NC Nutrient Criteria Development Plan – Scientific Advisory Council (SAC)

3/28/2018

Attendees

SAC members in attendance:

Lauren Petter
Bill Hall
Linda Ehrlich (online)
James Bowen
Clifton Bell
Astrid Schnetzer
Marcelo Ardon
Michael O'Driscoll
Martin Lebo
Drew Long (alternate for Linda)
Nathan Hall

SAC meeting facilitator:

Andy Sachs

NCDEQ DWR staff in attendance:

Jim Hawhee
Tammy Hill
Jeff Manning
Connie Brower
Christopher Ventaloro
Bongghi Hong
Nora Deamer
Brian Wrenn
Mike Templeton
Raj Rajbhandari
Bridget Flaherty
Jing Lin

Criteria Implementation Committee (CIC) members in attendance:

In person:

Andy McDaniel
Anne Coan
Doug Durbin

Participating audience members:

Jay Sauber

Meeting materials can be found on the Division of Water Resources Nutrient Criteria Development Plan Scientific Advisory Council webpage. Click here for a direct link.

Meeting notes

All questions, comments and answers are paraphrased

1. **Convene** (Andy Sachs, Brian Wrenn)
    a. Administrative business

i. Request comments on meeting notes from previous meetings.
   1. Bill H.: (to Clifton) Want clarification on Clifton's pH proposal. Did your pH proposal include a one-hour averaging period? Was the intent to use the assessment evaluation that the state normally uses (>10% exceedance with 90% confidence)?
      - Clifton B.: Proposed as a one-hour median. Intent is to use the current sampling and assessment methodology, but does not specifically call for continuous monitoring. It can be just one sample.
      - Bill H.: I have concerns that this can lead to one sampling event resulting in non-compliance.
   2. Marcelo A.: On page 4 and 5, check comment assigned to Bill where he states that "a pH of 9.0 is well below what we see in the lake when we look at instantaneous pH values".
      - Bill H.: I don't think I said that. The extrapolation part was related to the ammonia criteria which is bounded by a pH of 6.0 and a pH of 9.0.
      - Brian W.: I had to read that more closely as well and what it's saying is that the upper end of pH range for which EPA had data to determine the ammonia criteria, which is 9.0, is well below what we see in the lake. We can clarify in the notes.
   3. Bill H.: See page 9, section 5(A)(ii), check where it says Clifton stated that few algal blooms occur in HRL.
      - Clifton B.: The point that has been made numerous times is that algae is well dispersed in the water column in HRL and we don't see a lot of nuisance scums. That's the point we made.
   4. Bill H.: See page 11, section (C)(5), it says "what we don't know". It should say "what we know".
   5. Nathan H.: In that same section, where it says "cyanotoxins have not been observed", should add "in high concentrations".

2. **Staff updates** (Brian Wrenn, Pam Behm)
   a. APNEP Indicator and Assessment (Brian Wrenn)
      i. See presentation slides
      ii. APNEP workgroup had recent discussion on appropriate nutrient indicators and assessment methodologies for the Albemarle Sound.
      iii. APNEP efforts regarding nutrient will eventually be merged with the NCDP SAC efforts.

iv. Important to note that APNEPS assessment of the Albemarle has not been from a regulatory perspective. It has been from the perspective of assessing the quality of the Sound.
v. There are three main goals identified as part of the assessment of water quality in the Sound:
    1. Human communities
    2. Habitat support
    3. Water quantity and quality
vi. The indicator list is pretty much set, but there are indicators that don't match up with what DEQ does as part assessing water body health.
vii. Another item of note regarding these goals, there is no specified spatial component to dictate how the goals apply. Do they apply to the entire Sound or maybe to a watershed?
viii. Also, there are questions as to how we are grading the system? Is it based on water quality standards? Are we going to come up with some different assessment qualifications or metrics?
ix. Comments/questions:
    1. Clifton B.: Is submerged aquatic vegetation (SAV) considered?
        - Brian W.: There is a separate workgroup focusing on biological indicators that will consider this. There was some talk of SAVs, but they were mostly looking at primary indicators.
    2. Nathan H.: Are they looking at fishery landing data to evaluate the health of the fisheries?
        - Brian W.: Not sure. The people who have been involved has varied over time. There have been fisheries people involved, but I'd have to look back at the notes to see if this information has been considered. Part of this is also considering what data sets we can use so it's a good question. DWR may have a lot of this information, we are not the only source of information out there. How we may utilize data from other sources is something to be considered.
    3. Bill H.: Will this information be used for implementation purposes?
        - Brian W.: This information is not meant to be used for regulatory purposes. The official list of indicators is in another document that the group produced. The table I have here is just a summary I put together. We can provide the full document.
    4. Mike O.: One of the challenges in the coastal areas is that USGS will stop getting discharge data when there is tidal influence. If there's an effort to monitor places it would be helpful to have flow data collected for areas with low flow rates.

- Brian W.: I can take that back to the group to see if anyone is doing that work. We have been mostly looking at what data is currently available.

b. White Lake fish kill/algal bloom (Brian Wrenn)
   i. See presentation slides
   ii. Recent event that DWR has been involved in. White Lake is a state park in Bladen County. It is a Carolina bay lake with a small watershed. The lake itself is part of the park, but the shoreline is not and is built out with homes.
   iii. The lake had traditionally been primarily groundwater fed and had low pH (~5 S.U.), TKN and chlorophyll-a.
   iv. Around 2014 the lake started to experience eutrophication impacts including decreased Secchi depths and a change in algal community and the public began to complain.
   v. A DWR study of White Lake was done in 2017. It found that the artesian aquifer flows that had once been the dominant mechanism in maintaining stability in the lake have decreased. This has resulted in surficial groundwater becoming the driver of lake hydrology resulting in an increase of nutrient loading. Blooms occurred frequently and were persistent being observed throughout the winter months.
   vi. Phytoplankton has shifted from being primarily benthic species to cyanotoxins. The predominant species in the lake is not associated with toxin production. Hydrilla dominates the lake with 80-90% coverage.
   vii. A TAC was developed to address the issues in the lake. Alum identified as a short-term treatment method.
   viii. A pesticide permit was issued to address the phytoplankton blooms and an alum treatment was administered starting on May 3rd, 2017. The alum used was aluminum sulfate and sodium -aluminate. 50% of the lake was treated.
      1. A fish kill occurred on the same day following the alum treatment. Multiple thousands (later estimated at 115, 000) of dead fish were reported by the NC Wildlife Resource Commission.
      2. Pre-treatment monitoring showed the typical high pH and high DO saturation associated with bloom conditions.
      3. Fish necropsy concluded combined effects of rapid water chemistry changes and acute alum exposure was to blame for fish kill. Physical geography of lake may have played a role. The lake is shallow (~10 feet at deepest) resulting in no deeper waters for fish to escape to.
      4. Official DWR conclusion is that multiple stressors led to fish kill.
   ix. Comments/questions:
      1. Astrid S.: Was algal toxin testing performed?

- Brian W.: Microcystin samples were taken, but the results are not in yet. Algal composition analysis did not suggest typical toxin producing species present.

2. James B.: When was the alum treatment applied? It is usually done in the off-season when it is cool and dark. Was there guidance for when might be best to apply?
    - Brian W.: The treatment was applied on May 3rd and was driven by concerns for the tourist season.
3. Mike O.: Is there any information on the groundwater usage in the area over time? When we looked at groundwater use in the coastal plain, Bladen County was the biggest user.
    - Brian W.: There is a large draw from the aquifer. Many blueberry farms. UNCW is currently working on a groundwater study. There is also a high residence time in the aquifer.
4. Bill H.: What was the pH following the alum treatment?
    - Brian W.: The pH was between 8.0 and 9.0 immediately following treatment and continued to drop. It is now down to about 6.
5. Clifton B.: Were fish kills reported prior to the alum treatment and could this water body be listed as impaired?
    - Brian W.: We have no documentation of fish kills occurring prior to treatment. White Lake would be listed as impaired based on chorophyll-a. Chlorophyll-a values up to 50 have been reported. We are planning to monitor the lake again this year.
6. Jay S.: Want to add some clarity. For about the past 50-years, benthic filamentous algae have dominated the lake. Benthic algae have been displaced due to boat traffic raising aesthetic concerns. In recent years the algal population has shifted and is now dominated by water column dwelling species. We don't know exactly why the alga community shift has occurred.
7. Nathan H.: Are the surrounding homes on septic systems or are they part of a sewer system?
    - Brian W.: The homes are connected to a secondary treatment system, though the system is old and about 30% of the existing pipes are clay pipes.
8. Clifton B.: This might be a good test case for using a narrative assessment as part of determining if water body is impaired. You can build a case on the big shifts in the status of the lake.
    - Brian W.: We talk a lot about showing impacts to uses. When the water turned green in White Lake, there was public outcry. People

did not want to recreate. This serves as a good example of a documented impairment of primary recreation.

9. Bill H.: What were the chlorophyll-a levels at the time of the alum treatment?
    - Brian W.: I'm not sure if we have gotten the pre-treatment data yet. September was in the mid-50s (ug/L) and we did not see a noticeable decline in chlorophyll-a concentrations over the winter. The contractor who administered the alum treatment is doing post-treatment monitoring today. We know that the nutrient inputs have not been reduce so we are waiting to see how long it takes for the system to revert to its pre-treatment state.
10. Andy M.: I was called out to look at this lake. We found several ditches that fed the lake. It is not entirely groundwater fed. There was also a tremendous rainfall that summer. Also, was told that there was an outflow to the lake that had been altered.
    - Brain W.: There is a weir.
11. Bill H.: What were the phosphorous and nitrate levels over time?
    - Brian W.: Increasing trend over time. Ammonia is still low. We can send this data out.
    - Jay S.: Nutrient levels don't tell us much due the past dominance of algal mats. They acted as nutrient sinks.
12. Mike O.: Is there information on atmospheric deposition?
    - Nathan H.: The monitoring station in Clinton shows decreases.

3. **Assessment Method Changes** (Pam Behm)
    a. See presentation slides
    b. Changes were made in response to EPA's concerns with the 2016 303(d) impaired water bodies list.
        i. Changes were narrow in scope.
        ii. Desired outcome: EPA approves 2018 303(d) list in a timely manner.
    c. History
        i. 2014 list
            1. Added statistical confidence, did not apply confidence criteria for delisting.
        ii. 2016 list
            1. Received partial approval from EPA in December of 2016.
            2. Three areas of disapproval:
                - Delisting water for non-toxic pollutants when there is low confidence that waters are meeting criteria.
                - Assessment of small data sets.
                - Assessment of metals.

d. Delisting
    i. NC method did not address delisting of waters once they were on the 303(d) list.
    ii. Some waters were delisted when there was low statistical confidence.
    iii. EPA approved of some delisting where "good cause" was demonstrated.
    iv. NC should use the same 90% confidence requirements that are used for listing.
    v. Action: NC review delisting procedures of other states that use binomial assessment methods and developed a delisting plan. See slides for examples.
e. Small data sets
    i. NC methodology limits assessment to 5-year window and a minimum of 10 samples.
    ii. Issue mostly impacts lakes & reservoirs as they are typically only sampled once per year.
    iii. EPA proposed listing 11 waters where there were three excursions, but did not take final listing action.
    iv. Action: NC developed a process in 2018 for augmenting small datasets. See slides for examples.
f. Summary of updates to 2018 303(d) listing and delisting methodology:
    i. Data window updated to be from 2012-2016
    ii. Added delisting language
    iii. Added process for small datasets
    iv. Updated methods for numerical assessment
    v. Approved by the Environmental Management Commission in March of 2018.
g. Comments/questions:
    i. James B.: (Re: small datasets example on slide #7): Lumping the sampling stations might be better in HRL as it would provide a more accurate representation of the system.
        1. Pam B.: That would require a total change to our process. We're not really looking to do that without some good cause. You might end up calling an entire water body impaired when it might not be.
        2. James B.: But it sort of fits with what we've been talking about with HRL. That there isn't necessarily an argument from the system standpoint to call every station its own unit. We talked about it making sense to combine riverine and upper, middle and lower portions of the lake. It recognizes that the peak might move around and that combining the stations might provide a better understanding of central tendency.
        3. Nora D.: Combining the stations would result in all the stations being averaged into one value. "N" would still be 1.
        4. Pam B.: There are a bunch of questions that come up when you start talking about lumping data.

5. Nathan H.: I spoke to someone at DWR about this once and they mentioned how some of these assessment units are really some depending on the parameter being considered. (fecal coliform, for example)

ii. Nathan H.: Current delisting requires 40% confidence that it is now meeting criteria? Is that correct and how was the 40% decided?
   1. Pam B.: Sort of. (Refers to slides). If we don't have greater than 10% exceedance then we are looking at new data years and we are looking at confidence of meeting the criteria (the 40%). The 40% came from a combination of looking at other states and at the natural breaks in our data. The other pathway for delisting is if we have >10% exceedance, but we don't have 90% confidence. What we propose to do is to look at the new data years and if we have at least two exceedances we will leave it on the 303(d) list. So, it will be a combination of looking at new data years and using that 40%.

iii. Bill H.: So, if we recommend a seasonal chlorophyll-a criterion that is going to result in an N of 1 per year.

iv. Clifton B.: But there's a different approach. We'll talk about this when we discuss our chlorophyll-a proposals, but there is an approach to use data from multiple years.

v. Pam B.: And the greater than 1-in-3 frequency is going to be a bigger issue.

vi. Doug D.: When a water body is delisted what happens if there is a TMDL in place?
   1. Pam B.: The TMDL remains in place.

4. **pH Memo and Confirmation of Decisions** (Brian Wrenn, SAB members)
   a. Regarding the pH memo that was sent out to the SAC members
      i. The pH memo has been sent to everyone.
      ii. Goal is to provide a clear summary of the history and decision points related to the SAC decisions regarding the pH proposals.
      iii. Want SAC members to confirm their earlier voting decisions so that we all agree on where we are going with the process:
         1. Two proposals going forward
      iv. There was some confusion regarding previous votes that the SAC took when making decisions on different aspects of the pH proposals. Want to set the record straight so that we are all on the same page moving forward. Some straw polls were used to remove information from further consideration.
      v. We had 10 (got final response via email just before the meeting) out of 11 SAC members responding to the memo:
         1. 8 SAC members agreed with the pH proposals from Bill H., Clifton B., and Lauren P. moving forward for consideration.
         2. 2 SAC members disagreed.

3. 1 SAC member did not provide a response (final response agreed with decisions made).

vi. According to the SAC procedures, a 70% super majority (at least 8 members) is required to pass any votes. This has been achieved.

vii. The pH proposal as written will be forwarded to the CIC.

viii. Those SAC members that disagree with the results of the vote may submit a minority report. This does not need to be vetted by other SAC members and will serve to document the concerns of those members with the minority vote.

b. Comments/questions:

i. James B.: Can we clarify the voting rules? Do we only count the vote of those members that are present during the meeting?

1. Brian W.: We are hesitant to limit the voting power of members as we are juggling eleven different schedules and not everyone can make it to every meeting.
2. Jim H.: My recollection of this was that we count the votes of all members, not just those present at a particular meeting. I'll check the minutes on this.

ii. Clifton B.: The CIC should still consider the existing pH standard when comparing the implementation of the SAC pH proposals. This may help to comfort those SAC members who were concerned.

iii. Brian W.: We will continue to use straw polls for gauging the mood of the group, but we will use official votes if we are going to drop anything. Also, want SAC to think about how the response variables relate to the causal variables. How does a 9.5 pH relate back to developing total nitrogen and total phosphorous criteria?

iv. Bill H.: Just want clarity on Clifton's proposal. How does a 1-hour average fit in with the assessment methodology?

1. Clifton B.: It's the same as any other acute criterion. There is the option to do 1-hour of sampling, but it can also just be a single grab sample.
2. Bill H.: Typically, sampling is done as a grab sample. If it comes up as a pH of 9.6, is that a violation?
3. Clifton B.: That one sample would not determine a violation. The data would need to go through the assessment process. The 1-hour average is there to use if more data is available.

5. **Chlorophyll-a discussion** (Andy Sachs, SAB members)

a. See the chlorophyll-a proposal summary table

b. Synopsis of proposals

i. Clifton Bell's proposals:

1. Proposal CB-1:

- Proposed chlorophyll-a magnitude = 40 ug/L

- Literature suggests a range of acceptable chlorophyll-a concentrations (20 ug/L to 40 ug/L) based on various uses.
- Proposal serves as a compromise between information gathered from the scientific literature and the apparent lack of observed adverse impacts to the designated uses in HRL.
- High Rock Lake should be at the high end of this range. This would bring chlorophyll-a levels down from existing conditions of around 50 ug/L.
- Proposal is for a seasonal (April-October) geometric mean. Should have data from at least five months over the season.
- Frequency is not to be exceeded more than once in three years based on application in other states (mainly Florida). Based on a long-term perspective that if the lake is where we want it to be for at least two out of three years we have good statistical confidence that we are protecting the uses. This does not appear to be compatible with DWR's current monitoring and assessment methods as data for smaller lakes/reservoirs may limited.

2. Proposal CB-2:
    - Provides more of a statistical approach
    - Proposed chlorophyll-a magnitude = 40 ug/L
    - This more closely follows the state's current assessment methodology.
    - Meant to a seasonal (April-October) geomean assessed over multiple years. Lumps data from multiple years. Can be used in conjunction with statistical tests to determine if criteria are being met. Could use 90th percentile. May want to investigate this further.
    - At least ten data points are needed for assessment for at least two years.
    - Uses the data for each year, but averages out the outliers.
3. Comments/Questions on Clifton's proposals:
    - Lauren P.: You said multi-year assessment would be done over a 2-year period. Would the criterion still be 40 ug/L?
        i. Clifton B.: In CB-1, the break you get is that you don't have to meet the criterion every year. You toss out the highest year. In CB-2, you average out the data from each year and the break you get is that you are averaging out some of the variability. I don't think either approach is more stringent.

The percentile chosen might play into how the final magnitude is decided.

- Connie B.: When you said that "HRL should be at the high end" did you mean the lake itself should have a chlorophyll-a level at the high end of the range or that the criteria should be set at the high end of the range?
    i. Clifton B.: The site-specific criteria should be at the high end of the subjective range that we select for HRL.
- James B.: How does the averaging work with the statistical component?
    i. Clifton B.: Probably wouldn't be a binomial test anymore. Choices would be to not apply any kind of statistics and we just decide whether we are above or below a criterion. This would be ok because we are using a lot of data. If we did apply a statistic test it could be something as simple as a confidence interval on the geometric mean. I calculated some of these confidence intervals for station 152C in HRL and I can show everyone that if there is interest.
    ii. James B.: You're also combining all data from and assessment unit, but do you specify what the assessment unit is? Is it multiple stations?
    iii. Clifton B.: Part of the proposal was to consider aggregating sampling station that are in similar areas of the lake. I still support that. Proposal CB-2 is my choice to move forward.
- Lauren P.: There is a lot of averaging and lumping together of things in these proposals. Concerned that these proposals are more driven by trying to make sure the 40 ug/L can be met via assessment as opposed to what chlorophyll-a criteria is appropriate to protect the uses.
- Bill H.: If using a geomean, not sure that the 90% confidence fits. There may not ever be enough data.
    i. Clifton B.: I have similar concerns, but in proposal CB-2 it should not be a problem.
- Bill H.: RE: 1-in-3 assessment component, if the state has sufficient data it should not be a burden for the state to do this. Most states can't do this. The way it is done now is that impairment is assumed if a number is exceeded. Need to look at the available data to see how the proposal fits.
    i. James B.: So, if you only sample once every five years and you find a violation, it's not once in every three, so you're

good and you wait another five years…that's not what you mean, right?

ii. Bill H.: No, if there's not enough data that doesn't mean the lake passes. You look at the data you have. If I have a year of data, where does that fit in? If you're sampling once every five years it's probably not appropriate to consider 15-years of sampling to getting three points to determine a one-in-three exceedance. I'm still limited to considering a five-year period.

iii. James B.: I take that as it would take three to prove that you are not violating. You would need two good years to go with the one bad year.

iv. Bill H.: If you had an exceedance in one year, and that's all the data you have, there is a violation. If you have more data you can use the one-in-three as a basis for saying you're meeting/not-meeting criteria.

v. Jim H.: Still trying to make sense of what Pam said. Regarding the nutrient management strategies, if/when a HRL management strategy is developed, want to think about the uncertainty associated with these proposals for listing/de-listing. We may not be able to get to a point where we have enough confidence to remove lakes from the list. Want to make sure that any criteria that we pick have enough confidence to allow us to de-list waters.

1. Pam B.: If a nutrient strategy is in place and it is equivalent to a TMDL, the lake will be de-listed. How we consider if the lake is impaired after the strategy may be where this discussion comes into it.

- Marcelo A.: Regarding the 40 ug/L, you said that would bring the lake down from where it is now. However, if using the 40 ug/L as a geometric mean, you would actually be raising the standard from what it is now.

i. Clifton B.: I was referring to the conditions in the lake as they are now. HRL would still not meet a geometric mean of 40 ug/L. If it is above the 40 ug/L it will still be considered impaired, but this way also incorporates other indicators such as clarity and potential for toxin development. I'm not entirely satisfied with this approach, but it does represent a continuum of risk.

ii. Bill H.: I'd add the caveat that detailed studies have shown no impairment of uses. In comparison, the situation at White Lake is a good example of how high chlorophyll-a concentrations caused clarity issues that resulted in an aesthetic impairment of the uses of the lake.

ii. Lauren Petter's proposal
    1. Used different lines of evidence to maintain consistency.
    2. Tried to bring in efforts from other states.
    3. Used literature and site-specific criteria and modelling.
    4. Developed a criterion of 30 ug/L to bring the lake toward its natural condition which we had some information for.
    5. Used arithmetic mean and a seasonal component, though this does not need to be a strict requirement. Does not need to be sampled each month during the season.
    6. Comments/questions on Lauren's proposal:
        - James B.: How are you interpreting the 1-in-3?
            i. Lauren P.: You would look at the data record for any years that you are able to compute a season mean. If you only had one year of data within the 5-year assessment period, if that's exceeding that's not enough to list because you get one year to exceed. There can be a fluke year. Like Bill said, for nutrient we're more concerned with it exceeding regularly. It can encourage the state to do additional monitoring, but wouldn't result in a listing on its own.
            ii. Clifton B.: What if there were two 5-year periods with a year of data each and both exceeded?
            iii. Lauren P.: I think you would look at when the exceedances occurred. The state may need to use some judgement. If they were far apart from one another it may not make sense to consider it an impairment.
        - Jim H.: How would something get off the list?
            i. Lauren P.: Based on how it's been done in other states there needs to be more than three years. When states have enough data to have three years in a row it rolls into the next three years. To get it delisted you may need another year of data or more depending on where in the cycle the exceedance occurred.
            ii. Bill H.: Florida adopted lake nutrient standards using the 1-in-3 frequency. Do they always have three-years of data?

iii. Lauren P.: They have many lakes so I'm not sure in every case, but for the main lakes they were concerned with they do have adequate data.

- Bill H.: Regarding the levels of risk for cyanotoxin production listed in Lauren's proposal, low risk is presented as being <10 ug/L microcystin and medium risk as being 10-20 ug/L. Those are high level of microcystin. Are these levels appropriate?
    i. Lauren P.: The risk levels we taken from the World Health Organization (WHO) guidelines. Based on the WHO information a microcystin concentration of 10 ug/L compared to chlorophyll-a levels of about 30 ug/L. This isn't perfect, but it is something we can discuss further to make sure we establish a more defensible criterion.
    ii. Bill H.: If there is specific data from the lake that indicates that microcystin levels are low, would that be grounds to adjust the proposed chlorophyll-a criterion?
    iii. Lauren P.: You would need comprehensive data to establish that relationship.
    iv. Bill H.: Using copper as an example, if you can demonstrate that it is in a non-toxic form, you can have a less stringent site-specific standard.
    v. Connie B.: How would that apply to microcystin and chlorophyll-a?
    vi. Clifton B.: If we were able to show that microcystin in the lake was consistently low, we could use that as a justification for establishing a higher site-specific chlorophyll-a standard assuming the standard was based solely on cyanotoxin risk.
    vii. Lauren P.: Toxin production is not the primary driver, it is just one of the drivers.
    viii. Astrid S.: If there is high algal biomass there is always a greater risk of cyanotoxin production.
    ix. Bill H.: What is the risk that you are judging then?
    x. Astrid S.: You would never be able to prove there is no risk of toxin production.

iii. Bill Hall's proposal:
    1. Proposal is similar to Clifton's proposals.
    2. Should be allowed to modify the criteria if it can be shown that impairments are not occurring.
    3. Comments/questions on Bill's proposal:

- Connie B.: What is your view of impaired?
    i. Bill H.: There are defined uses and ways to assess how things are being impaired. For HRL, aquatic life is not impaired based on what we know about the health of the fishery. Other states might use a biological index to assess aquatic life, but we don't have that information available. We don't have a good way to assess recreation, but we know that people are recreating in the lake.
    ii. Connie B.: The Yadkin River Keeper did discuss that there have been concerns from the public. You seem to be suggesting that we should need to see impairments before we can regulate. How do we draw that line?
    iii. Bill H.: I didn't say that we need to see fish dying to develop criteria. If there is a fish kill we need to determine if it is related to nutrient levels. For recreation, we haven't heard about people not being able to use the lake.
    iv. Connie B.: My concern is understanding how to convey this to the Environmental Management Commission. It has been repeatedly stated by some SAC members in these meetings that there is no problem in the lake. If there isn't a problem we wouldn't be here or we wouldn't need to take some much time to address this. You said that if there is a fish kill we would then need to establish what the nutrient related issues were, but you have repeated that chlorophyll is not related to nutrients. We need to understand how this ties into coming up with numbers for criteria. At what point are we saying that this trigger (fish kills) is tripped and how does it tie to nitrogen and phosphorus? I'm not hearing that part and I want to make sure that we're heading towards what we came here to do which is to develop nutrient criteria for nitrogen and phosphorous.
    v. Bill H.: (To Clifton) If you look at the NCDP it says that we need to make a linkage between nutrients and the intermediate effects and end uses. Usually you have to start with an endpoint as a target. Using recreation as an example, maybe set an endpoint based on Secchi depth. That can be related back to chlorophyll which can be related back to nutrients. Until there is a target it is hard to come up with a chlorophyll number. From Clifton's

proposal, we picked 40 ug/L, but what is the linkage between the 40 ug/L and the loss of a designated use? How would the 40 ug/L relate to the Secchi depth (from example above) that would determine that the recreation use is impaired? We haven't done that work. I care about being able to demonstrate where the impairment is and then being able to select the criteria that relates to the actual impairments.

vi. Clifton B.: You do provide a number with a caveat that you need to demonstrate impairment.
vii. Bill H.: Just as a hypothetical situation, let's say that the lake has a chlorophyll-a concentration of 35 ug/L. Under Clifton's proposal, you would do a study to see if there are impairments to determine where in that range of 25-40 the appropriate criteria would be.
viii. Brian W.: Do any of these proposals have a list that would point to how specific numbers are to be chosen? What types of information would you need to see to determine if you can go above 40 ug/L or below 25 ug/L in Clifton's proposal, for example? How would this be determined?
ix. Clifton B.: You do provide a number (40 ug/L) and it also says that if the number is exceeded a use impairment needs to be demonstrated. The burden of proof is in demonstrating there is an impairment vs. needing to demonstrate that there is not an impairment with my proposal.
x. Bill H.: The number isn't what's important, being able to demonstrate a connection to the use is important. If someone can provide information that there are no use impairments would that be enough to allow the use of a more relaxed site-specific criterion?
xi. Pam B.: I don't know what that would look like.
xii. Bill H.: I don't either, but using Clifton's proposal, there is a range for chlorophyll that depends on an undefined narrative assessment to determine the correct number that will serve as the criterion. Most of the waters of the state will fall in that zone. I just want to extend that to apply to waters that are exceeding the 40 ug/L (or 30 ug/L in Lauren's proposal) if it can be confirmed that there are no use impacts.

xiii. Pam B.: If the standard is meant to be protective of the uses, should you be able to document an impact before you take some kind of management action? Where do you draw that line?

xiv. Bill H.: Let's say that there is a lake that has a chlorophyll of 35 ug/L Under Clifton's proposal we need to do an assessment to determine if there are impairments we can identify. If you provide the assessment and show no impairment then that position becomes the criterion for that lake?

xv. Clifton B.: It can be set within that range.

xvi. Bill H.: But if you observed at 35 ug/L and documented no use impacts you wouldn't then set it at 40 ug/L.

xvii. Clifton B.: You may want to take an antidegradation approach and say that you want to maintain the lakes water quality.

xviii. Bill H.: If doing that kind of assessment why can't you do it at a higher level?

xix. Connie B.: With the objective of hitting a level where someone would say that there is an impairment? If the proposal is 25-40 ug/L and we have evidence that the lake is at 23 is that where you set the level or do you set it at 25 ug/L? I'm struggling to understand this. Why would we bother to establish a number if we only need to show that people are swimming and drinking and that fish are ok? Where does the burden lie? The opposite is that we wait until people are complaining or we see fish kills and then say "Oops, we missed. The number is too high". When do we say that we have enough to make a decision?

xx. Bill H.: The intent is to not let the conditions get worse. If the existing chlorophyll-a condition is above 40 ug/L, but it is demonstrated that no impairments are occurring, do we need to meet 40 ug/L? If you're below 40, you do that assessment anyway. You would then set that as the number (provided there were no impacts).

xxi. Lauren P.: I'm concerned about dealing with something that might occur in the future. HRL is also listed for pH, turbidity and DO which are companion impairments that occur when a lake is enriched. We are not hearing a quantitative alternative that helps demonstrate other

things beyond the existing DO, pH, turbidity and chlorophyll impairments. We keep getting back to the preventative nature of what we are talking about. There is always the ability to develop another number for some other lake that we feel is not protected by some standard we suggest here. There's a suggestion for additional factors to show impairment when we already have the current impairments (DO, turbidity, pH, chlorophyll) providing that information. To discount that information to look for other information is where the disconnect is.

xxii. Astrid S.: We can see already that there are red flags. Are people ok with that? It is a working system right now, but can easily reach a tipping point. The demands on the lake may also change over time. For example, more people may want to draw drinking water.

xxiii. James B.: The issue is risk. The fact that there is not a negative outcome right now is ok. We don't want to see impacts. Can we come to an agreement on a number if we can tie it to a particular risk?

- Jim H.: Can you describe what you mean concerning magnitude in the last paragraph of your proposal?
  i. Bill H.: Between the 25 and 40 ug/L range you don't know what the value is. The state would need to assess conditions in the lake to determine the appropriate value to use. This would be easier if the state has a system in place to do this. Biological assessment might be a possibility, for example.
  ii. Astrid S.: We already have an existing chlorophyll-a standard. We are looking at additional information to determine if that needs to be changed.

iv. Existing chlorophyll-a surface water quality standard
  1. The existing standard is 40 ug/L as a not-to-exceed value.
  2. It was originally intended to be a seasonal average, but that language was not adopted by the Environmental Management Commission.

c. Proposal preferences
  i. James B.: Like CB-2 except that it would be better if it used the 10% with 90% confidence. Also, don't like that it has the 40 ug/L as a geomean. The geomean skews towards the center. Would be better to apply a Student's t-test if using the geomean. This reduces the significance of the higher concentrations which are

where the environmental impacts occur. Also like Lauren's proposal as it associates risk levels with the criteria.

1. Clifton B.: It's a choice. If you can associate specific impacts to a value then an arithmetic average is appropriate. If you are looking generalized effects, then geomean is more appropriate.
2. Jim H.: There is a continuum of risk where risk is more probable at higher concentrations of chlorophyll-a. This may be more appropriate for cyanotoxins where the high values are of concern.

ii. Clifton B.: I think the CB-2 proposal is more appropriate than Lauren's because it balances the risk with the existing information on impairments in the lake

iii. Astrid S.: Remember that blooms occur on an exponential scale. So, a difference between 10 and 100 is important. That is a very strong argument for not using a geomean.

iv. Lauren P.: Agrees with Astrid's statement. Difficult to vote on one thing because it depends on whether we're talking about. I suggest on not voting yet. I felt compelled to use a geometric mean in mine based on what we have been discussing. In my mind, compared to Clifton's proposal, the risk information I provide is more quantitative than the narrative statement in his proposals. We can discuss the weighting of them, but they provide some quantification opposed to the narrative statements in the CB-2 proposal. Brian questioned what the impact of reducing the chlorophyll would be, Alabama did work looking at a fishery and it can go down to a certain point without an adverse impact. In Georgia they saw a flip to a different kind of fishery which was also a good sport fish.

d. Moving forward

i. Astrid S.: Is the intent that some people go back to their original proposal for modifications?

ii. Lauren P.: I would like some feedback on my proposal to round out the proposal.

1. James B.: I see the benefit of a risk-based approach. Some tweaking can improve the argument. A statistic that captures the likelihood of a percent chance that an impact would occur…Would prefer a parametric approach.
2. Astrid S.: We have data from HRL and we know that we will get five to ten samples per assessment period. Can we use that to make a determination?

iii. Brian W.: Regarding optimization of uses, would a use suffer if we lowered the chlorophyll-a standard? People are more likely to swim in clearer water and the potential for toxins would be reduced.

1. Bill H.: There is no downside for aquatic life protection. There is a lot of discussion on determining if high chlorophyll-a levels result in acute impacts. I look at it as being similar to bacterial standards. Is it more important to catch the peak or the central tendency?

2. Nora D.: I work with the data. I get calls from the public and they are concerned with the peaks. How do you compare the current not-to-exceed with a geomean?
3. Astrid S.: The acute effect is very important when considering harmful algal blooms. Geomeans only represent long-term trends, it does not reflect acute impacts.
4. Brian W.: Not sure I understand what Bill meant.
5. Bill H.: How low is too low? The aquatic life use is not currently affected by the chlorophyll-a levels in the lake. That could change if chlorophyll-a is reduced.
6. Brian W.: We've characterized aquatic life as the fishery for HRL. Is there a difference between a chlorophyll-a level of 25 and 40 in available food for example? Is there no difference? Is it balanced out by other improvements?
7. Marcelo A.: When we looked into the HRL fisheries about 2-years ago we saw literature that showed that below a chlorophyll-a of 20 ug/L is where we start to see an impact to the fishery. Also, as part of the Jordan Lake management plan, the NC Wildlife Resources Commission produced a letter stating that below 25 ug/L chlorophyll-a is where we would begin to see an impact.
8. Brian W.: Regarding the geomean vs. the arithmetic mean, a geomean with a not to exceed value, similar to how bacterial indicators are done, might be a good option here to capture the high end values.

iv. Martin L.: Prefers Lauren's proposal. What James said is interesting. Nutrients are more of a long-term concern. The arithmetic mean will be more sensitive to large events where the geomean will discount those over time. I'm leaning towards strongly a seasonal arithmetic mean.

v. Nathan H.: Wanted to go back to what James was saying. It is different from what I've heard discussed so far which has been proving that the water body was in compliance rather than what we've been talking about which was proving, using a statistical approach, that a water body is in violation. Is that the direction you were going in? You mentioned an 80% confidence interval and not letting that upper confidence level approach the standard which would be proving that the water body is compliant. I don't like the 1-in-3 approach as it is a raw score approach and raw score can get messed up by outliers. I like a parametric statistics and weight-of-evidence due to the sampling. The current water quality standard does that too. I can go with the CB-2 proposal or the current standard.

vi. James B.: I only said 80% because that leaves 20% on the outside with 10% on the high side. It allows the ability to quantitate a high side. The intention was to push Clifton into considering a geomean with a certain standard deviation as opposed to

just the geomean as a particular number. Then it depends both on the central tendency and the variability.

vii. Clifton B.: Regarding the risk-based continuum, we are fooling ourselves if we can say that the literature or the WHO guidelines represent quantitative risk for HRL. We won't ever have that information. Regarding James' statistics, this approach includes a confidence level for the geomean itself. A compromise would be to consider the arithmetic mean. By using a seasonal average, we are putting a boundary on the geomean.

viii. Mike O.: Can be quantitative with chlorophyll-a if considering clarity. We have data for this.

ix. Marcelo A.: If looking at the data now, things seem to be ok. Let's leave things as they are. We shouldn't take the risk of raising the standards because we don't know what the impact of that will be. Regarding Lauren's proposal, there is data in HRL correlating chlorophyll-a levels and increasing dominance of cyanobacteria. I am in favor of either Lauren's proposal or keeping the existing standard.
    1. Clifton B.: None of the proposals would degrade the lake. With my proposal, the lake still wouldn't meet the criteria. I'm calling for a 30% reduction.
    2. Marcel A.: I think that things look ok in HRL, but that would point to leaving the standard as it is since we know that it's working.

x. Drew L.?: If reducing chlorophyll-a in the lake that will affect the fishery. Leaning towards CB2 proposal as it considers different things. Also need to keep in mind how this would relate to individual reservoirs.
    1. Astrid S.: has the fishery changed over time?
    2. Drew: I haven't fished the lake in about 7 years, but anecdotally, it has not.

xi. Lauren P.: regarding the 1-in-3, in cases where Florida did not have enough data they used a 10% exceedance.

xii. Lauren P.: I would appreciate feedback on my proposal. Maybe we can start to modify the proposals and they will begin to look more similar. I'm open to modifying mine. Helpful feedback would be:
    1. Info to replace the WHO cyanotoxin risk information
    2. Comment on the arithmetic mean
    3. Discussion of James' thoughts on the statistics
    4. Using water clarity as another line of evidence

xiii. James B.: Is it a non-starter for us to select specific stations to assess individually?
    1. Pam B.: The reason behind the assessment units as they are is that you are looking at similar water systems. We don't want to over nor under impair. Efforts are underway to collect more samples, but we will not always have increased data.

xiv. Mike O.: Flow is really important here. My student's Master's project showed relationship between flows below the median resulting in problems in HRL. This also corresponded to the data that we saw over the summer in HRL.

xv. Andy S.: Are we going to come up with a common proposal?

1. Clifton B.: There is commonality between mine and Lauren's proposals. I am concerned with trying to reduce chlorophyll-a too much.
2. I struggle with the range component in Clifton's proposal.
3. James B.: I like what Nathan had presented some time ago on geomean vs. arithmetic mean.
4. Nathan H.: HRL is a fairly even-natured lake.
5. Astrid S.: We may not have the resolution in the data to say that.
6. James B.: This relates to residence time in HRL. It may be that we miss the extremes, but we don't think that we will see big differences.

6. Final Thoughts

a. Lauren P.: Good discussion. People can submit comments on my proposal by June 21, 2018.
b. Clifton B.: We should give some thought to voting on some of this to avoid repeating the same discussion over.
c. Astrid S.: High values are important when considering toxin production.
d. Mike O.: We can make some quantitative relationships between chlorophyll-a and water clarity.
e. Connie B.: Just an update, the recreational criteria for cyanotoxins seems to be held up at EPA right now.