ 1 sample/month; allowable exceedance return frequency once/3 years [B. Hall]

*Need to calculate highest measured growing season geomean at YAD169F (lake discharge)

Chlorophyll-a Background (2 of 2)

Water Quality Goal: Recreation	Low	High	Range	Duration	Frequency	Special Considerations
Full-body contact	20					Low value derived from reservoirs that experience higher level of algal toxins. Use attainment status serves as basis for criteria implementation. [C. Bell]
Incidental/infrequent contact	30					[C. Bell]
Aesthetics	30					[C. Bell]
Aesthetics	0	50	50	inst.	<10% summer	ref: Lake Pepin, MN (Wasley and Heiskary, 2009) [J. Bowen]
Aesthetics	0	30	30	inst.	max	ref: MN WCP shallow (Heiskary & Wilson, 2008) [J. Bowen]
Aesthetics	0	16	16	inst.	max	NY users rated as awful (Smith et al. 2009) [J. Bowen]
Aesthetics TX	0	25	25	inst.	max	TX users rated w/ significant impairment (Glass 2006) [J. Bowen]
Main body 1	42.67			see notes	see notes	Sample at HRL051, YAD152A & C, YAD169B & F [B. Hall]
Main body 2	45.59			see notes	see notes	Sample as above, minus HRL051 (due to turbidity) [B. Hall]
Abbotts Creek	37.34			see notes	see notes	Sample at HRL052, YAD169A [B. Hall]
Town Creek	56.28			see notes	see notes	Sample at YAD152 [B. Hall]
Second Creek	55.39			see notes	see notes	Sample at YAD156A, YAD1561A [B. Hall]
Arm	35.95			see notes	see notes	Sample at YAD169E [B. Hall]

Growing season (May-Sept) geomean; ≥ 1 sample/month; allowable exceedance return frequency once/3 years [B. Hall]

pH

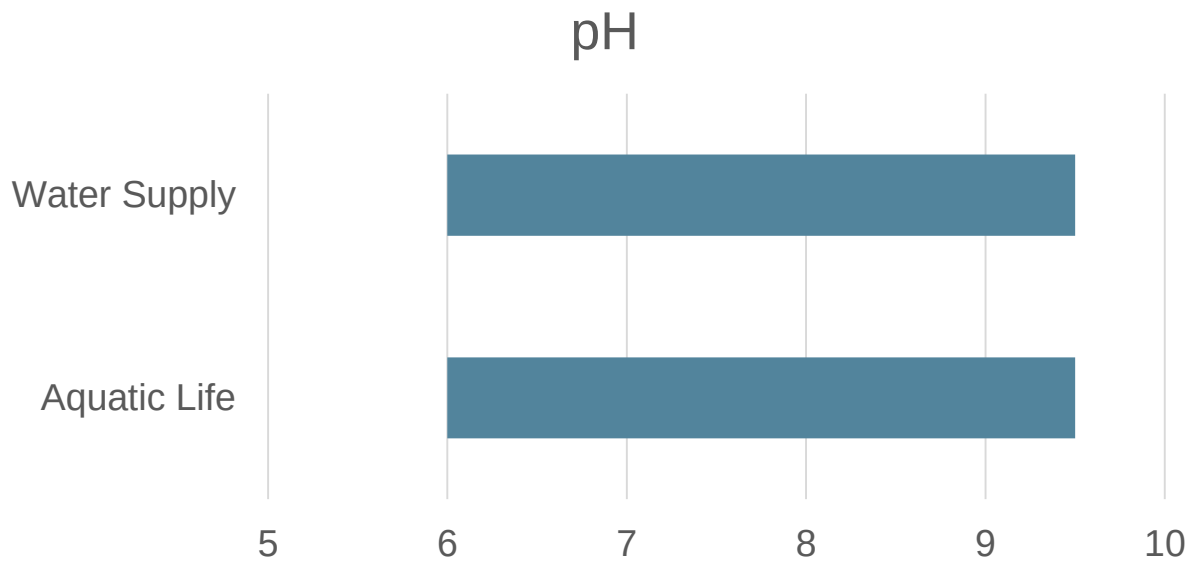
WQ Goal	Low	High	Range
Aquatic Life	6.0	9.5	3.5
Water Supply	6.0	9.5	3.5

Options for Frequency & Duration

- Use multi-year 10% exceedence with 90% confidence (current method)
- Express as an annual or seasonal 90th percentile

Spatial considerations

- Current method = surface only
- May want to aggregate data from mainstem



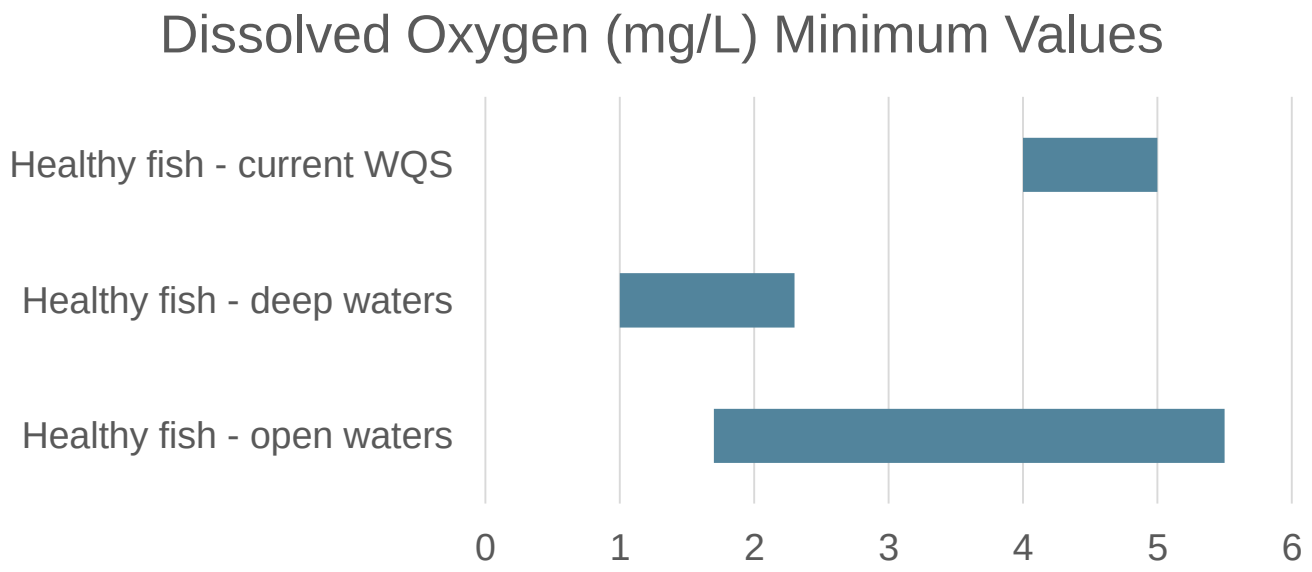
pH Background

WQ Goal: Aquatic Life	Low	High	Range	Duration	Frequency	Special Considerations
Healthy fish population	6.0	9.5	3.5	Annual or seasonal 90th percentile	1 in 3 years	Assumes salmonids absent. Assumes low levels of pH-dependent toxics (e.g., ammonia). Option: Use all epilimnetic observations, not just surface. Option: Lump all samples from lake mainstem. [C. Bell]

WQ Goal: Water Supply	Low	High	Range	Duration	Frequency	Special Considerations
Suitable drinking water source	6.0	9.5	3.5	Annual or seasonal 90th percentile	1 in 3 years	Based on optimizing treatability and aesthetic issues, not human health. Could be based on spatially-integrated conditions or conditions near intake(s), not just surface samples at individual points. [C. Bell]
No untreatable taste and odor issues						pH is readily adjusted during treatment. [C. Bell]

Dissolved Oxygen

WQ Goal: Aquatic Life	Instantaneous	Average	Range	Notes
Healthy fish - open waters	1.7	5.5	3.8	upper photic zone: instantaneous minimum; 30-day mean
Healthy fish - deep waters	1	2.3	1.3	below photic zone/thermocline: instantaneous minimum to protect benthic forage base; daily average to protect fish
Healthy fish - current WQS	4	5	1	minimum 4 mg/L; daily average 5 mg/L



Dissolved Oxygen Background

WQ Goal: Aquatic Life	Instantaneous	Average	Range	Duration	Special Considerations	Literature
Healthy fish - open waters	1.7	5.5	3.8	(1)	Open Waters (2) [M. Lebo]	See Lebo spreadsheet 4/2016
Healthy fish - deep waters	1	2.3	1.3	(3)	Deep Waters (4) [M. Lebo]	See Lebo spreadsheet 4/2016
Healthy fish - current WQS	4	5	1	(5)	Current WQS [M. Lebo]	NCDEQ WQS code viewed online

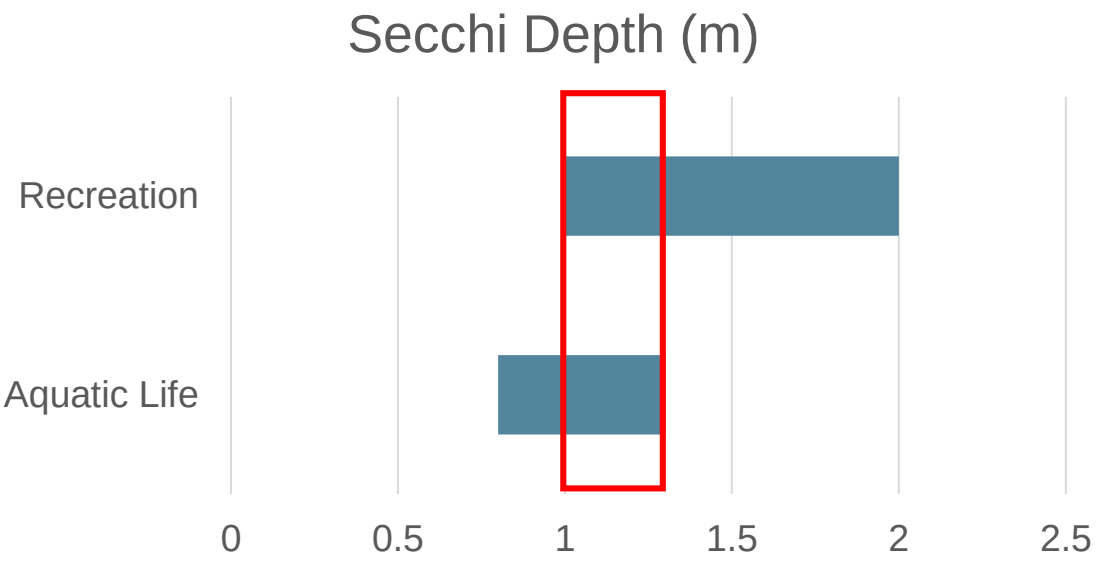
Notes: (1) low is instantaneous; high is for 30-day mean; (2) open waters is the upper photic zone; (3) low is instantaneous to protect benthic forage base; high is daily average of deep waters for protection of juvenile and adult fish; (4) deep waters below photic zone/thermocline; (5) minimum 4 mg/L and daily average of 5 mg/L. [M.Lebo]

Water Clarity

WQ Goal	Low	High	Range
Aquatic Life	0.8	1.3	0.5
Recreation	1	2	1

Criteria considerations:

- Determine duration & frequency protective of uses
- Is minimum the only criterion needed for Secchi (max not an issue)?
- Piedmont lakes reference condition Secchi depth = 1.66 m
- Current turbidity WQS = 25 NTU ≈ 0.5 m Secchi depth
- < 0.5 m = hypereutrophic, no recreation; > 1 m = clear, no blooms



Water Clarity

Indicator: Clarity (Secchi Depth in m)					
WQ Goal: Aquatic Life	**Low**	**High**	**Range**	**Special Considerations**	**Literature**
Healthy fish population	0.8	1.3	0.5	excellent to good; good to acceptable range	Burden et al. 1985, Younos 2007

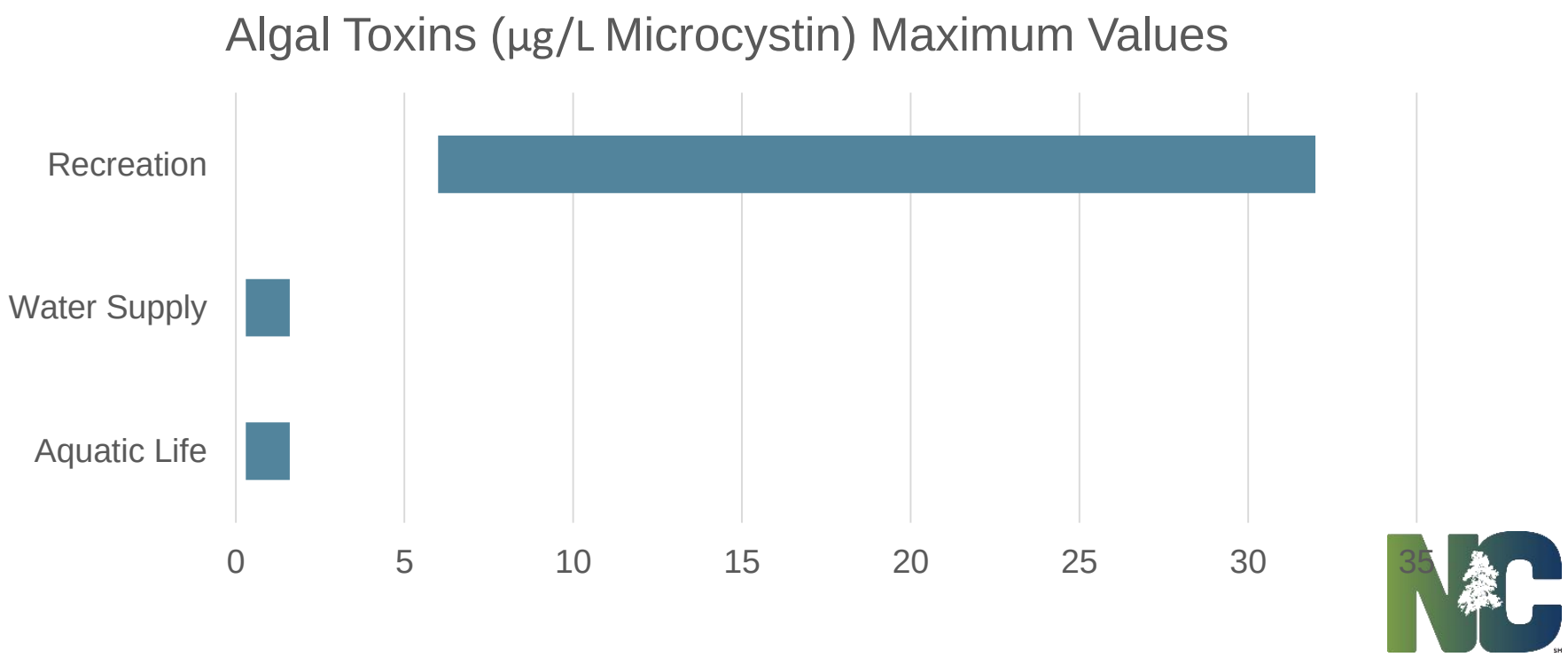
Indicator: Clarity (Secchi Depth in m)					
Water Quality Goal: Recreation	**Low**	**High**	**Range**	**Special Considerations**	**Literature**
Full-body contact	0.8	2	1.2		Smith et al. 1995, Younos 2007
Incidental/infrequent contact	0.5	2	1.5	0.5 hypereutrophic, no recreation	Lee et al. 1995, Younos 2007
Aesthetics	1	2	1	>1 clear, no blooms	Barica 1975, Younos 2007: Burkart et al. 2008

Algal Toxins

WQ Goal	Children	Adults	Range	Notes
Aquatic Life	0.3	1.6	1.3	Aquatic Life & Water Supply values based on drinking water for children (low) & adults (high)
Water Supply	0.3	1.6	1.3	Dissolved toxins = issue for drinking water; Cell-bound toxins removed in treatment process
Recreation	6	32	26	Recreation values based on accidental ingestion for children (low) and adults (high)

Criteria considerations:

- Values based on toxicological studies may be conservative
- Determine duration & frequency protective of uses



Algal Toxins Background

WQ Goal: Aquatic Life	Low	High	Range	Duration	Special Considerations
Safe fish consumption	0.3	1.6	1.3		Linkage between seston toxin levels and fish levels has not been established. However, biodilution of microcystin has been demonstrated (Kozlowski-Suzuki et al. 2012). Therefore, protecting drinking water will protect fish consumption. [A. Schnetzer/H. Paerl/N. Hall]

WQ Goal: Water Supply	Low	High	Range	Duration	Special Considerations
Suitable drinking water source	0.3	1.6	1.3	lifetime	Based on EPA 2015, 0.3 ug/L is for a small child, 1.6 ug/L is for children and adults, based on a study of liver disease in rats with an uncertainty (safety) factor of 1000 built in to account for 1) variability between exposed humans, 2) extrapolation from rats to humans, 3) extrapolation from "least" to "no" effect level, and 4) database insufficiencies and possibility that microcystin is also a tumor promoter, also assumes that water treatment is ineffective at removing toxin [A. Schnetzer/H. Paerl/N. Hall]

Water Quality Goal: Recreation	Low	High	Range	Duration	Special Considerations
Full-body contact	6	32	26		Based on accidental ingestion of 100 mL (WHO 1999) with the EPA standard for consumption of 2L of 0.3 ug/L (small children) and 1.6 ug/L (adults and children) microcystin containing water [A. Schnetzer/H. Paerl/N. Hall]

Nutrients…Add to Selected Indicators?

- Total Nitrogen?
- Total Phosphorus?
- Any other forms?

Algal Communities and/or Fisheries (narrative criteria)

Background Information Example

Large mouth bass

Indicator: Fish						
WQ Goal	**Low**	**High**	**Range**	**Duration**	**Frequency**	**Special Considerations**
Abundance (CUE/hour)	50	105	55			Based on samples every 3 years by NCWRC [M. Ardon]
Composition (length/weight) (length)	50	550	500			
Condition (safe for consumption)			0			There haven't been any advisories for Large mouth bass. There have been for catfish. [M. Ardon]

Crappie

Indicator: Fish						
WQ Goal	**Low**	**High**	**Range**	**Duration**	**Frequency**	**Special Considerations**
Abundance (CUE night)	4	31	27			Sampled every 3 years by NCWRC [M. Ardon]
Composition (length/weight)			0			
Condition (safe for consumption)			0			

Final Selected Indicators? (June 2016)

Parameters for Numeric Ranges	**# Votes**
Chlorophyll-*a*	
pH	
DO	
Clarity (Secchi depth or turbidity)	
Algal toxins	
Total N	
Total P	

Parameters for Narrative Ranges	**# Votes**
Algal community structure	
Fishery	

Nothing Compares
NORTH CAROLINA

Middle Cape Fear Monitoring

June 15, 2016

Department of Environmental Quality

WHAT?

- Provide supporting information to develop water quality models for the Deep/Rocky Rivers and Middle Cape Fear River
- Different purpose than Jordan, Falls, or High Rock Lakes, may or may not result in NMS

WHY?

- Support NPDES permitting for nutrients.
- Provide information on conditions associated with algal bloom frequency and duration.
- Provide additional information on existing impaired waters.
- Provide additional information for public water supplies.
- Potentially support nutrient criteria, as described in the North Carolina Nutrient Criteria Development Plan (NCDP).

WHO?

- DWR
- Coalitions – UCF/MCF
- **BOTH** depending on available resources

- EPA?

DRAFT

Where? Modeling Spatial Extent

Parameters of Concern

Based on existing impairments, known concerns, permitting needs

- Nutrients (primarily nitrogen and phosphorus)
- Chlorophyll-a
- Dissolved Oxygen (DO)
- Turbidity – indirect
- Algal blooms - indirect
- Total Organic Carbon (TOC)
- Others as identified by NCDP/Scientific Advisory Council(?)

Suggested Modeling Platforms

- Deep and Rocky Rivers (green and pink) – SWAT
- Middle Cape Fear (yellow) – CE-QUAL-W2

Supporting Studies

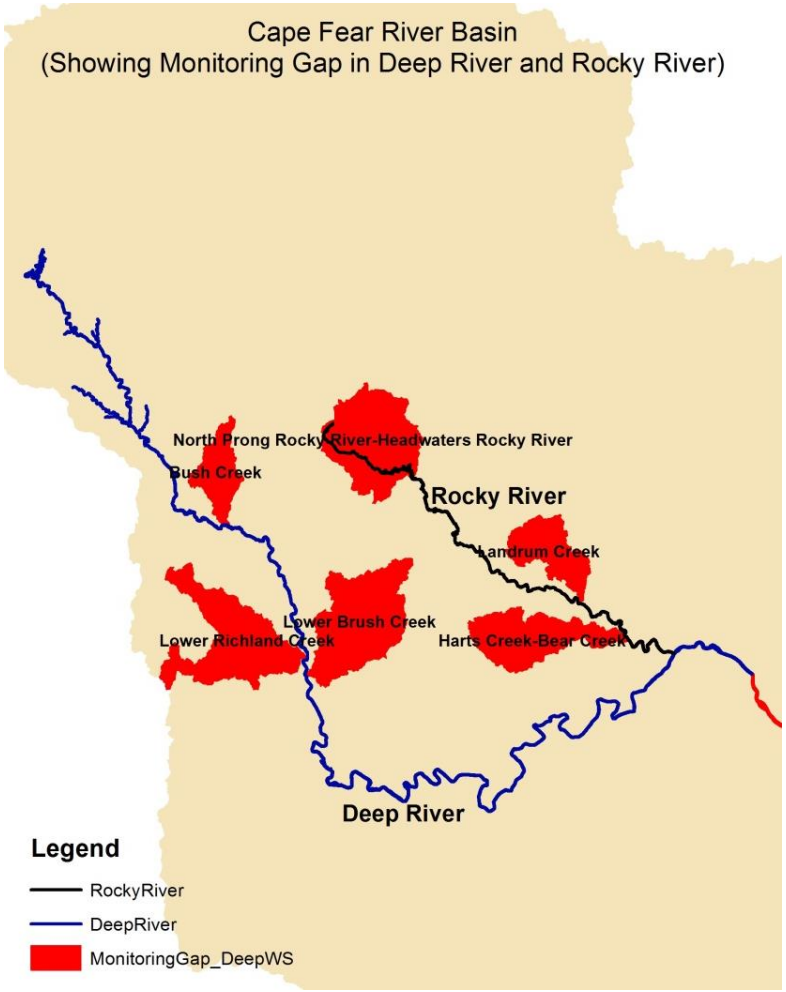
- Bathymetry study - DONE
- Rocky River special study – Summer 2016
- SOD/Nutrient Flux behind locks and dams
- **Deep/Rocky Rivers monitoring gaps**
- **Middle Cape Fear monitoring gaps**

Monitoring Gaps

- NCDP Identified Task – due Dec 2014
- Monitoring targets:
  1. Calibration and validation at critical sub watersheds: characterize nutrient loading from animal operations.
     - Based on DWR draft report "A summary of land applied nutrients from permitted animal operations in North Carolina (Draft, Dec 2014)
  2. Calibration at headwater steams: characterize headwater conditions.
  3. Characterize tributary inputs

DRAFT

Monitoring Gaps
Deep and Rocky Rivers



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Monitoring Gaps
Middle Cape Fear

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9 Proposed Monitoring Sites

Coalition	Watershed	Receiving River	Station Location		Road Crossing	Model Use
			Longitude	Latitude		
Upper Cape Fear	Bush Creek	Deep River	-79.713	35.753	SR 2226:	SWAT
	Brush Creek	Deep River	-79.583	35.602	SR 22 and 42	SWAT
	Richland Creek	Deep River	-79.619	35.608	SR 2873	SWAT
	Headwaters Rocky River	Rocky River	-79.493	35.802	SR1362	SWAT
	Landrum Creek	Rocky River	-79.275	35.688	NC 902	SWAT
	Bear Creek	Rocky River	-79.212	35.635	SR 2156	SWAT
Middle Cape Fear	Gulf Creek	Cape Fear River	-79.027	35.566	SR 1916	CE-QUAL-W2
	Headwaters Locks Creek	Cape Fear River	-78.855	35.047	SR 1006	CE-QUAL-W2
	Carvers Creek	Cape Fear River	-78.404	34.453	NC 87	CE-QUAL-W2

DRAFT

Water Quality Parameters – Gap Study

Physical Parameters:

- Water temperature
- DO
- Conductivity
- pH

Frequency: once per month

Duration: 2-3 years (resource driven)

DRAFT

Water Quality Parameters – Gap Study

Chemical and Sediment Parameters (grab samples):

- Nitrogen (ammonia, nitrate+nitrite, TKN)
- Phosphorus (total phosphorus, ortho-phosphorus)
- TSS
- Turbidity
- BOD5

DRAFT

Storm Event Monitoring – Gap Study

- 2 high flow events each year
- For each high flow event, include three sampling events to capture as best as possible (considering travel times and safety concerns) the rising limb, peak flow, and falling limb of the hydrograph.
- Physical/chemical parameters: physicals, nutrients (Ammonia, NOx, TKN, TP), TSS, turbidity

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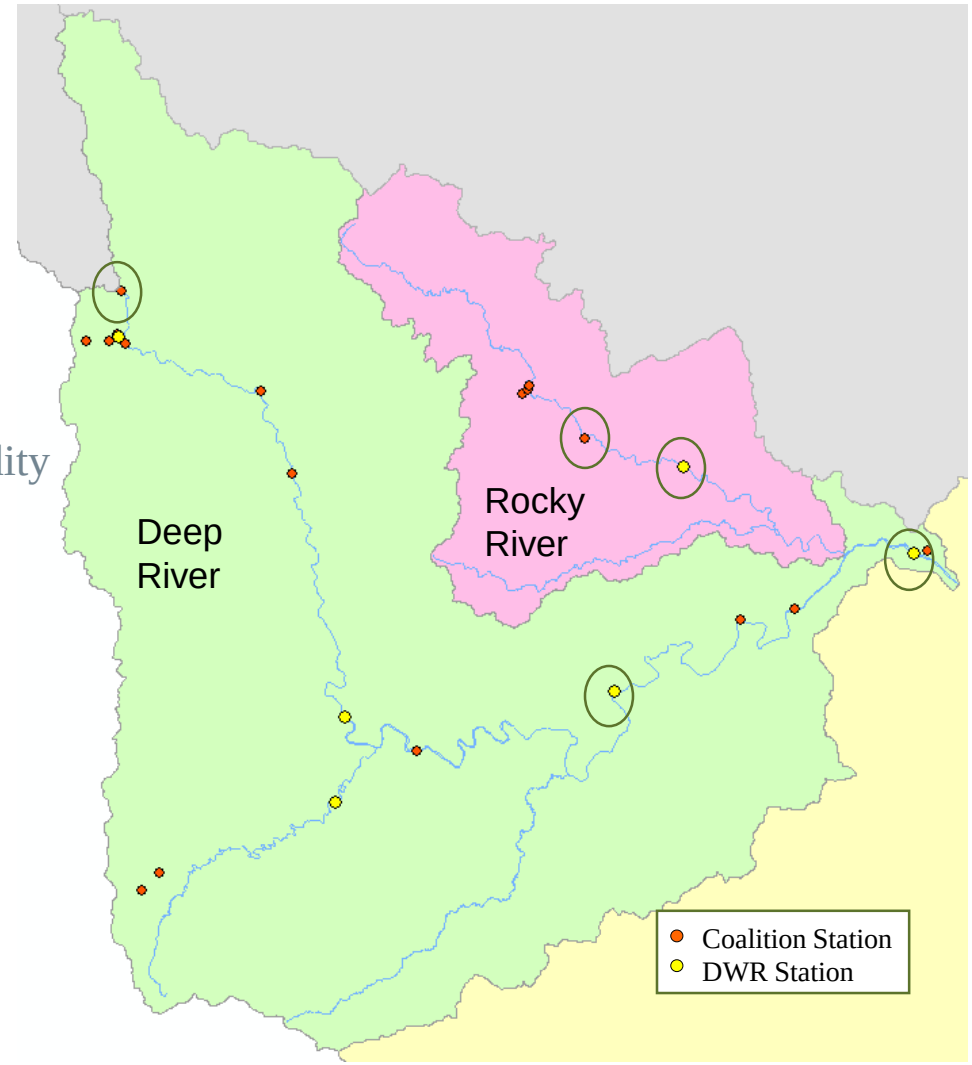
Existing Stations
Deep River
Rocky River

All stations:
physicals, nutrients, TSS, turbidity (monthly)

Circled stations:
Ortho-p, CBOD, BOD5, TOC (monthly)
LOC, ROC (quarterly)



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Existing Stations – Additional Monitoring

Based on Western Wake Modeling and Monitoring Plan

- 19 sites
- Increased summer frequency (biweekly, May-Oct)
- Chemical Parameters: DO, temperature, conductivity, pH, TP, NH4+, NOx, TKN, ortho-p (where noted), turbidity, TSS, chlorophyll *a*
  - *DWR – Chlorophyll a for ortho-p stations*

    Add BOD5, CBOD, TOC, LOC, ROC to 3 stations

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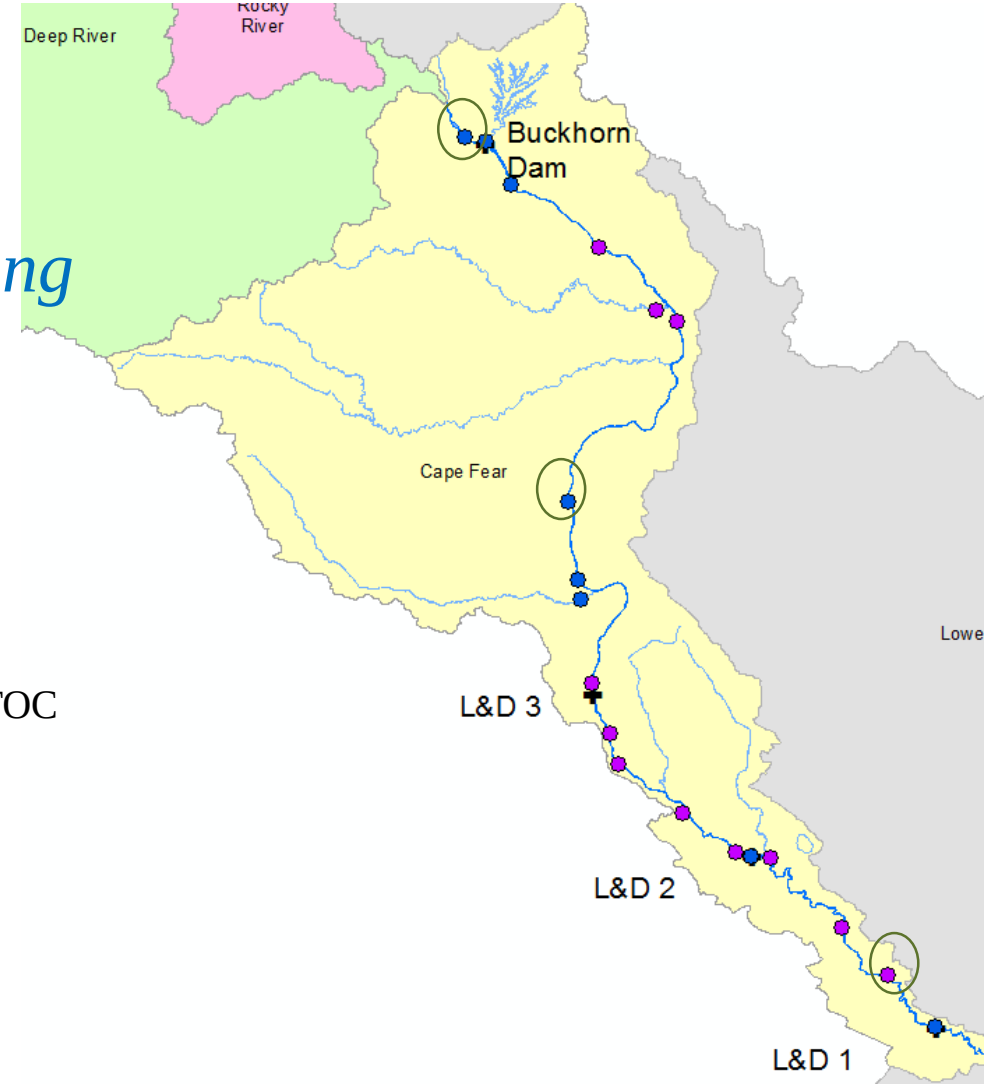
Existing Stations – Additional Monitoring



- Additional monitoring
- With ortho-p, chlorophyll-*a*, TOC
- *TOC, BOD5,CBOD - monthly*
  LOC, ROC - quarterly

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Summary

- Will provide a permitting tool to allow for future growth
- DWR will develop monitoring plan – will be looking for SAC input
- NCDP SAC work may change or redirect focus
- Resource availability - uncertain
- Modeling is not expected to begin for at least 2 or 3 years
- May or may not result in reduction requirements/ nutrient management strategy

Thank You!

Contact Information:

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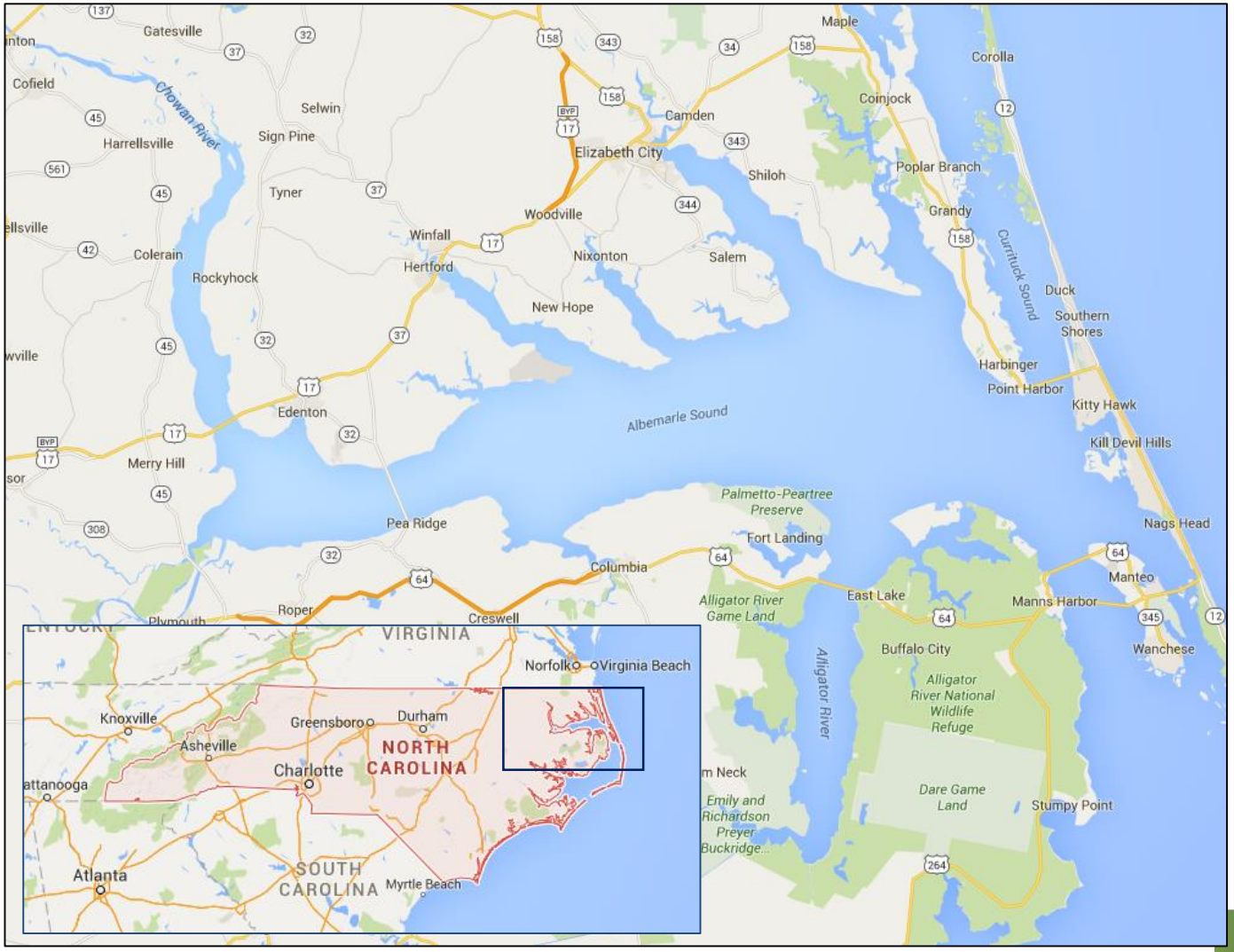
Albemarle Sound: Nutrient Criteria Development Progress

Jim Hawhee
N.C. Division of Water Resources
15 June 2016

Department of Environmental Quality

Albemarle Sound



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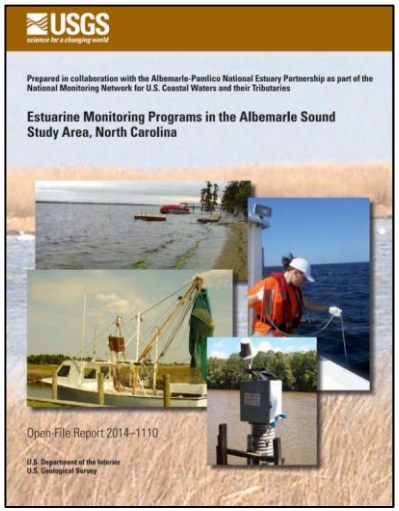
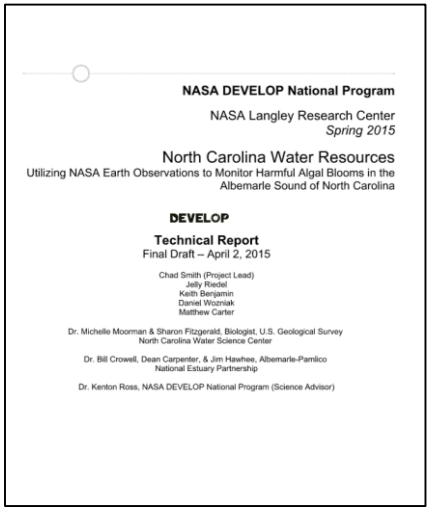
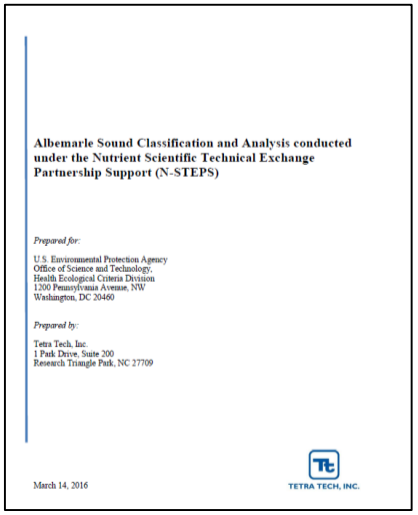
Albemarle Sound- Project Status

- Remote sensing evaluation: complete
- DWR data classification and analysis (Tetra Tech): complete
- National law and policy review: complete
- Literature compilation: complete
- USGS Albemarle Sound initiatives: some complete, one pending report
- DWR supplementary data analyses: substantially complete







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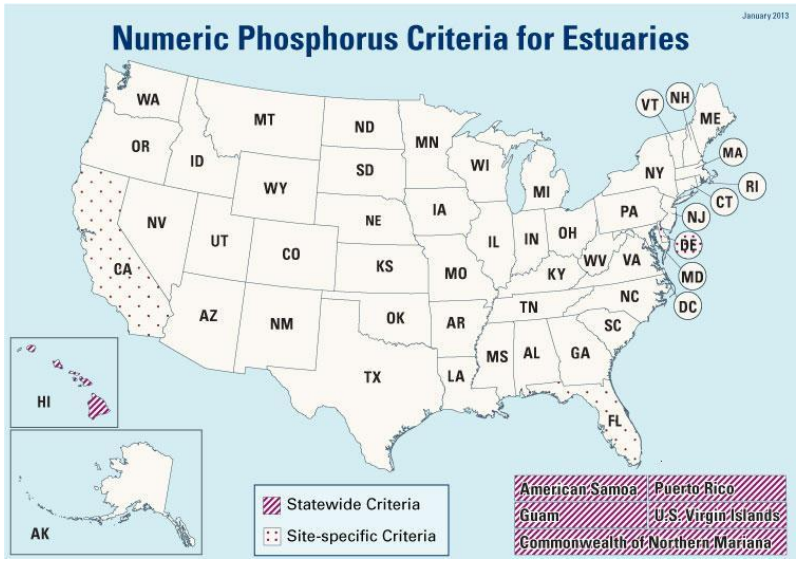
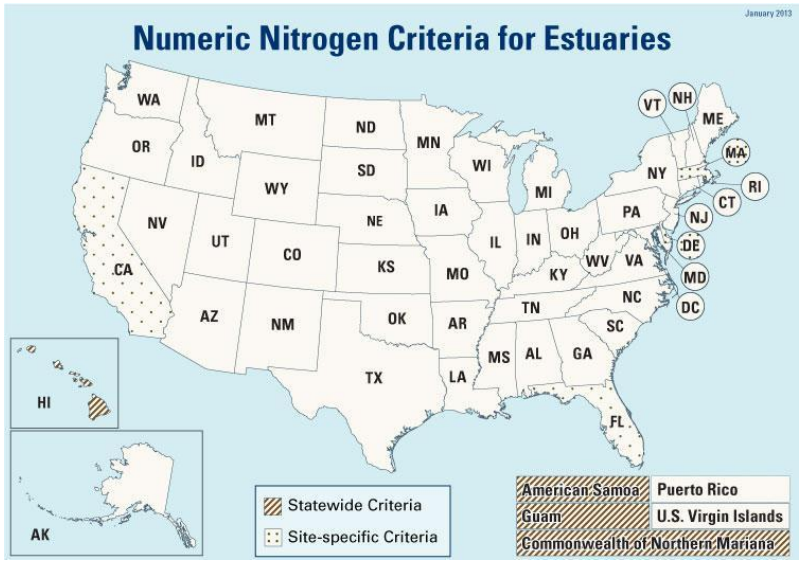
January Meeting: Case Studies





Review of 11 estuarine nutrient criteria case studies

- Varying approaches, parameters, thresholds, and states of progress
- Case studies available on website

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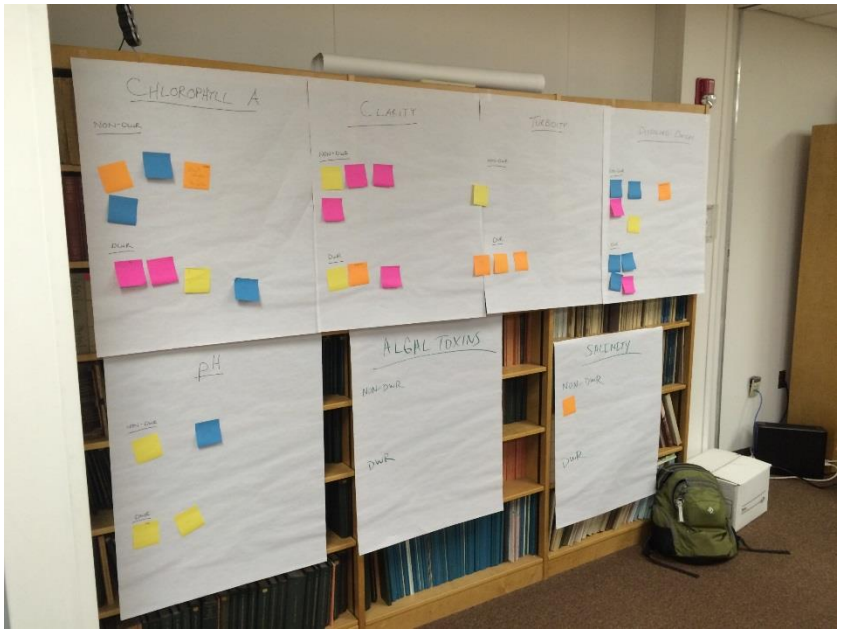
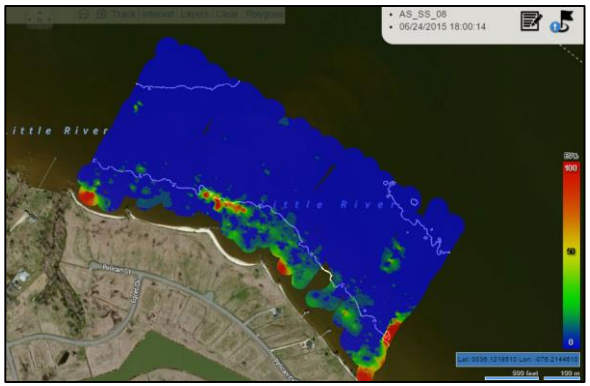
March Meeting: Data and Assessment

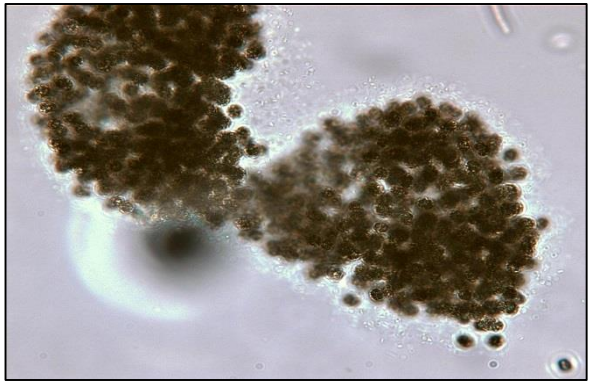
- Presentation of DWR data classification and analysis
- DWR assessment methodologies
- DWR monitoring approaches
- Discussion and nonbinding prioritization of response parameters for criteria development



May Meeting: Ecological Overview

- Algal communities
- Fish and fisheries
- Submerged aquatic vegetation
- Background materials provided re: benthics, geology, and general system characteristics
- Also, a discussion of present modeling limitations in Albemarle Sound.





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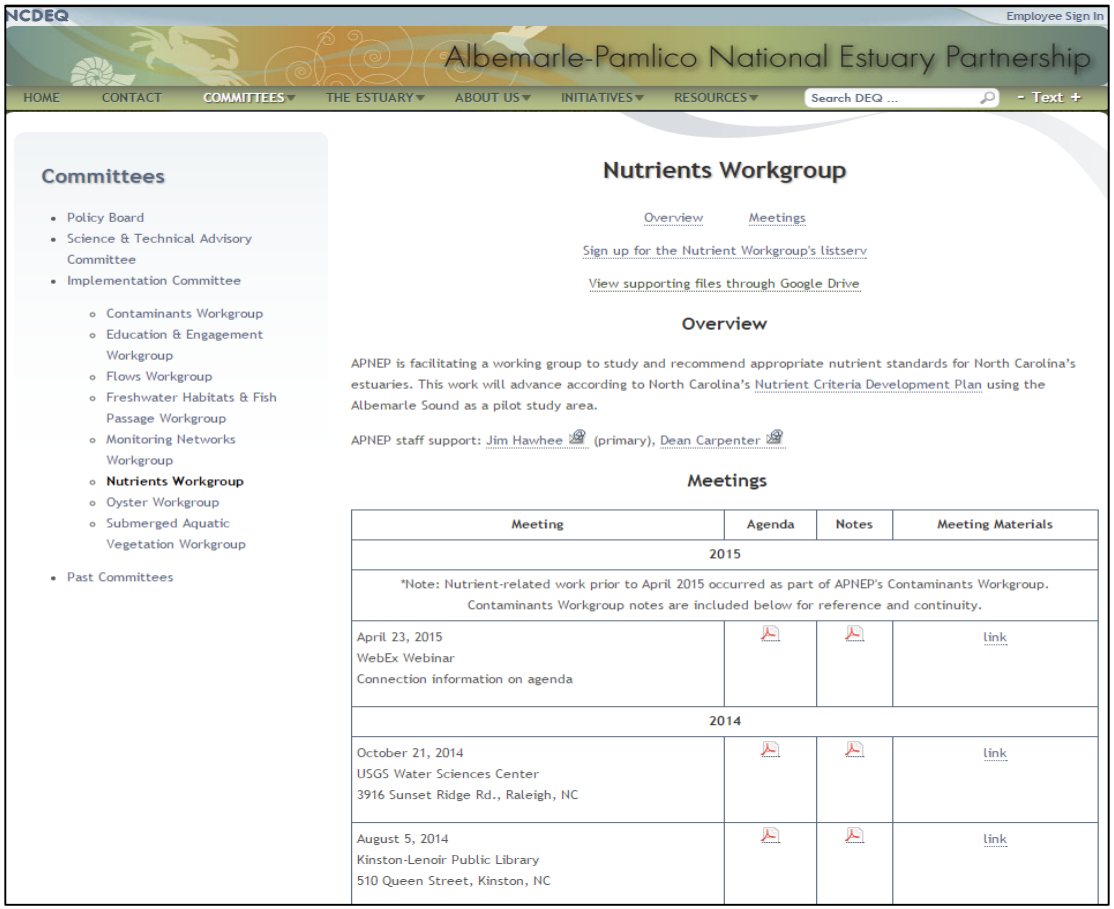
Albemarle Sound Planning Timeline

- July: Evaluate response criteria proposals and associated research recommendations
- September: Evaluate causal criteria proposals and associated research recommendations
- November: Draft report detailing Albemarle Sound proceedings and recommendations
- Winter 2016/2017: **SAC** and CIC review
- Spring 2017: Final phase I report adopted
- Summer 2017: Research and Phase II proceed if necessary.

Albemarle Sound- SAC (optional) Homework

- Supporting materials presently on workgroup website for review.
- Criteria proposals will be posted on the workgroup website by July 6.
- Next Albemarle Sound meeting: July 20th

APNEP Nutrient Workgroup Website



http://apnep.org/web/apnep/nutrients

Questions?

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