NC Nutrient Criteria Development Plan – Scientific Advisory Council (meeting #7)
2/17/2016

Attendees

SAC members in attendance:

Bill Hall
Annie Godfrey (for Lauren Petter)
David Kimmel
Martin Lebo
Linda Ehrlich
Clifton Bell
Deanna Osmond
Michael O'Driscoll
Hans Pearl (and alternate Nathan Hall)
James Bowen
Astrid Schnetzer

SAC meeting facilitator:

Andy Sachs

NCDEQ NCDP Team members in attendance:

Steve Kroeger
Carrie Ruhlman
Tammy Hill
Mike Templeton
Connie Brower
Pam Behm
Jing Lin
Christopher Ventaloro
Jucilene Hoffman
Jim Hawhee
Cyndi Karoly
Jennifer Schmitz
Nora Deamer

Other NCDEQ staff in attendance:

Jason Green

CIC members in attendance:

In person:
None
Online:
Anne Coan

Other participants:

Will Scott (Yadkin River Keeper)

Meeting notes

All questions, comments and answers are paraphrased

1. **Convene** (Andy Sachs)
    a. SAC members, DWR staff and audience attendees provide names and affiliations.
    b. Facilitator provides overview of meeting agenda. See agenda here

c. Facilitator asks for comments/questions/corrections for meeting notes from December 6, 2015 SAC meeting.
    i. There were no comments on the previous meetings notes.

2. **2016 Timeline** (Carrie Ruhlman, Steve Kroeger)
    a. See timeline here
    b. Arrivederci, Mr. Kimmel.
    c. Carrie reviews timeline for 2016 and asks for comments and/or questions.
        i. High Rock Lake:
            1. Will focus on HRL through April so that SAC has ample time to work on ideas for developing criteria ranges.
            2. Additional data will be collected this summer and will be available for SAC to review.
            3. Hope to have draft criteria for HRL by end of this year (2016).
        ii. Albemarle Sound:
            1. Jim Hawhee has been working with the APNEP workgroup on this.
            2. We are hoping that they will start discussing criteria.
        iii. Cape Fear:
            1. For 2016, we would like to start taking this through the same process that we have used for HRL.
            2. We will start providing information on the Cape Fear River during the next SAC meeting in April.
            3. Additional data will be needed. The SAC will be able to help us design a study plan for sampling during the summer of 2017.
        iv. Criteria Implementation Committee
            1. Have only met twice up to this point.
            2. Have discussed what their role would be and have been listening into the SAC meetings.
            3. We are hoping that by later this year they will begin to be able to chime in on the feasibility of implementing any criteria developed by the SAC. We see this as being a back-and-forth process with the SAC.
        v. This timeline is tentative. Things may change.
        vi. Homework
            1. Reading materials, discussion preparation, case studies for Albemarle Sound.
    d. Comments/questions:
        i. Clifton: Timeline shows a review of Albemarle Sound final criteria in August, 2016. Do you really expect to have final criteria proposed by then?
            1. Carrie: Not really. It is all tentative. We had to develop some kind of timeline to try and gauge when goals might be completed. We probably

won't have final criteria for Albemarle Sound by August, but maybe? Things can also be moved around.

3. **Review & Next Steps for HRL** (Carrie Ruhlman, Tammy Hill)
    a. See the final (edited goals) presentation here
    b. We were able to glean a lot of good information from the December meeting. You all provided a lot of good information on describing the indicators and the uses of HRL and with linking the indicators to the uses.
    c. We developed an indicator summary and a complete conceptual model.
        i. See the indicator summary here.
        ii. See conceptual model here.
        iii. The conceptual model can be tweaked as necessary and we will probably modify it for use with the other water bodies we look at in the future.
        iv. Comments/questions regarding the indicator summary and the conceptual model:
            1. Nathan: In the indicator summary sheets, Chlorophyll-a mentioned as both and indicator of biomass and algal assemblage. This may be true currently in HRL (when we have high chlorophyll-a, we see high levels of cyanobacteria), but this may not always be true. It's probably not right to use Chlorophyll-a as an indicator of algal assemblage.
            2. James B.: A detailed legend should be included in the conceptual model to clearly explain the differences between the different boxes (For example, which are considered the primary drivers?).
            3. Michael: I would ask for another arrow to go from suspended solids to water clarity in order to include non-biological sources.
            4. Hans: In the conceptual model, we should state that the indicators and parameters are determined by different techniques (methods) and approaches. How the indicators are determined can be clarified in the legend.
            5. Martin: The conceptual model should be used as a starting point for each system. A legend might cause more confusion. Rather, a conceptual chapter should be included that develops the understanding surrounding the relationships between the different components in the model. Then, for any given system, there would also be a conceptual chapter that describes the subset of indicators that further describes the characteristics of the individual system.
            6. Astrid (in response to Martin): This is a good framework. As an example, "Aquatic Life" is very broad group of organisms. As we look at a specific system, this can be refined in the text to better represent species of concern particular to the system of interest. For example: particular fish species under aquatic life.
4. **Narrowing Down the Indicator** (Andy Sachs, Carrie Ruhlman, Connie Brower, SAC members)

a. We further developed, and then refined, water quality goals based on the uses from the conceptual model (in the circles at the bottom of the model).
    i. The refined uses are: **Aquatic Life**, **Water Supply**, and **Recreation**.
    ii. Human Health was not really a use of HRL and so was incorporated into the other uses as appropriate.
b. How did we refine the water quality goals based on the SAC defined uses for HRL?
    i. Keep in mind that the water quality goals must be protective of the designated uses.
    ii. With that in mind, we compared the uses that the SAC decided on to the designated uses language in our rules and developed the following water quality goals for HRL:
    iii. **Aquatic Life goal**:
        1. *A diverse biological population that is safe for human consumption.*
            - In your discussions of the "Aquatic Life" use, the SAC kept coming back to the idea that HRL should be able to support the sport fishery as well as being able to support the act of recreational fishing. This is represented in the Aquatic Life goal as the fish being safe to eat.
    iv. **Water Supply goal**:
        1. *Potentially harmful (toxic or nuisance) algal bloom prevention.*
            - HRL needs to be maintained as a safe potable water drinking source.
            - Should not contain substances that contain taste & odor problems.
    v. Recreation goal:
        1. *Waters desirable and safe for recreation.*
            - Fishing, boating, and swimming on lake.
            - HRL should maintain an aesthetic quality that does not interfere with recreational uses.
c. Comments/questions:
    i. David asks: Is this always all relative to humans?
        1. Connie answers: We meant it as diverse as in ecosystem function.
    ii. Clifton: (referring to the handout): I suggest that, under the water supply goal, language should be changed to say something like "…free from cyanotoxins" that impair designated uses or in excessive concentrations".
    iii. Clifton: Struggling with the concept of a "healthy and diverse population" in a man-made system that is largely managed for sport fishing. We really don't have the species diversity in a reservoir that might be present in a natural system. Can we modify the goal to reflect this?
        1. Connie: This is a goal for the lake. We could add something like "appropriate".
            - Clifton follows up: I think "healthy" would be a better descriptor than "diverse".
            - Some discussion among the SAC members follows concerning the appropriateness of "diverse" vs. "healthy". Diversity is usually

associated with natural systems. It may be problematic to apply this term to an artificial system. This could become an issue when it comes time to defend any criteria that are developed for HRL.

i. Discussion concerning how do we measure what we consider healthy or diverse? This is where the criteria come in!
ii. Result of this discussion being substituting "healthy" for "diverse" in the Aquatic Life water quality goal.

iv. Michael: How are the fish consumption warnings, such as for Hg, used in lakes and rivers linked to what we are talking about here?
    1. Connie: HG issue is a toxic as opposed to a nutrient. The safe consumption guidelines do not tell someone to not eat fish, they inform them of how much they can safely eat.
v. James B. (referring to the left column in the handout): In the left column we have fish, benthos, and wildlife, but in the final goal we seem to have lost that. Is that a concern?
vi. James B.: To go along with the discussion of healthy vs. diverse, can we consider a system that is only focused on the health of a few species as being healthy or may it lack some of the resilience that a more diverse system would have?
    1. Discussion:
        - It seems that [Aquatic Life] is a biological resource that goes beyond just the fishermen.
        - Do you throw away resilience if you get rid of diversity?
        - Michael: Strictly speaking I could say that a system is healthy for designated uses, but it is neither diverse nor resilient. Empirical evidence shows that diversity and resilience are not necessarily tied together. You can define what is healthy for a system, but it is more difficult to deal with diversity because it does not necessarily imply that a system is healthy or resilient. For example: corn fields are low diversity, but they are highly productive and resilient to impacts.
vii. Pam: Was afraid that this goal is going too high by going straight to the fishery, but the discussions so far seem to be addressing this.
viii. Clifton: (Regarding the recreational description). We need to explicitly acknowledge that sport fishing is one of the big recreational uses.
    1. Bill: There's a tension between supporting sport fishing, which will require high nutrient conditions, and aesthetics, which will require low nutrient conditions.
    2. Connie: We just need to make sure that all of the designated uses are protected.
    3. Andy: It sounds like we can just add "sport fishery" in the Recreation water quality goal description to show that it is being considered.

d. Refining conceptual models for each of the goals (Carrie)
    i. Referring to the "Refining Conceptual Models" table in handout
        1. We filled out the "Refined Goals", "Potential Assessment Endpoints", and "Measure" sections.
        2. We want you to come up with the Final Assessment Endpoints, Response Indicators, and Causal Indicators which may then ultimately become the criteria.
        3. There is also a column for "WQ Range(s)" which can be filled in later. These should be backed up by literature and can be worked on at a later time.
        4. Comments/questions:
            - Andy: To keep things constant we should use the goals as the group has played with them now.
            - Connie: Concerning the Sports Fishery discussion we had earlier, this is where we can add an endpoint for Sport Fishery if we feel it is necessary.
        5. Carrie shows an example of the table all filled out.
    ii. SAC members split into groups to work on this.
    iii. SAC members report on their discussions
        1. Group #1 (James B., Michael O., Astrid S., Bill H.)
            - Commonality between goals.
                i. Algal biomass, water clarity and algal toxins need to be considered for each of the goals in a connected way.
                ii. Chlorophyll-a standard with sequential process so that chlorophyll detected at some level would trigger an examination of algal assemblage which may trigger an examination of toxin levels.
                iii. A chlorophyll-a criterion established this way would allow for routine monitoring of a relatively inexpensive indicator (Chlorophyll-a) that would trigger a more in-depth analysis at higher levels.
                    1. Related to nitrogen, phosphorous, light, and temperature.
            - For the "Water Supply" goal:
                i. The sequential approach would provide the means to protecting the water supply use from algal toxins.
            - For the "Recreation" goal:
                i. Range of chlorophyll
                    1. Enough to support fishery, but low enough to not deter recreational use. Trying to determine what

that range may be so that all goals are met. Not sure what that range might be.

- For the "Aquatic Life" goal
    i. Mike O. had pointed out that there is data to suggest nitrogen toxicity to fish in the area of a few mg/L. May need to investigate this potential for toxicity.
- Also discussed possibly altering the monitoring regime. Instead of going sampling one day each month, instead, sample every day for a week one time each season.

2. Group #2 (Dave K., Martin L., others?)
    - Indicators for the "Aquatic Life" goal:
        i. Assessment endpoints: Fish and Algae
            1. Fish
                a. Measure: Biomass composition, condition (health)
                b. Response indicators: threshold abundance, composition, condition (length/weight)
                c. Causal indicators: composition of food and prey, DO, and pH
            2. Algae
                a. Measure: Biomass, phycocyanin, composition (microscopy)
                b. Response indicators: Chlorophyll-a, assemblage, DO, and pH
                c. Causal Indicators: Nutrients, water clarity, residence time, and temperature
    - Indicators for "Water Supply" goal:
        i. Assessment endpoint: Algae
        ii. Measure: Chlorophyll-a composition, cyanotoxin concentration, and taste and odor
        iii. Response indicators: Chlorophyll-a, % cyanobacteria composition (microscopy), threshold toxin concentrations, taste and odor compounds (GC measured?), pH, and DO
        iv. Causal indicators: Nutrients, water clarity, temperature, and residence time
    - Indicators for "Recreation" goal:
        i. Assessment endpoints: Algae and water clarity
        ii. Measure: Chlorophyll-a concentration, cyanotoxin concentration, taste and odor, turbidity, sediment load, and dissolved organic matter (DOM)

iii. Response indicators: Chlorophyll-a, % cyanobacteria composition (microscopy), threshold toxin concentrations, taste and odor compounds (GC measured?), pH, DO, turbidity threshold, and DOM concentration
iv. Causal indicators: Nutrients, water clarity, temperature, and residence time, flow

3. Group #3 (Clifton, others?)
   - Tried to focus on the criteria and what the state might actually be able to routinely measure.
   - For the "Aquatic Life" goal:
     i. Response indicators: Chlorophyll-a, DO, and pH
        1. Can get at toxins, water clarity, and bottom DO through chlorophyll-a (correlation between seasonal chlorophyll-a and hypoxic volume)
     ii. Causal indicators: Nitrogen, phosphorous either as concentration or load. HRL might be managed better by loads.
   - Indicators for "Water Supply" goal:
     i. Response indicators: For HAB prevention look at algal toxins
   - Indicators for "Recreation" goal:
     i. Response indicators: Clarity, toxins and chlorophyll-a
4. Comments/questions
   - Andy: Is there anything that needs clarification?
     i. This was difficult to make out in the audio, but there was some discussion about whether it is, or may ever be, possible to be able to predict algal toxin production based on species composition. Neither Astrid nor Hans felt that it would be possible as the interaction of the variables that contribute to (1) the presence of toxin producing species and (2) the trigger of toxin production are not fully understood.
   - Andy: What stands out to you? Areas of overlap? Differences?
     i. Clifton: We approached this as if we were supposed to be coming up with causal indicators as potential criteria. Things like temperature and residence time may not really be manageable as criteria.
        1. Dave: We agree with that. What we were trying to say was that this has a causal link to the indicator. If you're going to measure DO, temperature is

important to know because it impacts DO concentration.

2. Martin: Our group was split on whether to include those as causal indicators. They were included more for purposes of informing the criteria.

ii. Linda: I liked that group #2 included phycocyanin
   1. Martin: It was interesting that the two groups looked at toxins and algal assemblage in different ways. One referred to using microscopy and the other chemical measurement of toxins.

iii. Clifton: I am concerned that some of these may not be suitable as final indicators as they are more like intermediate steps. Algal assemblage, for example. If you can measure toxicity more directly and you can determine water clarity more directly, what is the value of structuring a criterion around this.
   1. Martin: I would prefer to see it (algal assemblage) used as a diagnostic tool used to interpret a narrative rather than trying to somehow develop a quantitative criterion that is linked to assemblage.
      a. Andy: Why?
         i. Martin: In cases I have heard of where this is done, there have generally been unintended consequences and increased false positives. It's not a question of whether there is value in measuring it, it's a question of whether it's good to create a criterion on it that has regulatory action associated with it.
         ii. Astrid: It has value in that it is cost effective and informative of the kinds of organisms that are present. It can be tied into a threshold based criterion to protect uses.

iv. Andy: Will staff synthesize this in any way? What more do you need from the SAC to move forward?
   1. Tammy: We will put it all together like the conceptual model.

2. Andy: Is the information clear? Is there enough information to reach a consensus?
3. Hans: I think it's remarkable how similar each of the groups were in their response. The only real differences are in the level of complexity.
4. Michael: Those might be considerations for the CIC. They might say that we will not be able measure component "x" in this way.
5. Martin: There was also consensus in what we didn't do which was that none of us proposed numbers.

v. Andy: Tell me about that. If your homework is going to be to identify literature and maybe come up with some numbers, is that doable?
   1. Hans: I think for very few of these.

vi. Andy: So tell me about scientific defensibility. If you're supposed to be coming up with criteria that are scientifically defensible, how do you get there from here?
   1. Hans: This is what most limnologists would agree would need to be looked at for this situation given the designated uses that have been identified for this system.
   2. Andy: Are there citations that can support that statement.
      a. Astrid: I think there are a number of studies regarding cyanobacteria that may be useful for this.
      b. Annie: I think it is very important that we come up with numbers for at least some of these. I don't see how we could use these if it were just a narrative statement. Also, it should be kept simple enough that it would be realistic to implement.
      c. Hans: I think we can already put numbers up for some of these. Chlorophyll, pH, clarity, DO, temperature. For example, there's a minimum temp where you don't have to worry about cyanotoxin issues.
      d. Martin: The general ranges from other systems can be looked at, but the question is still how do we relate that to HRL. Is the current chlorophyll too high? The pH is

higher than the existing standard, but is that an impairment based on designated uses? Are the current levels impaired or not?

e. Carrie: There theoretically should be some area where all of these ranges overlap. That area should be what we look at to base any criteria on so that it would be protective for all those uses.

vii. Andy: What would you like the group to do between now and next time?

1. Carrie: Come up with those ranges.
2. Everyone: laughter.
3. Astrid: I'm happy to look up ranges for cyantoxins.
4. Hans: I can look at chlorophyll
5. Connie: Ideally, if you all can look at whether there is a relationship between finished water criteria and surface water for cyanotoxins.
6. Clifton: The existing lake condition is one end of these ranges. We probably all agree that the lake is meeting the fishery use and it may be meeting the recreation use. One part of this exercise should be that we look at existing data to determine what the current conditions are.

viii. Connie: Also need to consider magnitude, frequency and duration. Where do these components fit in. Do they all need frequency and duration?

1. Bill: Fishery seems to be doing fine. Recreation seems to be fine. We haven't heard anything about drinking water problems downstream. That means that the current conditions are meeting the uses. The question is how much can these conditions degrade before the uses become impacted.
2. Clifton: Algal toxins are a wild card as we don't have enough information to draw conclusions.

ix. Connie: There have been taste & odor issues reported from the Denton WTP downstream.

x. Annie: Is there any actual data to show that the recreation uses are not being impacted other than us just not hearing of people avoiding the water? Surveys?

1. Carrie: The Division does not have information on this, but the Yadkin river keeper may have something.

xi. Will Scott (Yadkin River Keeper): We don't have the resources to do a formal survey. This would be interesting especially during the summer period on the lower arms of the lake. We have had reports of red sores on fish this past summer so they may be some impairment there. This is primarily in the creeks on the two lower arms by the dam. This is also the area that has the most water during the summer so recreation tends to get pushed down to this area. Anecdotally, we have had reports of children getting ear and nasal infections after swimming in the lake. I haven't spoken with local doctors to confirm this. We have also had reports of small scale sewage discharges from vacation homes and camps on the lake.
    1. Astrid: Do you do fecal testing around there?
    2. Will: we're trying to get resources to provide citizens
    3. Deanna: Are there a lot of swimmers in the lake?
    4. Will: It depends on where in the lake you are talking about. The main areas are Flat Swamp Creek (public beaches) and areas with vacation homes. Second Creek has a boat gas station where people often recreate. Also, there are a lot of small coves around the lake that people use. Most of the swimming is done in the shallow arms of the lake while boating is being done in the main channel. The upper part of the lake sees the most recreational use in the winter (hunters, fishermen). The direct human skin contact is mostly occurring in the backwater tributaries.

xii. Clifton: What is your perspective on the aesthetics of the water? Are there mats and scums that may affect the aesthetics of the recreation?
    1. Will: Not so much. We did get pictures during 2008 which was during the drought and some of the lowest water levels.

xiii. Andy: Staff would like to reinforce the context of some of the decisions that you are making.

1. Connie: The idea that nothing is impaired in HRL and that nothing needs to be done is not where we are. We need to make sure that what we come up with are criteria that will protect/enhance the lake and that prevent any degradation. We often hear that there is no impairment, though we know that there are issues on the lake. If you all decide that the standards we have in place are suitable for HRL and that we don't need anything else, that's fine. However, if you decide that some of these other indicators would be appropriate to include we can do that.
2. Clifton: I've mentioned this a few times, but the intent wasn't to say that we shouldn't do anything. We have been discussing whether we feel the uses are being impacted and through these discussions we have generally found that they are being met.
3. Connie: So it then becomes, what criteria is needed to maintain that the uses will continue to be met?

xiv. Martin: So we're talking about what is there now. Does that also suggest that we may need to modify existing standards to better ensure the continued protection of the uses? For example, modifying the existing chlorophyll standard to include a seasonal component?

1. Connie: Absolutely. The bottom line is whether that can scientifically support the use.

xv. Bill: Aside from the existing criteria exceedances for the lake, what other impairments does the lake have? I'm not sure we've heard about that. The discussion has been: don't presume that the lake doesn't have problems. But, we haven't heard anything to suggest that it is in an impaired state. So, are there issues with the fishery or aquatic life, or water supply, or recreation?

1. Connie: The impairments are with the criteria.
2. Bill: Yes, the criteria that we are looking to modify because they don't seem to be aligned with the uses of the lake.
3. Connie: That's your goal. The goal is to protect the use. So if you believe that the current chlorophyll standard of 40 ug/L resulted in an impairment that you don't believe actually exists, at what point

(concentration) would you expect to see an actual impairment occur so that we don't get to that point?

xvi. Pam: So should we first talk about what we would consider an impairment of these uses? That would help us get to these numbers.
   1. Annie: Remember that we don't want to set the criteria exactly on the point of impairment because we don't want to reach that point. You want to establish at what level an impairment of the use would occur and then back off a bit to provide a buffer so that the impairment doesn't occur.

xvii. Andy: To Bill: Are you getting an answer to your question? Ask it again.
   1. Bill: Let's start with fish kill. Chlorophyll-a doesn't kill fish. What results in fish kills is low DO, maybe big changes in pH. So, if we are going to come up with a criterion for chlorophyll-a, we need to relate that to its effect on DO and pH. If we don't have a lot of information to do that and we haven't heard about any fish kills on the lake. It's hard to extrapolate from something that you haven't seen yet.
   2. Connie: I would say that we don't want to see.
   3. Bill: We are tasked with coming up with something to convince the public that something needs to be done, but under existing conditions we haven't seen any impacts.

xviii. Hans: In this exercise, the greatest unknown is the water supply. We don't know much about the algal toxins (frequency, magnitude) and that is a real impediment to us making an educated guess as far as what an appropriate chlorophyll criterion would be regarding blooms.
   1. Martin: I guess that is why two of the three groups had a nested approach for criteria related to chlorophyll.
   2. Andy: Are there even ranges for these integrated criteria?
   3. Astrid: Yes, there are ranges out there, but it varies.

xix. Andy: Would it be useful to use those ranges to inform your decision making?

1. Clifton: Lake specific data should override the literature there because it will be water body specific. And we shouldn't base a chlorophyll criterion on an assumed toxin response.
2. Annie: Have to remember that Chlorophyll-a is not just a concern because of algal toxins.

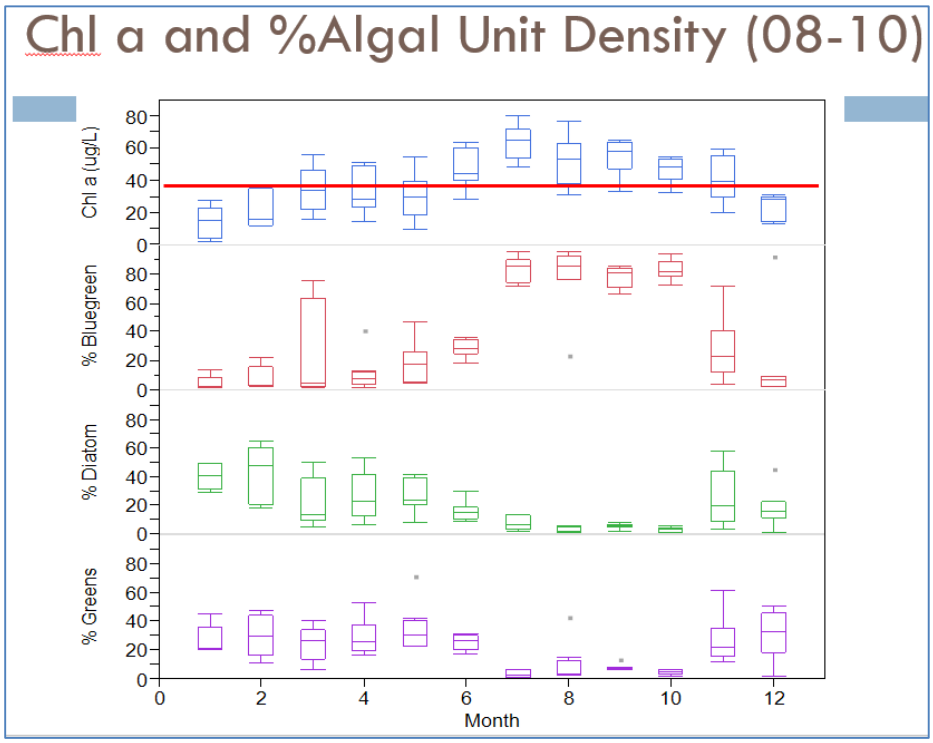
xx. Andy: Is it possible to start putting numbers around these ranges?
1. Hans: Yes.
2. Linda: It needs to have seasonal ranges.

xxi. Clifton: Ok. Let's take aesthetics and fishery quality. Getting back to what Bill was saying. We think that the lake has a good fishery and is meeting its recreation use. We can use the current values as an indication of this and consider frequency. For HABs, we can look at the literature, but it's going to be different for each lake and we won't really know if any of these numbers will be appropriate for HRL until we get some data back from the study this summer. We can come up with DO and pH numbers, but the chlorophyll-a number is more lake specific.

xxii. Andy: Do you all agree with that?
1. Hans: I think we can say that the probability of HABs increases at a certain chlorophyll-a level, especially since we have a history of cyanobacteria in the lake.
2. Astrid: Recent research is showing that as eutrophication increases there is a shift to more toxin producing cyanobacteria species in the algal assemblage. Increasing temperatures also appear to play a role in this. Based on a few studies.
3. Martin: Would that be a good indication that even if the lake is ok now, chlorophyll shouldn't go much higher?
4. Astrid: The literature should help to some degree with this. A few people have come up with toxin limits and ranges, but there is hardly any regulation of this out there.
5. Clifton: When we look at the literature we'll see that lakes with "x" amount of chlorophyll-a have a chance to have problems with toxins what we don't know is does it have a problem.
6. Astrid: Right, so we are stuck in between.

xxiii. Andy: I'm thinking either a subcommittee or everyone gets the assignment to come back with your best idea on appropriate ranges.

1. Linda: It might be more efficient for someone to stand up there and talk through this.
2. Astrid: Maybe we can get a summary of the existing data for these parameters?
3. Pam: Typical monitoring for lakes in May-September. HRL has had some more year round sampling, but for a limited time. Chlorophyll-a can get over 70 ug/L and regularly over 40 ug/L.
4. Bill: Other states have gotten averages for growing seasons for each year and that's the kind of thing that we would want. How far back does the data go?
5. Pam: We have data back to the 1980's, but it's really more concentrated around the 2000's. [Discusses the following slide].



a. Jing: These are for 2-years of data during the summer (April 2008-March 2010). Not sure of how many data points.

b. Astrid: Is there a lot of variability during the two years?
c. Jing/Pam: We were recovering from a drought, but I don't think that there was too much variability in the data. 2008 was very dry, 2009 was closer to normal rainfall, 2010 was also about normal.
d. Michael: If you look at the months that are above the chlorophyll standard (40 ug/L), they sometimes have predominantly blue-greens and sometimes don't.
e. Astrid: These are also different stations so that may play into it. If we could see the changes in one station over the 24 months that may be more useful.
f. Pam: I think we showed that in one of the first meetings. Keep in mind that our monitoring is structured around the existing standards.
g. Clifton: Do you know how many total years of data that you have with which to calculate an annual average or geometric mean for chlorophyll?
h. Jing: Before 2005 we probably don't have enough data. We can try calculating a seasonal mean.
i. Clifton: I'd be happy to do this if we have the data.

xxiv. Deanna: We need to reacquaint ourselves with the historical data (seasonally, trend line over time and by station). Then based on that the group can talk about setting these limits based on what we have seen and on the deep working knowledge that some folks here have.
xxv. Andy: Does this sound like a way forward.
xxvi. Michael: Do we have any more recent data?
1. Pam: No, it hasn't been sampled since. That will come from the summer study we are planning.
xxvii. Hans: I'm a little concerned that the word standard is being thrown around freely. I think what we are talking about here are thresholds to tie into criteria. There are very few issues right now that are calling for a standard. I think what we're struggling with now is what are the levels that are tolerable and realistic at which we could expect problems to arise.
1. Annie: What would be the regulatory impact of having these thresholds?

2. Hans: The threshold is established by experts and the standards get developed through management.
3. Andy: We've asked this group to come up with these thresholds which staff will then work from to create standards.
4. Carrie: We're taking the steps that lead to criteria and standards. There will be a point where this group proposes what you think. This part of the exercise is to narrow things down so that we can get to those proposals.
5. Andy: Can you move forward knowing that this is the plan?
6. James B.: I think some of these are harder than others. We could probably come up with numbers for some of them and then a broader threshold for the others.

xxviii. Andy: Clifton has offered to look at the HRL data in different ways.

1. Hans: Helpful to recommend some probabilities. For example, HABs. [Referring to the graph above] It's pretty clear that the probability of getting blooms jumps up in June and you don't need to worry about much after November. It might be useful to develop a threshold and probability component for criteria. What's the probability of a bloom occurring at a certain time of year?
2. Clifton: The probability concept is useful. But if we are looking at probability of "x", that "x" should be tied to use impairment. Blooms themselves may not necessarily be indicative of use impairment in HRL if we see that the fishery, water supply and recreation uses are being met. If it was associated with a certain level of algal toxins that might be more useful.

xxix. Astrid: Since we don't have information on toxins yet we should take a step back and look at the chlorophyll-a and biomass data changes over time (over the years) to look at variability at each station. Then we can identify trends that will help to set up a chlorophyll-a criterion. We have that data, right?

xxx. Pam: I'm not sure if we have enough data so that it will be statistically significant.
xxxi. Astrid: We're just looking for trends over time. Seasonal differences and differences in the stations.
xxxii. Some comments by Jing that I can't hear on the recording
xxxiii. Andy: Last thoughts.
1. Clifton: Can we revisit the indicators that we discussed at the last meeting and try come up with the basis for some numbers? Also, we should divide up some tasks so that we can move forward and not get stuck in the same conversations. I'm offering to look at the existing data to see how chlorophyll-a relates to existing conditions. Who might look at chlorophyll-a ranges/correlation and cyanobacteria, pH, and DO thresholds?
2. Carrie: We can fill in some of the ranges that you all came up with last time, but there still may be some gaps.
3. Linda: I think its ok to look at what we have to see if we can identify some trends.
4. Hans & Astrid: Will work on the HAB probability stuff.
5. Bill & Clifton: I can do some of the preliminary analysis on the 2008-2010 data, but it would help if we could get the early data. Review to see how it inform setting a chlorophyll-a level. Is there a floor, etc.
    a. Group: Data has been made available
6. Clifton: I will continue with pH.
7. Martin: DO
8. Michael: Water clarity.

5. **HRL Summer Study** (Jason Green)
    a. See presentation here
    b. See the study plan here
    c. Jason gives brief background on the Intensive Survey Unit.
    d. Background on how DWR collects lakes data:
        i. Data for the last 30 years
        ii. Indices back in the early 80's to do comparative studies of lakes. The same protocols can still be used today.
        iii. DO, diurnal cycling (flux) for HRL

1. May-Sept (Summer) is generally when we do these studies. Winter studies are more to assist in developing TMDLs.
2. Would like to hear exactly what information you want.
3. We proposed to be on the lake sampling at the same frequency that we would normally do (5 times for this cycle)
4. Planning on sampling at four sites representing the upper, middle, and lower parts of the lake as well as the Abbott's Creek arm. These sites are representative of the lake as a whole.
5. 24-hour profiling event for each of these sites. Is this enough information to go on?
    - James B.: My recollection it that we were concerned with diurnal fluctuations for pH and DO. There was concern that the once/day sampling was not catching either the high pH or the low DO, right? (to group)
        i. Group response: Yes
    - James B.: You want to go to the time & place where you have the highest pH and Lowest DO.
        i. Jing: The highest pH is found lower downstream (YAD152C) and lower DO at the bottom where it is deeper.
6. Jason asks: Is there other information that you would need?
    - Mike: When sampling the lake in the middle of the day, is that providing us all of the information (maximums, minimums, frequency, duration) that we need to create criteria? Would sampling at some other time provide different information than what we saw with that original daytime sample.
    - Astrid: Do you to integrated sampling or surface & lower level sampling?
        i. Jason responds: For assessment, the ambient lake program requires integrated sampling. We go to the bottom, but we are not generally looking at hypolimnetic nutrients.
        ii. Mike asks: How do you determine the photic zone depth?
            1. Jason: Twice Secchi depth.
    - Astrid: Are any other chemical parameters are going to be measured?
        i. Jason: These (referring to Powerpoint slide) are what we would normally collect from the photic zone. They will be collected one time between sunrise and 4 pm.
        ii. Astrid: Is the chlorophyll-a a discreet measurement?
            1. Jason: it is an extracted methodology from the photic zone.

a. Astrid: Can you do an additional filter for cyanotoxins?
    i. Jason: Yes. We've been doing it already so you have some waiting for you!

- Bill: At a minimum you need to add the Secchi depth to this. Also, would you add light intensity at the surface?
    i. Jason: Secchi depth is already included. Regarding light intensity…would it be for a correlative assessment?
        1. Bill: You will be measuring DO and pH affected by photosynthesis which is affected by the amount of light plus the time of day, etc…
            a. Group comment: If you're going to go through that trouble you might as well do a profile.
            b. Jason: We can do the profile.
    ii. Question: Do you have a PAR hooked up to a YSI?
        1. Jason: We run them side-by-side.
- Mike: Are there any rules regarding storm events and sampling scheduling.
    i. Jason: We would try to avoid sampling if there was a heavy storm a day or two before, but the system is pretty large and we may be limited by time constraints on our staff.
- Astrid: I'm wondering what we would really be able to coordinate a light profile to with, especially if you're just take snapshots?
    i. Bill: Would expect that it would influence the DO and pH that would be seen. Sunny vs. cloudy days might show different profiles.
        1. Deanna: There would also be some migration of phytoplankton to avoid intense light. (integrated sampling of chlorophyll-a might show this)

7. Jason: What other interest would there be in boundary layer or hypolimnetic sampling? Are we looking at species migrating to access nutrients?
    - Astrid: It would be a lot of work to resolve community structure. Is there a reason to believe that nutrients may be limited in a part of the water column?
    - Group consensus: Taking an extra nutrient sample in the upper and lower water column will be useful to determine the degree of stratification that may be occurring.

- James B.: Is the DO that you take once/day at the surface?
    i. Jason: We take it as far down as we can go in one meter increments. What kind of resolution do we want? We
- Bill: You're going out to four stations one day each for two months. That is going to fill in a gap, but that is still only a snapshot of two days during two summer months. Will this be representative of general conditions in the lake? Will it be good only for summer months? It's a start. Once we have these results we can then identify other information that we may need.
- Clifton: What are the chances of deploying a continuing sampling device at one station for a couple of depths?
    i. Jason: There are a couple of options. One, we do the profile ourselves on-site (this is the easiest for us.). Two, we do just top and bottom. Three, we use automated profilers that will collect a lot of data, but will require the same amount of manpower to maintain. We don't have any automatic profilers. Also, we have lost equipment at HRL. We can turn the physical data around in a few days.
        1. Hans: Doing it in the order you proposed is good.

8. Mike: Concerned about n = 2. There will be no context for the diurnal event measured. It's better than no data, but hard to provide context.
    - Jason: So, how valuable is doing a profile? Are we looking for a boundary layer and changes in that boundary layer?
        i. Mike: We are looking for a range for a particular parameter that possible for us to see. Can we get a clear picture of the data ranges that we would see in HRL. For example, are we exceeding criteria that we might set every day, because DO is going from zero to supersaturation? Or is that not occurring?
        ii. David: Maybe a hybrid approach would be useful. There are new, low cost, sensors that might be used in tandem with what is being proposed. These could be left out for some extended period of time. This would give us a better long-term understanding of at least a few parameters (temp, conductivity, others?) and would help to provide some context for the profiles being done during the summer.
        iii. Astrid: Should we just do more frequent integrated sampling instead of a profile? This would maintain consistency with the normal lake sampling and assessment methodology and allow the SAC to seamlessly incorporate data from previous sampling events and assessments.

1. Jason: That is easily doable for us (DWR). We can also incorporate the probes.

9. Some questions concerning whether DWR has YSI chlorophyll sensors. We don't use them.

iv. Closing comments
1. Jason: Suggests a top, bottom approach. He will write it up and give to Steve who will submit to SAC for review.

6. **Albemarle Update & Homework** (Jim Hawhee)
a. See presentation here
b. Jim H. updates SAC on nutrient development process in Albemarle Sound
i. Albemarle Sound workgroup is progressing on a similar path as the SAC is with HRL.
ii. This workgroup is composed of some SAC members (Hans, Martin, and Clifton), as well as members of the CIC and also interested stakeholders.
iii. The workgroup started meeting in summer of 2014 with the idea of synthesizing the data available and the ultimate goal of making whatever recommendations that could be made whether it be for criteria, parameters, or further research.
iv. In the NCDP there is a temporal gap where additional information can be added as well as a phase 2 approach that ultimately will be synthesizing any recommendations that may come out of the workgroup.
v. Jim H. shows the map of Albemarle Sound and discusses projects that have been completed thus far. All of this information can be found on the APNEP website. (http://portal.ncdenr.org/web/apnep)
1. NASA Development Project
- Status: Complete
- Results: Inconclusive
- Summary: Analysis of satellite color imagery to evaluate accuracy for detecting chlorophyll-a. Results showed poor correlation with previously collected water quality data.
- Full report on Google Drive.

2. USGS Albemarle Sound Initiatives
- Status: Nearly complete
- An inventory of monitoring programs and available data in the watershed has been completed.
- DUKE MEM project offers preliminary trend analysis of variables including chlorophyll-a, DO, turbidity, nitrogen, and phosphorus.
- Both reports available via Google Drive.
- USGS report analyzing results of field efforts available soon.

3. Tetra Tech Literature Review
- Status: Complete

- Summary: ~4,000 estuarine literature citations organized and associated with keywords. Abstracts provided for most sources. Tags include geographic sorting, environmental endpoints, and methods.
- Endnote database, Excel sheet and a series of text files are available via Google Drive

4. Data Review and Analysis
    - Summary: Advanced statistical and spatial analysis of historical DWR monitoring data in and near Albemarle Sound to inform criteria development
    - Status: Final draft submitted.
5. Law and Policy Review
    - Status: Complete, report on Google Drive
    - Summary: Evaluation of case law regarding nutrient criteria development nationally and high-level policy case studies of other jurisdictions that have revisited nutrient criteria.
    - Analysis conducted by a legal fellow associated with NC Sea Grant and the NC Coastal Resources Law, Planning and Policy Center.

vi. Discussion of the February 2016 APNEP meeting
1. The group reviewed 11 estuarine nutrient criteria case studies.
2. Spanned the scale of jurisdictions that had extensive nutrient criteria to those that had limited criteria. Varying approaches looked at.
3. Available on Google Drive.

vii. What's next?
1. Trying to keep in step with the SAC meeting schedule. Ideally Albemarle Sound group will meet as frequently.
2. Plan to share insights/products from this group with the Albemarle group and vice versa.
3. March 2016 Albemarle group meeting agenda:
    - Planning to talk about the Tetra Tech data analysis, 303d listing methodology and updates on monitoring efforts by DWR.
4. Optimistically, conclusion of Phase I is targeted for summer 2016. Could possibly take longer, however.
    - This will result in a summary of the groups progress and any recommendations that the group has developed.
    - The Albemarle group will consult with the SAC and the CIC before moving forward with any recommendations proposed in this report.

viii. Albemarle Homework
1. The HRL conceptual model should be applicable to the Albemarle Sound with some tweaking. Can the SAC consider this as part of their homework?

2. Look at the Albemarle case studies. They are very informative.
3. Review the Tetra Tech data analysis report when it comes out.
4. See the APNEP website at http://apnep.org/web/apnep/nutrients for the support documents discussed above on Google Drive.

ix. Comments/discussion

1. Andy: Is there anything regarding the Albemarle planned for the next SAC meeting?
   - Carrie: Yes. We are going to discuss the Tetra Tech report and Jim H. will review the Albemarle meeting that occurs in March.
2. Dave: We were talking about concentration criteria vs. load. Wondering what other people in the southeast were doing?
   - Jim H.: I would ask your colleagues. Florida and Chesapeake Bay were looked at in the southeast. Generally, it is challenging with Albemarle in that we don't have gauges for this information.
     i. Carrie: Those case studies are in your handout for you to look at.
   - Hans: Most of the studies reported concentrations. If they needed loading information they plugged the concentrations into loading models.
   - Clifton: In the Chesapeake and the James River, the in-stream criteria were the response variables and they used the models to allocate loads.

7. Attachments

a. Meeting agenda

SAC-Feb2016-Agenda.pdf

b. Timeline

Tentative-SAC-2016-timeline.pdf

c. Next Steps Presentation (Final)

Next Steps for HRL-FINAL.pptx

d. Indicator Summary

Indicator-Summary-from-Dec-2015-SAC-

e. HRL Conceptual Model

HRL-Conceptual-Model.pdf

f. HRL Summer 2016 Study Plan

HRL-2016-StudyPlan.pdf

g. HRL Summer 2016 Study Presentation

High Rock Summer2016 Monitc

h. Albemarle Sound Update

Albemarle Sound Nutrient Criteria Up