NCDP Scientific Advisory Council Agenda

10:00am – 3:30pm
February 26, 2019
Agronomic Division Building Conference Room
4300 Reedy Creek Road, Raleigh, NC 27607

Desired Outcomes:

- Shared understanding of the Chlorophyll *a* document status.
- Shared understanding and resolution of "tabled" response variables.
- Shared understanding Nitrogen numeric criteria options.
- Shared understanding of next steps.

Time	Topic	Speaker(s)
10:00	Convene • *Introductions* • *Approval/Comments on meeting minutes – November and December 2018* • *Administrative Business*	Jenny Halsey (facilitator)
10:15	Chlorophyll *a* Document Update	Jim Bowen
11:00	Break	
11:15	Revisit "tabled" response variables	Jenny Halsey (facilitator)
12:00	Lunch	
12:30	Nitrogen Numeric Criteria Discussions	Brian Wrenn Jenny Halsey (facilitator)
2:00	Break	
2:15	Continued – Nitrogen Criteria Discussions	Jenny Halsey (facilitator)
2:45	Next Steps – Water body selection	Brian Wrenn Jenny Halsey (facilitator)
3:15	Wrap-up, closing remarks, and adjourn	Jenny Halsey (facilitator)
3:30	Adjourn	

Working Title: Chlorophyll-a for High Rock Lake

Section No.	Name	Notes on Content
	Abstract	
1	**Introduction (DWR Staff & Lauren; Jim/Chapter Leader)**	Provide background on NCDP and the reservoir pilot (HRL). Explain SAC goals of deriving site-specific criteria for HRL, but also developing framework for other lakes/reservoirs.
1.1	Existing Chlorophyll-*a* Criterion	Describe existing criterion and how it is used for assessment of NC lakes. Provide background on how it was derived.
1.2	Overview of SAC Approach	Brief, high-level overview of the SAC's thinking; e.g., using both lit and HRL-specific observations, balance fishing with other uses, manage risk at reasonable level, etc.
2	**Literature Review of Chlorophyll-a and Use Attainment (Nathan)**	Each subsection identifies ranges of CHLa at which other lakes/reservoirs have either met uses or experienced problems.
2.1	Fish/Aquatic Life (Marcelo/Nathan/Hans)	
2.2	Potable Water Supply (Bill H.?)	
2.3	Recreation (Linda, Astrid, Bill and Jim)	
2.4	Other Uses	
3	**Current Conditions in High Rock Lake (Jim)**	Each section would utilize graphics/tables developed from HRL datasets, and associated interpretation.
3.1	Spatial patterns	
3.2	Temporal patterns (Marcelo?)	
3.3	Relation with other Indicators	
3.1.1	Dissolved oxygen (Clifton, others?)	
3.1.2	pH (Marty?)	
3.1.3	Water clarity (Michael O'?)	
3.1.4	Algal taxonomy (Linda?)	
3.1.5	Algal toxins (Astrid?)	
3.4	**Narrative Use Attainment in High Rock Lake**	Summarize available information on each sub-topic; e.g., fishery status, other aquatic life present, existing water supply use & impacts, recreational use, etc.
4.1	Fish/Aquatic Life (Marcelo/Nathan/Hans?)	
4.2	Potable Water Supply (Bill H.?)	
4.3	Recreation (Bill H.)	
4.4	Other Uses	
4	**Recommended Framework for Site-Specific Criteria (**Clifton)	Building on previous sections, the SAC would lay out an approach for deriving site-specific criteria. The following section (6) would apply that approach to High Rock Lake to recommend a specific magnitude. Section 5 would provide rationale for recommended elements of the criteria that would not be expected to change between lakes/reservoirs (e.g., averaging period & statistic, frequency/allowable exceedance). As currently organized, this section uses elements of one proposal discussed by the SAC (screening range + narrative evaluation + antideg. policy ➔ site specific criterion). If SAC does not reach consensus on that, it

Section No.	Name	Notes on Content
		could be reorganized based on whatever else the SAC comes up with re. a general framework for deriving site-specific criteria.
5.1	Temporal Averaging Period and Statistic	Present rationale for how the CHla value would be calculated. This would address topics such as type of mean, months to include, individual year vs. multi-year, minimum data requirements.
5.2	Spatial Considerations	Includes recommendations on spatial aggregation of data, should the SAC reach consensus on this topic.
5.3	Statistical Test for Assessment	If the SAC chooses to recommend a statistical test for use with the CHLa criteria, describe it here.
5.4	Chlorophyll-a Screening Range	Synthesize literature and HRL-specific observations to identify range of CHLa values for initial assessment step. Literature can inform the both the upper and lower end of the range, especially the lower. The HRL-specific observations can inform the upper end of the range, because HRL is representative of a high-CHLa reservoir that does not necessarily experience many of the impairments reported in the literature.
5.5	Narrative Use Evaluation	Describe elements of a narrative use evaluation for lakes with mid-range CHLa values. What types of information should DEQ consider (e.g., fishery status, nuisance blooms, algal toxins, fish kills, taste and odor problems, etc.)
5.6	Antidegradation	Describe how lakes with CHLa less than screening values would be protected from degradation.
5.7	Summary of Proposed Framework	Synthesize previous subsections to describe the recommended approach for expressing criteria and deriving site-specific magnitudes.
6	**Proposed Site-Specific Criteria for High Rock Lake (Marty)**	Apply the framework described in section 5 to derive a site-specific criterion for HRL. Content will represent SAC consensus on magnitude.
6.1	Application of CHLa Screening Range	
6.2	Summary of Narrative Use Evaluation	
6.3	Antidegradation Considerations	
6.4	Summary of Recommended Criterion	
7	**References**	

Working Title: A Chlorophyll-a Criteria for High Rock Lake (~30 pages total, divided into abstract + five sections, each w/ designated section leader/editor)

Sec. No.	Name	Notes on Content of each section (A few phrases or sentences on what's in the section, what source material is used)
	Abstract (need to assign author for this)	Approximately one-page summary of criteria document
1	**Introduction (Jim, w/ DWR staff)** **~5 pages total**	Provide background on NCDP and the reservoir pilot (HRL). Provide map of HRL. Excerpt relevant parts from NCDP for big picture criteria development. Explain SAC goals of deriving site-specific criteria for HRL, but also address portions of pilot that are transferable to other lakes/reservoirs. Describe overall outline of document.
1.1	Existing Chlorophyll-*a* Criteria (Jim, Lauren w/ DWR staff)	Describe existing criteria and how it is used for assessment of NC lakes. Provide background on how it was derived.
1.2	Overview of SAC Approach (Deanna)	Brief, high-level overview of the SAC's approach; i.e., using both lit and HRL-specific observations, balance fishing with other designated uses, manage risk at reasonable level, etc. Discuss importance of use protection in setting criteria rather than analysis based upon feasibility/attainability considerations. Discuss CIC role as advisor to SAC.
2	**Literature Review of Chlorophyll-a and Use Attainment (Nathan)** **~ 7 pages total**	Each subsection identifies ranges of CHLa at which other lakes/reservoirs have either met uses or experienced problems.
2.1	Fish/Aquatic Life (Marcelo/Nathan/Hans)	Summary of literature on Chl a impacts on fish. Below are results from some relevant studies- NSH Chla doesn't directly impact animals but does impact other plants through shading. No SAV in HRL. Chl a is indicator of trophic status with covarying water quality conditions that impact fish (e.g. dissolved oxygen, pH, communities). However, some phytoplankton, notably cyanobacteria (Chorus and Bartram 1999) but also some eukaryotes (Roelke 2016) produce toxins and in those cases phytoplankton have a more direct link to health of fish/ aquatic life. NSH Total fish biomass increases with higher chla (metanalysis by Deines et al 2015; Iowa lakes/reservoirs Egerston and Downing 2004; Florida lakes Bachmann et al. 1996)- NSH

		Proportion of piscivore biomass declines with higher chl a due to increase in planktivores (florida lakes Bachmann et al. 1998) and decline in piscivores (northern european lakes Persson et al. 1988)-NSH Body condition (mass/length) of largemouth bass increases up to 80 ug/L but declines at higher chl a (Florida lakes Boucek et al. 2018). Largemouth numbers and growth decreased in Westpoint Res., Georgia when chl-a decreased from ~40 to ~20 ug/L. Spotted bass in creased but overall black bass biomass decreased (Maceina and Bayne 2001) Similar declines observed in VA, AR, and NV reservoirs after oligotrophication (Ney 1996)-NSH Relations between chl-a and cyanotoxins are existent but weak. Strong relations exist within specific water bodies where toxin producing species are major bloom formers (eg. Otten et al. 2014) -NSH Will show figures of relation between microcystins and chl-a from the National Lake Assessment data for the whole US and the southeast. -NSH
2.2	Potable Water Supply (Bill H.)	Summary of main effects on the ability to make water potable-NSH 1) Disinfection by products due to high DOC 2) Taste and odor 3) Toxins 4) Costs of additional treatment
2.3	Recreation (Linda, Bill)	Relationship between chl-a and micocystins from National Lake Assessment indicates a 90% chance of microcystin being below the World Health Organization recreational limit at a chla value of 78 ug/L based on all US lake data. For SE lakes the same value is 230 ug/L-NSH
2.4	Other Uses (aesthetics,swimming) Bill	Summarize references relating chl-a conc to suitability for swimming, aesthetics, etc.
3	**Current Conditions in High Rock Lake (Jim)** **~ 7 pages total**	Each section would utilize graphics/tables developed from HRL datasets, and associated interpretation.
3.1	Chl-a spatial patterns (Jim w/ input from DWR staff)	Describe monitoring data sets available. Summarize sampling programs in a table. Describe DWR photic zone sampling methodology. Give map of lake showing monitoring

		stations. Present and describe chl-a w/ box and whisker plots to show photic zone chl-a data by station.
3.2	Chl-a temporal patterns (Marcelo)	Show long-term and seasonal trends in chl-a data in HRL.
3.3	Chl-a relation with other Indicators	Use HRL data to relate chl-a w/ other WQ indicators
3.3.1	Dissolved oxygen (Clifton)	Show empirical relations between CHLa and DO in HRL, both using grab samples w/ vertical profiles and the 2016 sonde (diel variability). Address both concentration and % saturation. Put in context of NC's DO criterion and literature-based consideration of diel variability in DO and % saturation.
3.3.2	pH (Marty)	Show plots of pH in surface waters versus CHLa. Also, show vertical profiles of pH for different CHLa levels. Place elevated surface CHLa in context of overall water column habitat with pH conditions of 7-9 below surface layer.
3.3.3	Water clarity (Michael O')	Present chl-a vs. secchi depth plots or other information relating chl-a to water clarity. Explain any trends in data
3.3.4	Algal taxonomy (Linda, Astrid)	Describe available taxonomy data from DWR. Summarize the known phytoplankton flora in HRL.
3.3.5	Algal toxins (Astrid)	Describe algal toxin grab sample and SPATT sampling program. Summarize toxin data and describe spatial/temporal trends (if any) and any relationships w/ other measured data (e.g. chl-a, taxonomy, etc.)
3.4	Use Attainment in High Rock Lake	Summarize available information on use attainment in HRL for each sub-topic; e.g., fishery status, other aquatic life present, existing water supply use & impacts, recreational use, etc. Each component should include how it was considered to support/modify/not support chl a criteria selection.
3.4.1	Fish/Aquatic Life (Marcelo/Nathan/Hans)	Summarize information presented by WRC on fish stocks, Hard to separate effects of water quality from fisheries management
3.4.2	Potable Water Supply (Bill H.)	
3.4.3	Other Uses (aesthetics, swimming) Bill H.	

4	**Proposed Site-Specific Criteria for High Rock Lake (Marty) ~6 pages total**	Apply the framework described in earlier sections to derive a site-specific criterion for HRL. Content will represent SAC consensus on magnitude.
4.1	Designated Uses in HRL affected by CHLa	The designated uses applicable to HRL waters to be considered in development of a proposed site-specific CHLa standard will be defined. Literature presented in section 2 will be applied to identified uses to develop a target range for CHLa that would be protective for all uses.
4.2	Temporal and spatial averaging considerations	Consideration of time and spatial averaging components for development of CHLa standard development. Expression would be as a long-term average CHLa concentration in the photic zone expressed as the geometric mean. Data assessment would be by assessment unit.
4.3	Protection of Sport Fishery	Monitoring data for CHLa would be used to develop a target long-term CHLa geometric mean in the region of HRL with maximum CHLa concentration that would maintain adequate CHLa in downstream regions of the reservoir.
4.4	Proposed CHLa Standard	Proposed CHLa standard will be described in terms of protection of designated uses and development basis. Included will be details on magnitude and duration of CHLa concentration as a long-term average expressed as a geometric mean.
4.5	Summary of Proposed CHLa standard	Key details on CHLa proposed standard will be summarized.
5	**Potential Elements of a Framework for Deriving Site-Specific Criteria** (Clifton) ~5 pages total	A previous version of this outline placed the framework before the HRL recommendation, so that the the HRL recommendation would simply be the application of the framework to HRL. However, the SAC has not yet developed the details of the statewide framework and will revisit the topic later in the NCDP schedule. This reworked section is intended to capture the SAC's discussion to date on potential elements of the statewide framework; i.e., how to transfer what has been learned with the lake pilot to other water bodies. It will discuss the concepts and provide examples without recommending specific indicators or decision guidelines. Preservation of these concepts will be useful when the SAC returns to the statewide process.

5.1	Desired Characteristics of a Framework	Concepts to address here include protection of uses, reduction of Type I/II assessment errors, considering both literature and lake-specific characteristics, and ensuring that the framework is not overly burdensome for DWR to apply.
5.2	Potential Common Elements	Discuss which elements are of the HRL recommendation are most likely to be transferable between water bodies, and which are more likely to merit reexamination on a water-body specific basis. For example, if the SAC is recommending that a seasonal average criterion be expressed and evaluated in a certain way, it is probably not necessary to reinvent that for every water body. The magnitude is more likely to need adjustment; e.g., some water bodies may be well below the HRL CHLa criterion already, and therefore require a lower target for antidegradation purposes.
5.3	Chlorophyll-a Screening Range Concept	Discuss the concept of a CHLa screening range and how it could potentially be used to facilitate the derivation of site-specific criteria by (1) limiting the range of values for consideration; and (2) focusing attention on lakes within the grey zone; and (3) streamlining criteria development for lakes outside the grey zone.
5.4	Consideration of Other Narrative and Numeric Indicators	Describe how indicators other than CHLa can be used to provide insights into use attainment and thus inform the site-specific CHLa criterion. Discuss concepts of primary vs. secondary indicators, and narrative vs. numeric indicators. This section will provide examples but make it clear that the SAC has not yet derived a detailed list of indicators with specific thresholds.
5.5	Considerations for Decision Guidelines	This section emphasize the need for a consistent and clear process for integrating the concepts discussed above into site-specific criteria. The process will not be so formulaic that it removes the need for professional judgment, but must equip DWR with a solid basis to defend its decisions without cost-prohibitive study of every water body. This section will provide examples of decision guidelines but, once again, make it clear that the SAC is not yet recommending a specific set of decision guidelines.
6	**References**	Plan to use a shared endnote library in google drive to generate references, w/ complete set of references available as pdf's in NCDP literature library

High Rock Lake Nutrient Criteria Schedule		
Task	**Date**	**Comment**
Complete development of Chla criteria	**December 3, 2018**	Draft criteria for Chla agreed to by SAC
Complete development of N criteria	**February 2019**	Draft concentration/loading rate as criteria or "action level" for bioconfirmation process agreed to by SAC
Complete development of P criteria	**February/April 2019**	Draft concentration/loading rate as criteria or "action level" for bioconfirmation process agreed to by SAC
Complete development of any bioconfirmation criteria	**April/June 2019**	Draft bioconfirmation methodology agreed to by SAC
Complete revisits of other response variables previously discussed	**June 2019**	Draft criteria for any response variables previously discussed agreed to by SAC
Draft criteria proposal documents	**August 2019**	Completion of draft documents for review by SAC
Submit final documents to CIC	**October 2019**	Final HRL criteria package submitted to the CIC

Charter
North Carolina Division of Water Resources
Scientific Advisory Council on Nutrient Criteria Development

Nutrient enrichment is one of the leading causes of negative environmental impacts to surface waters, such as algal blooms, low dissolved oxygen concentrations, fish kills, excessive growths of filamentous algae or bacteria, and generation of cyanotoxins. To better manage nutrients, the US Environmental Protection Agency (USEPA) has established a goal for states to develop and adopt nutrient criteria for all jurisdictional waters. The North Carolina Nutrient Criteria Development Plan (NCDP; June 20, 2014), which was mutually agreed upon with the USEPA, details the Division of Water Resources' (DWR) strategy to accomplish this goal. The plan includes the development of a Scientific Advisory Council (SAC) to assist DWR with the incorporation of the best available data and science to establish defensible nutrient criteria that protect designated uses and are scientifically sound. Subsequent to criteria development, a separate group of Criteria Implementation Advisors (CIC) will work with the Division to determine fiscal implications of the proposed nutrient criteria.

Section I. Establishment

The NCDP SAC will be established under the DWR. The SAC will be comprised of nine to twelve voting members appointed by the DWR Division Director. The SAC's objective will be to provide advice and recommendations to the DWR, on site specific nutrient criteria based solely on data and scientific judgments about pollutant concentrations and their effects.

The members appointed to the SAC shall be persons satisfying the qualifications as defined in Section II.A below. One USEPA representative will be asked to participate on the SAC. SAC members will serve two to three year terms and may be reappointed. The SAC shall annually vote one member as Chair and another member as Vice-chair. Members with doctoral degrees and experience in the designated fields are preferred, but individuals with significant experience and otherwise appropriate academic credentials may be considered for appointment. Additional members with comparable or complementary qualifications may be appointed at the discretion of the DWR Director.

A Criteria Implementation Committee (CIC) will work with the Division after site specific nutrient criteria have been recommended by the SAC and evaluated by the Division, to determine implementation details and fiscal implications. The CIC members shall be persons satisfying the qualifications as defined in Section III.A below. CIC members will serve two to three year terms and may be reappointed. A USEPA representative will be asked to serve on the CIC. Members with advanced degrees and experience in the designated fields are preferred, but individuals with significant experience and otherwise appropriate academic credentials may be considered for appointment. Additional members with comparable or complementary qualifications may be appointed at the discretion of the DWR Director.

Section II. Scientific Advisory Council

The objective of the SAC is to provide regional knowledge and technical guidance to the DWR during the process of developing nutrient criteria. The recommendations of the SAC will be considered by the DWR as criteria are selected.

Section II.A SAC Qualifications

The SAC shall consist of eight to ten members meeting the following qualifications:

1. A scientist with expertise in the study of nutrients in freshwater ecosystems.
2. A scientist with expertise in the study of nutrients in estuarine ecosystems.
3. A scientist with expertise in process-based and statistical water quality/nutrient response modeling.
4. A scientist with expertise in the study of fisheries and food webs in freshwater and saltwater ecosystems.
5. A scientist with expertise in freshwater and saltwater hydrology and hydraulics, including the effects of dams on water movement.
6. A scientist currently serving on the Contaminants Management Workgroup of the Albemarle Pamlico National Estuary Partnership

Section II.B SAC Duties

The SAC shall have the following duties:

1. Review and assess the quality of currently available nutrient data both nationally and regionally.
2. Identify data gaps in the scientific and technical information necessary for nutrient criteria development.
3. Recommend additional monitoring.
4. Provide regional knowledge and technical guidance to DWR to aid with development of numeric nutrient criteria.
5. Review proposed nutrient criteria, including revised chlorophyll-a criteria for new (not existing) nutrient management strategies.
6. Other duties as identified by the members of the SAC and the DWR.

Section III. Criteria Implementation Committee

The objective of the CIC is to work with the DWR on implementation options and economic feasibility of the proposed nutrient criteria. The CIC will begin collaboration with the DWR after appropriate nutrient criteria have been selected for a specific water body or water body type.

Section III.A CIC Qualifications

The CIC shall consist of four to five members meeting the following qualifications:

1. A North Carolina licensed professional engineer with expertise in nutrient abatement technologies in best available technology for wastewater.
2. A North Carolina licensed professional engineer with expertise in nutrient abatement technologies in best management practices for non-point source runoff.
3. An environmental professional with national/regional experience in linking the scientific aspects of nutrient controls, including criteria development, TMDLs, permitting and water quality management planning.
4. An economist with expertise in water quality/nutrient management.

Section III.B CIC Duties

The CIC shall have the following duties:

1. Advise DWR on the social and economic implications of implementing the proposed criteria.
2. Assist DWR with Administrative Procedure Act (APA-Rulemaking) process.
3. Other duties as identified by the members of the CIC and the DWR.

Section IV. Administration

1. The DWR will assign a staff member to provide support to the SAC and CIC. The support that will be provided includes but is not limited to the following: arranging meetings, ensuring notes are taken, distributed and made available to the public, collecting information requested by the members, ensuring requested analyses are performed and documented, maintain the web site, etc. This staff member shall not participate in the deliberations of the SAC or CIC. This staff member shall accept written comments from interested parties and disseminate appropriately.
2. Telephone or web conferencing may be conducted in lieu of meetings. Meetings may be streamed live if the technology is available.
3. Members of the SAC and CIC will be reimbursed for necessary travel (mileage) to and from meetings.

Section V. Implementation, Duration, and Frequency

1. This charter shall become effective January 1, 2015.
2. The SAC and CIC shall meet at intervals determined by the DWR-NCDP Program Manager in consultation with the members.
3. The SAC and CIC shall continue for an indefinite period of time at the pleasure of the DWR Director.
4. All meetings will be open to the public.

Designated Use Management Goals & Criteria Development Approaches for HRL				Recommended Criteria by Use & Indicator							
				DO	pH	Turbidity	Chlorophyll-a	Cyanotoxins	Clarity	TN	TP
Designated Use	**SW Class**	**Definition (where defined in rule)**	**SAC Management Goal**	**Criteria**	**Criteria**	**Criteria**	**Criteria**	**Criteria**	**Criteria**	**Criteria**	**Criteria**
Secondary Recreation	C	Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner.	**Example**: Prevent algal surface scums and dense water column blooms that may deter recreation. Prevent potentially harmful algal blooms to protect the health of recreators.	Maintain current 02B standard	6.0-9.0 vertical average within the water column where DO>=4.0 mg/L	Maintain current 02B standard	35 µg/L geomen within the growing season				
Fishing	C	Fishing means the taking of fish by sport or commercial methods as well as the consumption of fish or shellfish or the propagation of fish and such other aquatic life as is necessary to provide a suitable environment for fish.	**Example**: Ensure that nutrient levels support those species managed as a sports fishery by the NC Wildlife Resources Commisions. Minimize occurrence of algal blooms to limit bioaccumulation of cyanotoxins in fish tissue.	Maintain current 02B standard	6.0-9.0 vertical average within the water column where DO>=4.0 mg/L	Maintain current 02B standard	35 µg/L geomen within the growing season				
Fish Consumption	C	Fishing means the taking of fish by sport or commercial methods as well as the consumption of fish or shellfish or the propagation of fish and such other aquatic life as is necessary to provide a suitable environment for fish.	**Example**: Ensure that nutrient levels do not directly or indirectly impact the taste and/or odor of fish tissue or other aquatic life suitable for consumption.	Maintain current 02B standard	6.0-9.0 vertical average within the water column where DO>=4.0 mg/L	Maintain current 02B standard	35 µg/L geomen within the growing season				
Wildlife	C	Best Usage of Waters: aquatic life propagation and maintenance of biological integrity (including fishing and fish), wildlife, secondary recreation, agriculture, and any other usage except for primary recreation or as a source of water supply for drinking, culinary, or food processing purposes;	**Example**: Ensure that water quality is such that all aquatic-dependent wildlife that can reasonably be considered to inhabit HRL are able to maintain self-sustaining populations both within and downstream of HRL.	Maintain current 02B standard	6.0-9.0 vertical average within the water column where DO>=4.0 mg/L	Maintain current 02B standard	35 µg/L geomen within the growing season				
Aquatic Life including propagation, survival and maintenance of biological integrity	C	Biological integrity means the ability of an aquatic ecosystem to support and maintain a balanced and indigenous community of organisms having species composition, diversity, population densities and functional organization similar to that of reference conditions.	**Example**: Ensure that water quality is such that all aquatic, and aquatic-dependent life that can reasonably be considered to inhabit HRL are able to maintain self-sustaining populations both within and downstream of HRL.	Maintain current 02B standard	6.0-9.0 vertical average within the water column where DO>=4.0 mg/L	Maintain current 02B standard	35 µg/L geomen within the growing season				
Agriculture	C	Agricultural uses include the use of waters for stock watering, irrigation, and other farm purposes	**Example**: Ensure that algal blooms and cyanotoxin levels do not impact stock watering, irrigation, and other farm uses.	Maintain current 02B standard	6.0-9.0 vertical average within the water column where DO>=4.0 mg/L	Maintain current 02B standard	35 µg/L geomen within the growing season				
Primary Recreation	B	Primary recreational activities include swimming, skin diving, water skiing, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis.	**Example**: Prevent algal surface scums and dense water column blooms that may deter recreation. Prevent potentially harmful algal blooms to protect the health of recreators.	Maintain current 02B standard	6.0-9.0 vertical average within the water column where DO>=4.0 mg/L	Maintain current 02B standard	35 µg/L geomen within the growing season				
Water Supply	WS	Waters used as sources of water supply for drinking, culinary, or food processing purposes. These waters are also protected for Class C uses.	**Example**: Minimize occurrence of algal blooms to limit taste & odor problems and cyantotoxin production.	Maintain current 02B standard	6.0-9.0 vertical average within the water column where DO>=4.0 mg/L	Maintain current 02B standard	35 µg/L geomen within the growing season				

Nothing Compares
NORTH CAROLINA

Selected Indicator Ranges

Scientific Advisory Council

October 19, 2016

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."

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

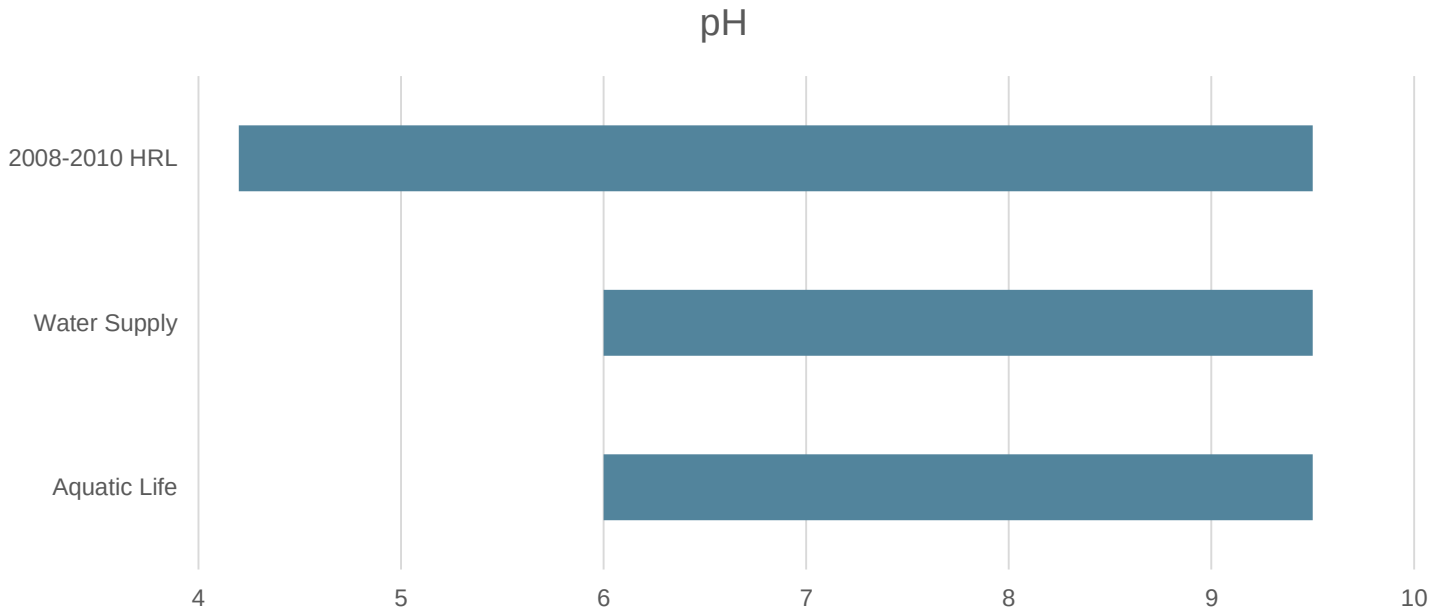
pH

Options for Frequency & Duration

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

Spatial considerations

- Current method = surface only
- May want to aggregate data from mainstem
- May want to consider different depths or zones of lake



WQ Goal	Low	High	Range	Duration	Frequency
Aquatic Life	6.0	9.5	3.5		
Water Supply	6.0	9.5	3.5		
2008-2010 HRL	4.2	9.5	5.3		3 of 3664 results < 6.0

pH Background

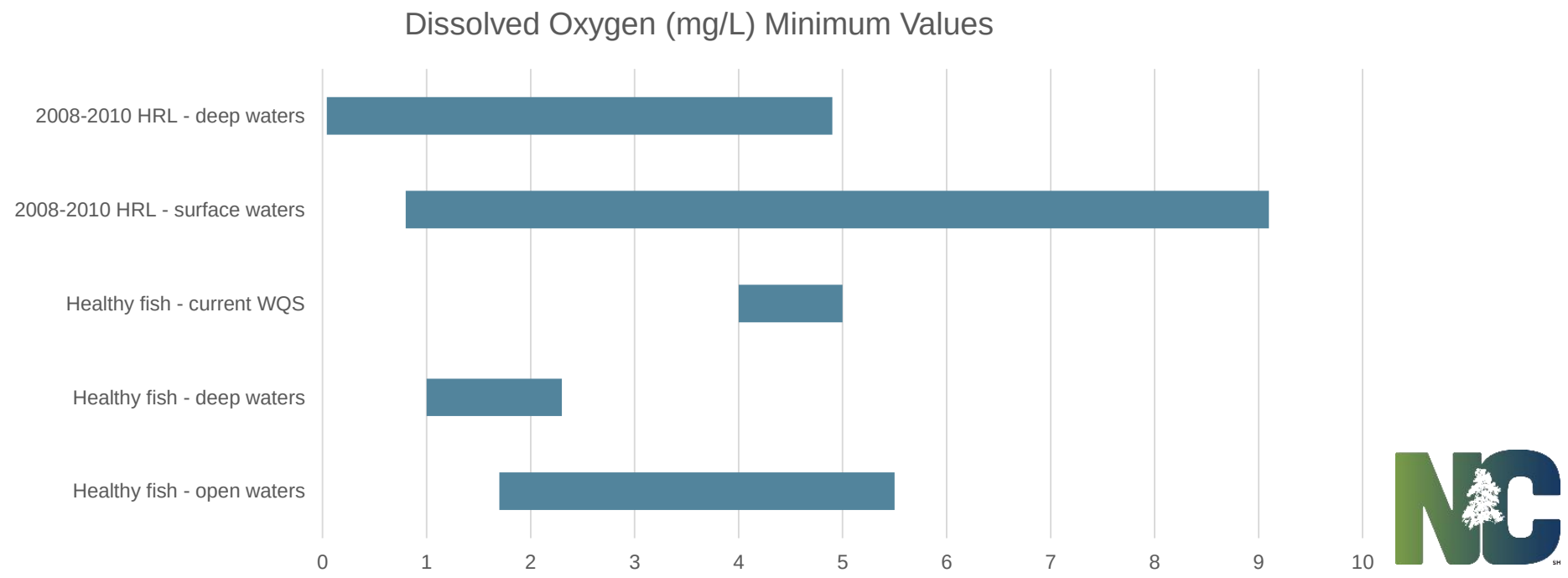
WQ Goal: Aquatic Life	Low	High	Range	Duration	Frequency	Special Considerations
Healthy fish population	6.0	9.5	3.5	Annual or seasonal 90th percentile	1 in 3 years	Assumes salmonids absent. Assumes low levels of pH-dependent toxics (e.g., ammonia). Option: Use all epilimnetic observations, not just surface.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

- Likely want to consider different depths/zones of lake
- Proposed values from Chesapeake Bay criteria, EPA Gold Book & NCDEQ WQS
- Measured values from NC DWQ & Alcoa sampling, 2008-2010

WQ Goal: Aquatic Life	Inst Min	Average	Range	Notes
Healthy fish - open waters	1.7	5.5	3.8	upper photic zone: instantaneous; 30-day mean
Healthy fish - deep waters	1	2.3	1.3	below photic zone/thermocline: instant. min to protect benthic forage base; daily avg to protect fish
Healthy fish - current WQS	4	5	1	minimum 4 mg/L; daily average 5 mg/L
2008-2010 HRL - surface waters	0.8	9.1	8.3	Sample depths <0.2 m (n=448); 2 results <5 mg/L
2008-2010 HRL - deep waters	0.04	4.9	4.86	Sample depths >5 m (n=1235); 306 results <1 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

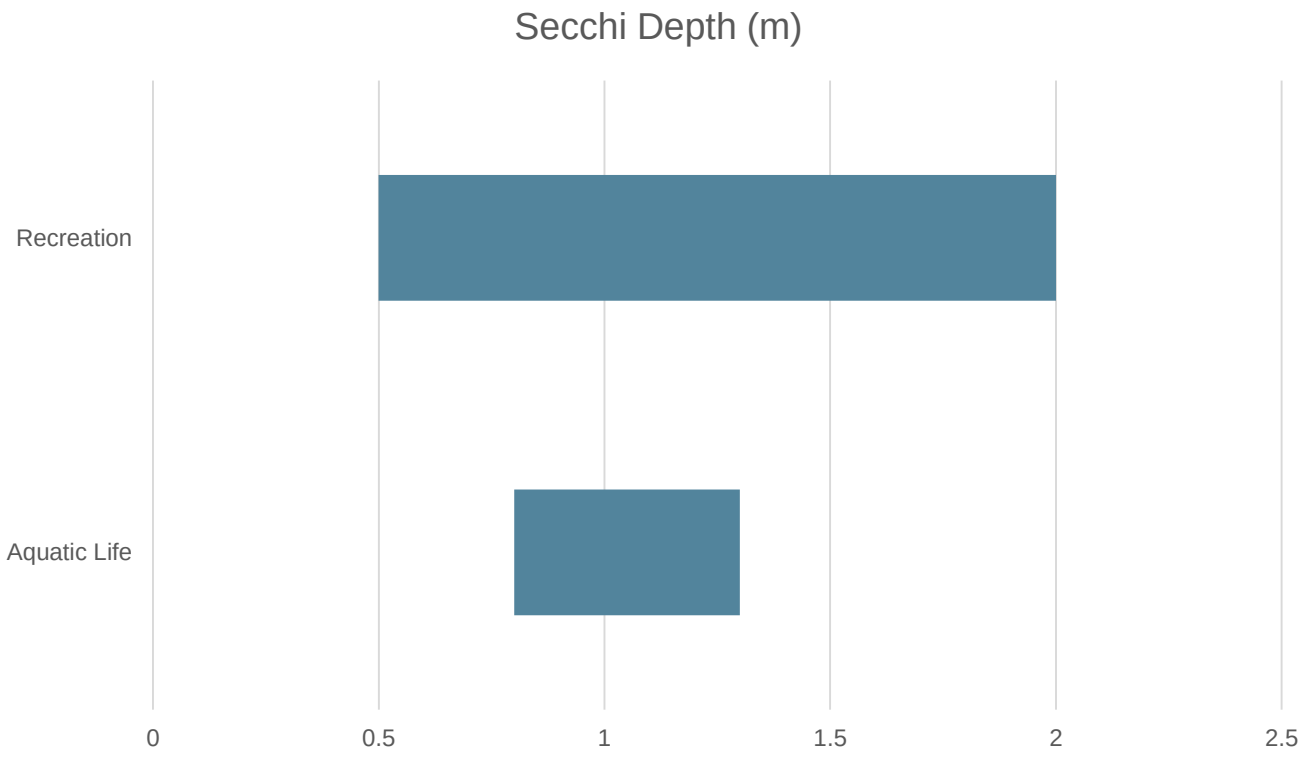
Notes: (1) low is instantaneous; high is for 30-day mean; (2) open waters is the upper photic zone; (3) low is instantaneous to protect benthic forage base; high is daily average of deep waters for protection of juvenile and adult fish; (4) deep waters below photic zone/thermocline; (5) minimum 4 mg/L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

Water Clarity

Clarity	Low	High	Range
Aquatic Life	0.8	1.3	0.5
Recreation	0.5	2	1.5

Criteria considerations:

- Determine duration & frequency protective of uses
- 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 Background

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

High Rock Lake Turbidity Criteria (link to rules)

15A NCAC 02B .0211 FRESH SURFACE WATER QUALITY STANDARDS FOR CLASS C WATERS

General. The water quality standards for all fresh surface waters shall be the basic standards applicable to Class C waters. Water quality standards for temperature and numerical water quality standards for the protection of human health applicable to all fresh surface waters are in Rule .0208 of this Section. Additional and more stringent standards applicable to other specific freshwater classifications are specified in Rules .0212, .0214, .0215, .0216, .0218, .0219, .0223, .0224 and .0225 of this Section. Action Levels for purposes of National Pollutant Discharge Elimination System (NPDES) permitting are specified in Item (22) of this Rule.

(1) Best Usage of Waters: aquatic life propagation and maintenance of biological integrity (including fishing and fish), wildlife, secondary recreation, agriculture, and any other usage except for primary recreation or as a source of water supply for drinking, culinary, or food processing purposes;

(2) Conditions Related to Best Usage: the waters shall be suitable for aquatic life propagation and maintenance of biological integrity, wildlife, secondary recreation, and agriculture. Sources of water pollution that preclude any of these uses on either a short-term or long-term basis shall be considered to be violating a water quality standard; …

(21) Turbidity: the turbidity in the receiving water shall not exceed 50 Nephelometric Turbidity Units (NTU) in streams not designated as trout waters and 10 NTU in streams, lakes, or reservoirs designated as trout waters; for lakes and reservoirs not designated as trout waters, the turbidity shall not exceed 25 NTU; if turbidity exceeds these levels due to natural background conditions, the existing turbidity level shall not be increased. Compliance with this turbidity standard can be met when land management activities employ Best Management Practices (BMPs) [as defined by Rule .0202 of this Section] recommended by the Designated Nonpoint Source Agency [as defined by Rule .0202 of this Section]. BMPs shall be in full compliance with all specifications governing the proper design, installation, operation, and maintenance of such BMPs;

2016 303(d) Listing Methodology (EMC approved May 2015) (link to full document)

1. ASSESSING NUMERIC CRITERIA

The following sets of evaluations will be used for the 2016 assessment for these parameters: chlorophyll-a, dissolved oxygen, MBAS, mercury, nitrate/nitrite, pH, temperature, toxic substances, and turbidity. For each parameter there is a brief discussion of the standard used for assessment of the parameter including any parameter-specific good causes for not assessing in Category 5.

The true frequency of criteria exceedances cannot be measured. It must be estimated from a set of samples, which introduces statistical uncertainty. The degree of uncertainty depends on the sample size. NC will use a nonparametric hypothesis testing approach based on the binomial distribution. The binomial method allows a quantifiable level of statistical confidence (90%) for listing decisions, which provides a 10% probability of listing an assessment unit when it should not be listed. The null hypothesis is that the overall exceedance probability is less than or equal to the 10% exceedance allowance.

- Exceeding Criteria-Category 5
    - Greater than 10% exceedance with greater than or equal to 90% confidence

- Sample size is greater than nine.

The standards (criteria) and additional considerations are included for each parameter as applicable….

TURBIDITY (AQUATIC LIFE) CRITERIA The turbidity criteria are 50 nephalometric turbidity units (NTU) for freshwaters, 25 NTU for reservoirs and estuarine waters, and 10 NTU for supplemental classified Trout waters.

EPA's REVISED Recreational AWQC/SA Recommendations

Application of Recommended Values	Microcystins			Cylindrospermopsin		
	Magnitude (µg/L)	Duration	Frequency	Magnitude (µg/L)	Duration	Frequency
Swimming Advisory	**8**	One day	Not to be exceeded	**15**	One day	Not to be exceeded
Recreational Ambient Water Quality Criteria		1 in 10-day assessment period across a recreational season	More than 3 excursions in a recreational season, not to be exceeded in more than one year[b]		1 in 10-day assessment period across a recreational season	More than 3 excursions in a recreational season, not to be exceeded in more than one year[b]

[a] These recommendations can apply independently within an advisory program or in WQS. States can choose to apply either or both toxin recommendations when evaluating excursions within and across recreational seasons.
[b] An excursion is defined as a 10-day assessment period with any toxin concentration higher than the criteria magnitude. When more than three excursions occur within a recreational season and that pattern reoccurs in more than one year, it is an indication the water quality has been or is becoming degraded and is not supporting its recreational use. As a risk management decision, states should include in their water quality standards an upper-bound frequency stating the number of years that pattern can occur.