NC Nutrient Criteria Development Plan – Scientific Advisory Council (meeting #9) 6/15/2016

Attendees

SAC[1]	Staff/others in person	On-line
1. Deanna Osmond	**1.** Steve Kroeger - DWR	**1.** Chad Ham (AM)
2. Linda Ehrlich	**2.** Connie Brower - DWR	**2.** Heather
3. Clifton Bell	**3.** Nora Deamer - DWR	**3.** Haywood (PM)
4. Martin Lebo	**4.** Tammy Hill- DWR	
5. Lauren Petter	**5.** Jucilene Hoffman - DWR	
6. Mike O'Driscoll	**6.** Christopher Ventaloro - DWR	
7. Bill Hall	**7.** Jeff Manning - DWR	
8. Marcelo Ardon	**8.** Andy McDaniel - DOT	
9. Astrid Schnetzer absent AM; present 1:30	**9.** Anne Coan – NC Farm Bureau	
10. Hans Paerl	**10.** Jing Lin - DWR	
11. Nathan Hall (Paerl 's-alternate)	**11.** Pam Behm - DWR	
12. Deanna Osmond	**12.** Mike Templeton - DWR	
	13. Jim Hawhee - DWR	
	14. Cyndi Karoly - DWR	
	15. Jim Hawhee - DWR	
	16. Sushama Pradhan	
	17. Keith Larick – NC Farm Bureau	
[1] Absent: Jim Bowen	**18.** Andy Sachs - Facilitator	

Note: Presentations are embedded within this document – See Attachments, page: 29

Final version: October 28, 2016.

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 Attachments, page 29.
    c. Facilitator asks for comments/questions/corrections for meeting notes from the April 2016 SAC meeting.
        i. Bill: During Pam's presentation she stated that the lake model was going to be completed by the end of April. Was it?

1. Pam: I said that our goal was to have it done. We are currently working with Tim Wool (EPA) to finalize the model.

ii. Bill: Regarding Clifton's presentation on pH: You had a statement that said "When the pH is >9 it may require additional WTP treatment". Typically, WTPs will soften with lime and drive the pH up. I'm curious if a higher source water pH would actually have a cost impact since the WTP is going to be adjusting pH anyway?

1. Clifton: I think for pH >9.0 it would be adjusted down and for a pH <7.0 it would be adjusted up. pH >9.0 may be too high for effective chlorination.
   - Linda: I have heard that higher source water pH can impact treatment costs.
   - Andy: Would you like staff/SAC members to look into this?
     i. Bill: Yes. Or if anyone knows from their practice.
     ii. Linda: I'll volunteer.
   - Connie: Just to be clear, are we asking if a high pH source water is a problem which would require additional treatment at the plant?
     i. Bill: I guess the direct question is: Does it present a problem for the plant if the water comes in at a higher pH?
   - Linda: I will follow up. Am I authorized to contact Tom Boyd directly?
     i. Andy: Dies anyone object?
        1. No objections.
2. Mike O.: Small item. Page 12 – Stated as "If you remove Piedmont lakes you get 1.xx for the 75th percentile secchi depth". The wording might be confusing here. Recommend replacing "If you remove Piedmont lakes…" with "For Piedmont lakes…"
3. Bill: Regarding Nathan's presentation: You talked about a reference (Hollister). Can you make that available?
   - Nathan: Yes.
   - *Update 8/16/2016, the paper is "Associations between chlorophyll a and various microcystin health advisory concentrations" and is available here: http://f1000research.com/articles/5-151/v2*

2. **NCDP SAC Update** (Steve Kroeger)
   a. See presentation slides See Attachments, page 29
   b. Steve updates the SAC on a number of items:
      i. Staff changes
         1. Carrie Ruhlman has left the Division of Water Resources and has moved to the Wildlife Resources Commission
         2. Steve Kroeger will be retiring at the end of September 2016

3. A new lead person for the NCDP has not been selected yet
    - *Update 8/16/2016 – The new point of contact is Jim Hawhee*.

ii. SAC member alternates
1. Steve asks all SAC members to select alternates and inform DWR staff of their selection

iii. Travel authorizations
1. DWR staff will put together TAs for the upcoming fiscal year (2016-2017)

iv. House Bill 1030 Section 14.13 – **Development of New Comprehensive Nutrient Management Regulatory Framework**
1. Steve mentions the new bill and its potential implications

v. EPA Nutrient Criteria Webinar – Lakes and Reservoirs
1. Steve mentions the upcoming EPA webinar scheduled for June 21, 2016

vi. Literature Compilations – EndNote
1. SAC and Albemarle literature has been uploaded to an EndNote database
2. This will be sent out to SAC members soon

vii. High Rock Lake – Technical Support Document
1. Steve mentions that the NCDP staff will be developing a document (white paper) to summarize the discussions the SAC has had regarding the development of nutrient criteria for HRL.
2. We will want to look at applying this information to all lakes & reservoirs in the state
3. The document will be sent to the SAC for review prior to finalization

c. Where we left off in April
i. Presentation and discussions of the following response variables:
1. pH (Clifton Bell)
2. Algae and Toxins (Nathan Hall and Astrid Schnetzer)
    - Water Supply
    - Recreation
    - Toxins
3. Dissolved Oxygen (Martin Lebo)
4. Aesthetics/Taste & Odor (Jim Bowen)
5. Turbidity (Mike O'Driscoll)
6. Fisheries (Marcelo Ardon)
7. Chlorophyll-a (Bill Hall and Clifton Bell)

ii. We still need to discuss causal variable (Total Nitrogen and Total Phosphorous) which we will begin doing today.

iii. Indicator Short List
1. This list shows the results following a SAC member vote to determine which parameters to continue developing criteria for HRL:

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

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

d. Questions/comments:
    i. None.

3. **Possible TN and TP Ranges for High Rock Lake** (Lauren Petter)
    a. See the presentation slides - See Attachments, page 29
    b. Overview
        i. EPA's February 2015 "Preventing Eutrophication: Scientific Support for Dual Nutrient Criteria" supports adopting both TP & TN criteria
        ii. Criteria can be done as loadings, concentrations, or both. There are pros & cons each way
            1. Can be harder to monitor when using loading based criteria because you can't just go and take a sample, you need the other data to go with it
            2. HRL already has a watershed model so loading information is already available
        iii. Will focus on magnitude first and then discuss duration & frequency toward the end
    c. Tools for Nutrient Criteria Development
        i. Various approaches: Reference Condition, Stressor-response Analysis, Mechanistic Modeling
        ii. Will focus on Reference Condition and Mechanistic Modeling for this presentation
    d. Selecting a Defensible Percentile
        i. Must be based on statistical reasoning. General guidelines:
            1. For small data set with greater heterogeneity, choose a lower percentile
            2. For a large data set with greater homogeneity, choose a higher percentile
        ii. Support percentile choice with scientific literature and other supporting info
    e. Reference Conditions
        i. Should support designated uses
        ii. Need not mean pristine
    f. HRL data analysis
        i. HRL

1. Almost 500 sampling points, excluded non-photic zone data
2. 12 stations, 30-years of records with 3 stations excluded due to small sample size
3. See slides #6-9 for summary statistics for TP & TN
    - Summary statistics tables for the entire data set and for the 2008-2010 sampling event.

ii. Questions/comments:

1. Bill: The x-axis are dates. Are those just individual dates when measurements were made or is that a uniform scale?
    - Lauren: Each vertical column corresponds to a particular sampling date. The data started around 1981 and the last year is 2012.

iii. See slide #10 for seasonality and segment classification slide

g. EPA's Lake Ecoregion Document
   i. Can use the ecoregion data as a resource
   ii. HRL is in ecoregions 45b and 45c
      1. 25th percentile of all season data, Ecoregion 45 = 0.0225 mg/L TP, 0.304 mg/L TN

h. All NC Lakes Chemical Data Spreadsheet
   i. See slide #12-13 for statistics summary
   ii. Used data from the 2015 Tetra Tech Report on NC Lakes funded through NSTEPS
   iii. Filtered for ecoregions 45b & 45c
   iv. ~4000 data points for TP & ~3000 data points for TN. Also ~ 3000 data points for chlorophyll-a

i. Region 4 States - Criteria for TP & TN in Lakes
   i. See slides #14-15 for criteria from other region 4 states
   ii. Florida, Georgia, South Carolina
   iii. Questions/comments:
      1. Marcelo (00:24:28): Georgia used a concentration criterion for TN, but a loading criteria for TP?
          - Lauren: It had to do with the modeling work that was done on these lakes.
      2. Andy M.: How are the criteria ranges used?
          - Lauren: They are used as bounds to show that if TN & TP fall within those ranges then it is very likely that the chlorophyll criteria (20 µg/L) will be met. There are also three different categories of lakes represented by these ranges.
      3. Bill (00:26:37): For Florida, do those numbers represent growing season averages?
          - Lauren: All of the numbers are annual geometric mean in Florida

j. Duration and Frequency

i. Short-term exposure may not be easily noticed
ii. Long-term exposure may be irreversible
iii. Current research on the effects of nutrients on ecosystem health and aquatic life provide basis for establishing criteria magnitude
iv. Understand and characterize nutrient dynamics
v. Match compliance monitoring with analysis used to support criteria development
vi. See slides for comparison of frequency & duration in EPA Region 4 states vs EPA
vii. What do we want to use for High Rock Lake?
    1. 2015 Tetra Tech Report on NC Lakes provides good information

k. Questions/comments:
    i. Connie: Question about the annual geometric mean not to be exceeded once in every three years. Do they do a geometric mean from Jan 1 to Dec 31 or is it rolling?
        1. Lauren: It's based on a calendar year.
    ii. Mike O.: Concerning seasonality. If you look at our long term data, we tend to have summer data and not annual data. Does that make it more difficult to look at annual averages?
        1. Lauren: It would make it harder if there is no data to represent the different times of year. It may be more appropriate to look at growing season instead.
        2. Bill: We would have to specify what measurements are made and how the criteria are applied.
        3. Lauren: Are you suggesting that annual would be better?
        4. Bill: No, suggesting that when you are basing the development of criteria on a set of data, the context of that data is important. If the data are based on July & August, then any criteria developed using that data should be applied only to that time period.
    iii. Pam: The way we typically monitor lakes right now is to do 5 samples during the 5 growing months (May-September) once every 5-years. So, every 5-years it's one snap shot of 5 samples. This leads to the question of what resources for monitoring will be available for sampling so that we can know how we can do assessment for lakes in NC. Right now we can't really do assessment for lakes because there's not enough data as defined in our assessment methodology which requires 10 samples for assessment.
        1. Lauren: We might be able to use other data (Ecoregion, Tetra Tech) to help fill in gaps.
    iv. Pam: I also want to mention South Carolina's standards and the repercussions we will have to deal with as a result. They are stand-alone standards for chlorophyll, TN and TP. SC is working on TMDLs for their Catawba lakes. A big portion of the loading is coming from NC. Based on modeling, they are saying that TP will control for chlorophyll-a and that reductions in TN will have no impact on chlorophyll-a, though they still have a TN standard. So, in this case, having a standard for TN will not

directly address a response variable (chlorophyll-a, for example). For HRL it would be better for us, from a modeling perspective, to make sure that any causal parameter standards that we may adopt has a direct connection to a response variable.

1. Hans: So there's no impact from the TN in those systems?
    - Pam: When they run the modeling there is no impact. Though it is still carrying downstream. We've seen this in the Catawba lakes. The TMDL for Lake Wiley resulted in TP limits for dischargers.
    - Hans: This is similar to what went on here in NC early on, but downstream protections still need to be considered.
    - Lauren: NC already has language in rule addressing the protection of downstream uses.

v. Jeff: You presented averages for TN & TP. I noticed that they are higher than what is presented in the Ecoregion data. So if the existing data show concentrations higher than what was published in the Ecoregions document, how do you get past that when establishing TN & TP standards?

1. Lauren: These are just bounds. In HRL there will be values that are higher. If you are doing percentile based standards, you don't have to achieve the Ecoregions values. EPA has guidance for 25th percentile, we would have to justify if we wanted to use different percentiles. Also, if you can directly show a relationship between TN and/or TP with a response such as chlorophyll-a, this helps support a decision to not use the Ecoregion value.
2. Jeff: It sounds like you would prefer that a TN/TP standard be coupled with a response variable if we don't want to use the Ecoregions value. There's a number for TN & TP published by EPA out there so if we want to use something different we will have to wrestle with that as we proceed.
3. Lauren: By demonstrating a relationship between the causal and response variables we can argue for why we feel whatever values we decide on are appropriate instead of using the Ecoregions values.

vi. Hans: Regarding the Georgia TN criteria (not to exceed in the photic zone): I don't feel that this would be appropriate for HRL. Not sure why they are focusing just on the photic zone as there can be a lot of variability there.

1. Connie: I think this is just for certain lakes in Georgia.
2. Lauren: Yes, I think there are about six lakes that this applies to. They may have done this due to the availability of data.
3. Hans: I don't think we want to fall into the trap of defining criteria just within the photic zone for HRL as it may not accurately represent the actual conditions in the water column.

vii. Martin: Embedded in reference approach is a presumption about the status of a water body. Use of a 25th percentile presumes that nutrients are too high. An

important question for HRL is it presumed that nutrients are too high and must be reduced, or are we talking about maintenance?

1. Lauren: We have talked about HRL impaired status.
2. Martin: We have had a lot of discussion about the impairment status of HRL. This group hasn't formally concluded that HRL is impaired. It's listed as impaired based on the current standards and we are discussing as a group what would be needed as standards to protect the water quality.
3. Lauren: As it exists, it is impaired based on existing standards.

viii. Linda: Hans has done a lot of work in Florida. I have doubts as to whether we would get as good a relationship of nutrients and chlorophyll as they do in Florida.

1. Hans: Florida doesn't have as big an issue with turbidity as NC does so there may be some variables there. I still think that chlorophyll is the best way to go, but we do have to take into consideration turbidity.

ix. Andy M.: Does any other state base their criteria on the reference condition approach in which the reference site wasn't defined as being pristine or close to pristine? Is use attainment part of the definition of reference condition?

1. Lauren: Florida did this for some streams. Yes, use attainment is part of the definition.

x. Bill: Regarding the question of meeting the EPA Ecoregion numbers: those numbers are guidance. Unless they are adopted into state standards they are irrelevant for assessing waters. Regarding other states using the reference approach: the one that stands out is Montana. They picked really low numbers, but then gave out variances to every discharger in the state. They were numbers that could never be met. Also, in Florida, they have used the reference approach, but Florida is a nutrient rich state. In one of the Ecoregion areas the TP criteria is 0.5 mg/L. That is a number that does not limit anything. It doesn't protect a use. The Ecoregion approach is not tied in to use attainment and criteria are supposed to protect a use and not just meet a statistical value.

1. Lauren: Reference condition does result in use attainment though it may not be tied to a specific end point. Ecoregion values provide a starting point and where more information is available other options can be explored.
2. Connie: Addressing Bill's comment: What Bill has said is actually correct. If a number exceeds the 25th percentile, that does not mean that a use is not attained.

xi. Mike O.: Since that document is from 2000, is there a plan to have updated data provided?

1. Lauren: I believe there is newer data up to 2012. Tetra Tech has more information in their report. There's also a lot of data available for other NC lakes that can be looked at.
2. Andy M. I recall that Tiffany previously mentioned that it was not EPA's intent to update that document

4. **Indicator Ranges Summary** (Tammy Hill)
    a. See presentation slides – Attachments, page 29
    b. Review of what indicators have been discussed so far.
        i. See slide #2 for the indicators that were selected by SAC members during the April 2016 meeting.
    c. Chlorophyll-a (slides #3-6)
        i. Chlorophyll had the most votes (11) to move forward for further criteria development.
        ii. See slide #3 for chlorophyll-a concentration ranges by designated use
            1. *HRL Measured Values* are maximum growing season geomeans from existing HRL data as compiled by Bill.
            2. *Aesthetics/Recreation* based on user surveys. Also incorporated some information on accidental ingestion during recreation.
            3. *Water Supply* are based on literature values (low end) and the closest point to the Denton WTP (high end) with an arrow indicating that treatment methods may allow for higher concentrations of chlorophyll-a in the source water.
            4. *Aquatic Life* based on literature that suggested various ranges from lows of about 10 µg/L to a high near 60 µg/L. An appropriate range may be based on the types of aquatic life being considered and the specific use being protected (ex: Bass fishery vs Trout fishery). The star represents a value of 25 µg/L which may be a concentration that we do not want to go below based on the species and uses specific to HRL.
        iii. Questions/comments:
            1. Hans: Regarding the ability to treat water supplies: Is that technology realistic?
                - Tammy: We may need information from water treatment plant operators on this. We have received some information from Tom Boyd (DWR Public Water Supply Section) on this (see slide #4).
                - Hans: Taste & odor can be independent of chlorophyll concentration. Algal species may cause taste & odor problems even if chlorophyll concentrations are low. We need some technical input on these processes
                - Martin: Is it that they can't me the water quality requirements or is it a dosing and operations issue?
                - Hans: Also, removing that much biomass may be a problem.
                - Bill: For facilities using surface water, they need to filter, control for DOC by adding activating carbon. So, these processes already exist and they typically can get out the algae.

- Lauren: Some of this discussion is getting into implementation. The thing to focus on is do we agree with the range that is here.
- Hans: I feel uncomfortable about that arrow. Until somebody can tell us more about this. These Chlorophyll values mostly represent integrated values, if a cyanobacterial bloom floats up to the surface it's going to be much at a much higher concentration. WTPs can get overwhelmed under those conditions.
- Tammy: So this may be OK as a theoretical range, but before a criterion can be developed we may need more technical information?
- Connie: If we can get someone from a water plant to come in they may be able to tell us where in that range chlorophyll concentrations may cause unreasonable impacts. We can then adjust the range based on that.
- Hans: They probably don't know a lot about chlorophyll-a, but they do know a lot about organic carbon. If they give us that information we can determine what organic carbon levels correspond with chlorophyll concentrations.
- Lauren: Do we want to include bloom related ranges? Doesn't NC have some documentation on how much chlorophyll = a bloom?
- Pam: That guidance was put together by Mark Van der Borgh. There is a pretty clear relationship between chlorophyll-a and blue-greens in HRL. We seethat once chlorophyll-a gets above about 30 µg/L in HRL the species profile shifts to being dominated by blue-green bacteria.
- Jing: We can also relate chlorophyll-a concentrations with cell density.
- Lauren: That may be a good response variable.
- Tammy: I think that this may fit better when we discuss the different approaches for developing nutrient criteria which we will probably do during the next meeting.
- Clifton: Regarding having someone come in to talk about treatment aspects: I offer to look for someone from a consulting firm to come and talk about this. They can provide their perspective on this from an engineering/consulting perspective.
- Connie: Maybe we can have both an engineer/consultant and a WTP operator?

2. Bill: Just an observation: The *Water Supply* number applies to the forebay only.
    - Connie: Are you saying that is should or that it does?

- Bill: It should.

d. pH (slides #7-8)
   i. pH had 10 votes to move forward for further criteria development
   ii. Both Water Supply and Aquatic Life uses ranges were identical (6.0-9.5 S.U.)
   iii. Questions/comments:
      1. Clifton: Jing had raised a question in a previous meeting about PCB leachability and pH. The reference provided showed that there is a relationship between PCB leachability and pH and that there could be a fish tissue concern. A few things to note: 1) In HRL, pH at the surface is where it goes above 9.0 and is more variable. 2) pH at depth is much lower, typically by 2 units and is more consistent over time. 3) According to the reference, the drop in pH leachability occurs to the greatest degree at pH between 5 & 6. Since the highest pH occurs near the surface in HRL, and the pH of the waters in contact with the sediment are much lower, my conclusion is that pH will not have a big impact on PCB leachability in HRL.
         - Hans: Did you look at the issue with unionized ammonia?
         - Clifton: We did. We looked at EPA's 2013 ammonia Criteria. Ammonia is very low in the lake and there's an inverse relationship with the ph. It doesn't appear that you would have a problem with ammonia toxicity based on the pH in HRL. That doesn't mean that there couldn't be issues downstream.
      2. Bill: How would we treat this as a pH standard? Will it apply "anywhere, anytime"? How do you look at it? As a surface sample or would it be integrated?
         - Clifton: I wouldn't look at it below the epilimnion because the fish won't be going there in the summer when the DO is too low. If you aggregate the epilimnetic data and look at the 90th percentile, even at the stations where it is currently impaired for pH, it would be very close to the existing standard of 9.0.
         - Tammy: Those thoughts about having zones within the lake can be discussed more during the next phase of criteria development.

e. Dissolved Oxygen (slides 9-10)
   i. DO had 10 votes to move forward for further criteria development
   ii. Current standards, Healthy Fish – Open Waters, and Healthy Fish – Deep Waters
   iii. Questions/comments:
      1. Bill: question about the current state standard, is there a provision for needing to meet it in deep lakes?
         - Chris: There is a narrative statement that says that lake bottom waters may have lower values if caused by natural conditions.

- Bill: So it does have that provision, but we have to consider if what we have in HRL is "natural".
- Martin: Isn't it deep water and tributaries?
- Chris: For lakes it just says "lake bottom waters." It also references "swamp waters, coves, and backwaters."
- Jeff: I would also first ask if it's a lake before you get to the "natural" condition.

2. Clifton: It might be good if this slide had bullet points as the other slides do raising the question as to whether we should be applying different standards to the deep waters. That may be something that we can't control.
    - Connie: I think we are really primed to do something like that. They have done that in other states where they are recognizing that the standard is not a one-size-fits-all value for every water body. I don't think EPA would disagree with that.
    - Clifton: It's not a question of what does the DO go down to, it's more how fast does the hypolimnetic DO get to below 1 mg/L. We may need a token criterion of 1 mg/L, but then have a variance when stratification occurs because we can't do anything to attain that DO standard.
    - Bill: You may remember I presented a chart that shows that some stations go down to 0 mg/L for just four months and then come back.
    - Clifton: And when you use a model, you're not modeling DO directly, you're modeling the hypolimnetic oxygen demand. You're saying you're consuming "x" amount of oxygen over the season, but you can't necessarily say when you are going to reach a particular level of DO.
    - Connie: so we have to be careful in how we write the rule so that we maintain protection of the uses in different areas of the lake while still acknowledging that there are conditions that will naturally occur.

f. Water Clarity (slides #11-12)
    i. Water clarity had 9 votes to move forward for further criteria development
    ii. Ranges for Aquatic Life and Recreation
    iii. Overlap in a narrow range
    iv. Recreation values often based on user perception
    v. Questions/comments:
        1. Martin: Most of the user surveys were from places like Minnesota and other places not typical of NC.

2. Tammy: One question that I had was if we are concerned about a maximum. If the lake is clear all the way to the bottom that may not be good for this situation.
    - SAC: Laughter.
3. Clifton: Mike, is this consistent with your presentation? I'm recalling that the existing conditions were something like 0.6 and 1 was a number derived from some other places. You were also talking about splitting the difference.
    - Mike O.: It does represent the range I was discussing, but that range was for areas unlike NC. The current 25 NTU Turbidity standard generally corresponds with a 0.5 m secchi depth. There are times when HRL violates that and there is data that goes under that 0.5 m secchi depth. Within the lake, the two more riverine stations had low secchi depths and high turbidity. If this is a case where the turbidity is due to high mineral concentrations being washed into the lake, it may be a challenge to differentiate between what's caused by nutrient related factors (chlorophyll-a) and what is not. Based on the data that we looked at for HRL, which was mostly summer data, HRL can meet the 0.5, but it seems less likely to meet higher secchi depths.
4. Bill: Just a caution: We are talking about numeric nutrient criteria. When you violate a water clarity standard because of turbidity that is not a nutrient issue. We need to consider how to characterize that with respect to nutrients.
    - Andy: Part of this is for you to decide which of these indicators you want to keep and which you may want to remove. Would you be making an argument to remove water clarity as one of the indicators?
    - Bill: Yeah, I would.
    - Deanna: Question for Bill. I agree with what he is saying. There is this interaction between water clarity, sediments, and nutrients. If you drop turbidity, would you then see more problems from the nutrients? How do you think of this interaction?
    - Bill: Do you mean turbidity vs nutrients? There's a "reasonable" relationship between water clarity and chlorophyll-a. We're already covering aesthetics in chlorophyll-a. If you leave it at chlorophyll-a, you don't have to worry about the effect of turbidity influencing the result.
    - Lauren: Could it be that water clarity remains an option for those parts of the lake not influenced by flow induced turbidity from minerals/sediments?

- Jim H.: In the Albemarle Sound workgroup there has been interest in water clarity for the purpose of submerged aquatic vegetation. This may not be a concern in HRL as there is little to no aquatic vegetation, but it may be important when we consider other lakes. I think it's good to come up with these specific indicators for HRL, but we should remain open minded about bringing back indicators when they are appropriate.
- Andy S: So what are we talking about now, HRL or all lakes/reservoirs?
- Tammy: We are talking about HRL. We may need to go through this process again when we start to look at all lakes/reservoirs.
- Andy S: Is there a consensus to throw out water clarity for HRL at this point?
- Jeff: I would like to clarify the question first. We have an existing standard for turbidity that applies to all waters. When you say throw it out, do you mean throw out the idea of refining the existing standard or do you mean throw out the standard entirely?
- Connie: For application to HRL.
- Bill: I think you keep the general water clarity standard, but not as a numeric nutrient criterion. So you can say that a combined effect of chlorophyll and turbidity has impaired water clarity, but it's not only a nutrient issue.
- Jeff: So if you don't set a specific standard for nutrient criteria purposes, the more stringent standard always applies. So the 25 NTU turbidity standard is still applicable to this lake.
- Jing: I just have a comment on the relationship between water clarity, chlorophyll and turbidity based on my experience with looking at the data. The turbidity value affects the chlorophyll concentration a lot. Areas with high turbidity can push the chlorophyll downstream to other parts of the lake where the turbidity is lower.
- Hans: I have a similar concern. I don't think you can divorce turbidity from nutrients. Sediments are a source of nutrients. If they get trapped in the system they are, ultimately, a nutrient source. The turbidity can actually qualitatively affect the phytoplankton by leading to a preference to surface dwelling cyanobacteria giving them an advantage.
- Clifton: Regarding the existing 25 NTU standard, is that for the protection of aquatic life or recreation?
- Jeff: It's in the aquatic life (Class C) rules.

- Connie: That is an old one. I'd have to check on why it was developed, but I believe it was for aquatic life.
- Clifton: I also don't feel comfortable divorcing the clarity from the nutrients. There may be parts of the lake where the chlorophyll-a is reducing clarity.
- Jim H.: When we talking about clarity we should be clear about what we are taking about. Is it secchi depth, turbidity, light attenuation. We monitor for secchi depth, but we don't have a standard for it. Though there is a turbidity standard.
- Tammy: I think turbidity is mixed in with this discussion of clarity. I think the current turbidity standard was equivalent to about 0.5 m secchi depth.
- Mike O.: The temporal variability in the lake is also important. Timing of sampling events following storms may be something to consider if you want to try to separate out the mineral vs the nutrient related effects on clarity.
- Deanna: If you already have a standard for turbidity that's separate from the nutrient standards, do you need another standard for turbidity based on nutrients? Do you need an additional standard for turbidity or are you saying we've already got a standard and let's leave it at that?
- Jeff: You could have two different standards. For example, the turbidity standard for Trout waters is more stringent.
- Deanna: But in this case it seems that the existing standard would be more stringent than what might be appropriate for HRL. I don't see how you could have a less stringent standard when a more stringent standard is already in place.
- Jeff: You could have two different standards based on the different uses. The more stringent will always trump the less stringent, however.

5. Martin: Is this indicator list for HRL only, or is this list something we will use going forward when we look at other lakes and reservoirs? Might we want to keep all of these indicators in mind for other lakes/reservoirs even if we decide a particular indicator is not appropriate for HRL?
    - Connie: I think our goal here is to consider what is appropriate for HRL and then we can reconsider any removed indicators when we begin to look at other lakes/reservoirs.
6. Clifton: My recommendation is to have the lower end of the range be 0.8 m secchi depth based on the information we have (slide #12).
    - Bill: What is the water clarity of HRL? Isn't it 0.6 m secchi depth?

- Tammy: I don't know off the top of my head. That wasn't part of the research that was done for this discussion.
- Bill: As far as we know, HRL is not impaired for anything from a designated use perspective. Shouldn't the low end of the range be at 0.6 m?
- Tammy: The ranges presented here came from the SAC members' literature reviews. That could be addressed in the next step.
- Bill: Maybe there should be another entry for what HRL is doing?
- Pam: There are a number of turbidity impairments in HRL.
- Connie: I agree with Pam. I really am having trouble with this statement that keeps getting repeated that the lake is not impaired. The lake is listed as being impaired for the purposes of this group because of the exceedances in the lake. We've heard this outside of this group as well (that there really is nothing wrong with the lake) and I really do disagree with that.
- Andy S: When I listen in as a non-expert I hear that it is impaired relative to certain regulatory limits and then other people are saying that it is not impaired relative to particular designated uses and both of those things are true we just need to clear on what we are talking about and not use short hand language.
- Hans: There are certain unknowns that fall on the impaired side. One of those is toxicity due to the occurrence of toxic blooms in HRL.
- Bill: Let me rephrase. There's no disagreement that there are exceedances of the chlorophyll-a, turbidity and DO standards. The fishery seems to be the best in the state. We haven't heard of any recreational use impairment, and we haven't heard that use of the lake as a water supply is impaired. From a use perspective, there don't seem to be impairments. And since criteria are to protect the uses, when you say it violates the criteria, but meets the uses there's a disconnect.
- Connie: There are additional statements that would argue that if a WTP is having to do additional treatments beyond what is considered normal then that is a partial impairment of the use. There are also pictures of people in the lake where they are covered in green goo. There are different perspectives, but under our current look at what we are dealing with, we are having to consider that the lake is impaired and we are having to consider that.
- Andy M: As a CIC member, we will be reaching out for cost related information and those people will, undoubtedly, be asking us

questions on this process so my question to staff is: As part of the SAC's work here, is staff planning on asking the SAC for a formal statement on whether the lake is impaired?

- Andy S.: Impaired relative to what?
- Andy M.: That's sort of the issue. Under the current standards it's impaired, but the SAC is looking at/rethinking those standards so it seems to be an open question as to whether there is an impairment. Will there be a "expert opinion" statement regarding the impairment status of the lake for the various uses?
- Clifton: I think we've had this discussion during each meeting so far and we will probably continue to have this discussion. What we are trying to determine is whether the use impairments are "real" impairment, as in the use cannot be attained. One of the things we've asked of people out on the lake (Yadkin Riverkeeper, DWR field staff) was whether they've seen things that might impact recreational use (scums, etc..).
- Andy S.: Going back to Andy's original question, will this board make some kind of finding with respect to is the lake falling short with respect to protecting/maintaining the uses?
- Pam: I think we'll have to talk about that. That wasn't in the charter for what the role of this group is. I don't know if we have the information to justify saying that it's not impaired. Studies to date have not been targeted towards investigation of impacts to designated uses. We have anecdotal pieces of info that say things are ok (fish are ok, people use the lake), but do we have to get to the point where there are fish kills before we say it's impaired? It's a tough question to define.
- Andy S.: So then the driver for this is more about the regulatory definition of impairment at least for staff. Short answer for Andy then would be no, we are not looking for this board to make a statement as to the impairment of the uses.
- Martin: To justify whatever numbers come out of this, if they are different to existing standards, we'll need to offer some opinion of impairment. If it's deemed that it's not impaired, but on the threshold maybe you don't go any higher? If it's deemed that it's too high and should go lower? Where that bar gets set is part of a statement of impairment based on expert opinion. We can't set a bar scientifically without that.
- Hans: Wanted some clarification on the drinking water issue. That is an area where we know there are toxic blooms occurring and there

are taste & odor issues. Drinking water has been stated as a use, correct? Since we don't have a lot of information on these toxins, we should want to err on the side of impairment until we are convinced that toxins are not a problem. The context of impairment being that it does exceed 40 µg/L chlorophyll-a and that cyanobacteria are a dominant feature of the lake while the data for toxicity is currently insufficient.

- Jim H.: HRL is next on tap for a nutrient management strategy. I've been hearing similar things from stakeholders (that HRL is fine). If that's what this group ends up recommending, then I think that's ok. I think this focus on designated uses is good, but to really focus on those we should come up with the criteria first and then see how the data we have compares to it. Until we do that it may be premature to talk about impairment.
- Bill: EPA has a guidance document on criteria development which is focused on toxics. Some of the guidance, however, is useful for nutrient criteria as well. One of the statements is that you have to have scientifically defensible data. You need to have the right data. Saying that you have to err on the side of caution is fine, but not when you are developing criteria, you need to have data. You can't presume that we are having algal toxicity impacts on the downstream WTP when we don't have any data to suggest they that they are having that problem. Clifton mentioned that we talk about uses every meeting. This is the first time we have heard that there is a documented impairment of recreation (green goo discussion) or that WTPs are having to employ additional treatment methods. Just having to treat more does not necessarily indicate an impairment. It does cost more, but that is not necessarily a use impairment.
- Hans: In that case, the jury is still out for toxins, we certainly can't say it is not impaired. What if it is a problem and has been a problem, but we say as a group that there is none. The data isn't there to make that call. There certainly is a reason to believe that it may be an issue based on the high chlorophyll-a concentrations in the lake.
- Andy S.: Why has this come up in the context of the water clarity discussion? Is it due to the uncertainty related to water clarity?
- Clifton: I think it's because with a lot of these parameters one of our options is to look at the existing state of conditions and that came up. I think on the toxins issue we have the advantage of being able

to look at data after the summer sampling is complete so we can discuss it further then.

- Clifton: One more thing, even if we decide that the lake is meeting its uses, that would not be a no-action alternative. As growth occurs in the basin and the lake ages you would probably take more of an antidegradation approach to protect the uses into the future.

g. Algal Toxins (slides # 13-14)
   i. Algal toxins had 8 votes to move forward for further criteria development
   ii. Recreation numbers were based on incidental contact and accidental ingestion
      1. Low end is for child, high end is for adult
   iii. Aquatic life and water supply came from WHO and EPA
      1. EPA added a safety factor of 1000 to those numbers to extrapolate rat to human toxicity potential
   iv. Questions/comments:
      1. Connie: The Water Supply number, was that from the work done for finished drinking water?
         - Nathan: Yes, that was based on what you drink.
         - Connie: Just a reminder, our Water Supply standards would look at those same factors (2 L/day, body weight, etc. …).
      2. Tammy: There was discussion about the ability of WTPs to remove dissolved toxins vs. suspended toxins. Not sure where that needs to be considered (in the tables).
         - Nathan: It adds another level of uncertainty. The total toxins will definitely be lower in the finished water than what's in the source water.
         - Hans: You might get more dissolved toxins depending on the treatment.
      3. Marcelo: Wanted to mention that USGS & EPA came out with a report from the National Lake Assessment and, from what I can tell, it seems there is some data from 2007 for two sites in HRL. They had 0.17 µg/L & 0.52 µg/L for total microcystin.
      4. Tammy: Jason wanted me to pass along that the HRL study is starting and data should be available later this month.
      5. Jim H.: Is anyone aware of any work on toxins that is being done other than for microcystin?
         - Connie: According to DHHS, they don't have any kits for cylindrospermopsin. They were hoping to get more data on anatoxin and saxitoxin.
         - Hans: I would say no in that we just don't know. I don't think that microcystin can just be used as a proxy for the others.

- Marcelo: This USGS report in only 27% did the three toxins appear.

6. Bill: Looking back at the notes from last session (page 7) it says Jim Bowen said that "References regarding WTP flocculation suggest that it does not release the toxins."
    - Hans: That's true, but other treatments can release the toxins. I know in Florida there is a study on finished water relative to source water. In ~20% of the cases microcystin was higher in the finished water than in the raw water due to the lysing of cells during treatment. I don't know if there's a difference in the treatment.
7. Tammy: I think UCMR 4 has a number for microcystin and another toxin.
    - Connie: It should be for intake and finished water for selected WTPs.
8. Bill: Why don't we grab some samples this summer?
    - Steve: For the summer study we will get toxins on the filters and in the filtrate. I'm not sure if we can get finished water. It may be a possibility.
    - Connie: Regarding the finished water might be tricky. We can ask WTPs to do this, but they don't have to participate as they are not required to do it.
    - Pam: Denton's intake is right below the dam, but water is not discharged from the surface where the algae are, discharged water is from below the photic zone, so I'm not sure we'll see those kinds of impacts.
    - Bill: While you're doing the sampling at the lake maybe somebody can grab some samples of finished water. It doesn't have to be from the WTP. You can go to the closest tap you can find.

h. Nutrients (slide #15)
    i. Questions/comments:
        1. Tammy: We talked about TN & TP earlier today. Do we want to add then to the indicator list for the future development of criteria?
            - Lauren: I think it's important to address. There was a lot of comments on some of the data from the Ecoregions document.
            - Clifton: Loads vs. concentrations would be something to consider first. I would recommend loads for this situation. Either as criteria or as waste load allocations, TMDLs, etc. If you have models to look at the loads and define it that way you are less likely to make assessment errors with independently applicable nitrogen & phosphorous. A lot of water bodies will assimilate the integrated effect of loads over time. That is why the Chesapeake does not use

TN & TP concentration criteria, but address those very stringently on the loading side.

- Martin: The loading in that case is to meet the standards in Chesapeake Bay so they weren't set as standards themselves?
- Clifton: Right.

2. Tammy: All we wanted to get to today was whether the SAC are going to want to look at developing criteria for TN, TP, etc. We probably shouldn't vote today as we don't have enough members.
    - Bill: What Clifton is saying is correct. When an environmental engineer looks at a lake problem they base their evaluation on loading. You need to collect the lake data anyway, but you need to additionally collect the loading data. Either way we would need to show a link between the load or concentration levels and the response variables we are considering.
    - Bill: With respect to load, my understanding is that the residence time in HRL is short.
    - Pam: Yes.
    - Bill: Like it can be as high as 5 days and as low as what?
    - Jing: I think the range is from 4 – 30 days.
    - Bill: That probably informs you as to the kind of sampling you need to do to characterize load. If the lake can wash out in five days, you need a lot more sampling.
    - Pam: We do have a watershed model that can help characterize the load.
    - Hans: But you cannot equate the loading with nutrient concentrations in the water because of sediment loads. One of the important things in the lake is internal loading when the residence time is long, because that is when you have your algal problems. You need to know TN & TP into the lake for sure, but also need the dissolved forms of those nutrients.
    - Martin: Not necessarily P. DWR doesn't do inorganic P anymore.
3. Andy S.: So before people volunteered to do presentations on what is known for the indicators and what some possible ranges are. Do we want that for TN & TP?
    - Tammy: I feel like that was what Laurens presentation was today.
    - Andy S.: So what more do you need?
    - Tammy: The previous process was to try and narrow down the indicator list so these are the remaining ones that have not been voted on to continue.

- Andy S.: Would anyone object to moving forward with TN & TP for nutrient criteria development in HRL?
    i. Clifton: Objects to nutrient criteria for TN & TP as concentrations.
    ii. Lauren: Would you feel that way if we can do magnitude, frequency and duration with confidence?
    iii. Clifton: It may lead to a situation where you are meeting all of your response variables which are closer to the use, but not meeting the TN or TP and therefore you are making an assessment error.
    iv. Bill: So, if we were to use concentration, it could be conditional based on other factors.
    v. Clifton: Similar to a bioconfirmation approach.
    vi. Nathan: How would you then deal with all of the other lakes in the state? Probably couldn't have a model for each one.
    vii. Clifton: Having a model or not does make a big difference in that so whether a model exists should play a role in that decision.
    viii. Hans: I have similar concern. I think you are putting a lot of faith in the model. There's a lot of things that we don't know in this lake that would have to be assumed. And aren't we measuring concentration anyway? They would have to be measured anyway to get loads.
    ix. Clifton: we do this a lot with other TMDLs nutrient strategies where we have a model and we regulate on that basis. The model would have to be of a certain quality.
    x. Lauren: Is there value for having both concentration and loading?
    xi. Jing: In looking at the HRL data, there was no relationship apparent between chlorophyll-a and TP concentrations. The only statistically significant relationship was between chlorophyll-a and TN during the summer and that was not very strong.
    xii. Martin: We're not really at a consensus on a path forward looking at TN and/or TP as possible criteria. I'm not sure how loading as a standard would work. We have a lower end of what might be derived out of reference conditions, but we don't' have a real range yet for HRL.
    xiii. Andy S.: Is there a proposal for either moving forward or not?

xiv. Connie: I'd like to recapture some of what was discussed. I'm not sure I've seen a standard written as a load. FL and GA have loads as TMDLs, but not as standards.

xv. Clifton: It's usually waste load allocations and load allocations as part of a TMDL or as part of some TMDL alternative.

xvi. Connie: Because loading is relatively straight forward to implement, but I don't think I've seen a standard.

xvii. Jeff: In Laurens's presentation she presented a slide that mention criteria as loading format.

xviii. Lauren: So, GA & FL have adopted into their standards loading based numbers. Those were derived from TMDL & modeling efforts, but they are in the standards as loads. It's easy to implement in permits, but hard to implement in assessment.

xix. Connie: Clifton mentioned translation. They did that in the Chesapeake, they do not have TN & TP, but they did translate upstream to a load/load reduction. This idea still holds merit. Next is the bioconfirmation approach. EPA did not approve our bioconfirmation approach for toxics, but they have provided information that bioconfirmation can be used for nutrients. That may be another possibility to add to a standard.

xx. Mike O.: How does the modeling fit in? Has there been an effort to construct a nutrient and water budget for the lake. If we could see the nutrient budget, we may be better able to understand loading & concentration issues. It may help focus things.

xxi. Pam: I agree. We can look at this once we get the final model from EPA.

xxii. Hans: It would be useful for now to have both concentrations and loads at least until we get the final model, then we can examine further.

xxiii. Pam: As far as in-stream or in-lake concentration criteria I'd point to the issue we're dealing with concerning SC (See above). Without some matrix approach it would be tough to do. For loading, it's very much tied to rainfall and it can be hard to tease out that concentration impact.

xxiv. Bill: I agree with Clifton. Concentration based criteria for nutrients don't tend to work, but maybe they will here?

xxv. Jim H.: I think if we drop TN & TP today, we may not get the rigorous review that the other indicators have received and that may be warranted. I think it will be important to document the approach taken so that we can more rigorously defend the choice to either keep or drop TN & TP.

xxvi. Astrid: Is there also emphasis on changes as opposed to nutrient concentrations? There is a time delay when nutrients enter the system and when you see some indication of the effects of those nutrients (biomass, etc.). Nutrient concentrations are not a good indicator of blooms because everything is usually depleted by the time the bloom appears. In terms of absolute changes with nutrients might be a good thing to keep in mind rather than finite levels of concentrations.

xxvii. Andy S.: Who wants to give us a presentation on what's available to move us forward?

xxviii. Connie: I would like more information on bioconfirmation from Lauren. Where it's been used and how.

xxix. Lauren: I'd be happy to talk about it. There are a few states that have attempted it. FL and some others.

xxx. Andy S.: What will we see for the next meeting?

1. Lauren will bring info on the bioconfirmation approach.
2. More discussion on TN & TP
    a. More literature reviews & background
    b. Staff will discuss, but it will be great for SAC members to brush up
    c. Clifton & Martin to discuss loading vs concentration criteria. Pros/cons.

5. **Cape Fear Data, Modeling & Potential Gaps** (Pam Behm)
    a. Presentation - See Attachments, page 29
    b. We looked at what monitoring was going on the middle Cape Fear and developed an analysis of where the monitoring sites are and what additional monitoring might be needed going forward.
    c. We are all starting together in the same place as opposed to HRL where there was a lot of existing data.
    d. What are we doing?
        i. Looking at monitoring needs to support the development of water quality models for the Deep/Rocky Rivers and Middle Cape Fear River.
        ii. This would serve a different purpose than what has been done in Jordan, Falls, or High Rock Lakes and may or may not result in a Nutrient Management Strategy

e. Why are we doing this?
    i. Need a tool to support NPDES permitting for nutrients.
    ii. Provide information on conditions associated with algal bloom frequency and duration.
    iii. Provide additional information on existing impaired waters.
    iv. Provide additional information for public water supplies (Fayetteville).
    v. Potentially support nutrient criteria, as described in the North Carolina Nutrient Criteria Development Plan (NCDP).
f. Who would be doing this monitoring?
    i. DWR
    ii. Coalitions – Upper Cape Fear/Middle Cape Fear
    iii. **BOTH** depending on available resources
    iv. Will be asking EPA for support
g. Where will this happen?
    i. See slide #5 for map of study area.
h. Parameters of concern (based on existing impairments, known concerns, and permitting needs)
    i. Nutrients (primarily nitrogen and phosphorus)
    ii. Chlorophyll-a
    iii. Dissolved Oxygen (DO)
    iv. Turbidity – indirect
    v. Algal blooms – indirect
    vi. Total Organic Carbon (TOC)
        1. Water treatment plant related
    vii. Others as identified by NCDP/Scientific Advisory Council(?)
i. Suggested modeling platforms
    i. Looking for feedback from SAC members on this. Currently looking at:
        1. Deep and Rock Rivers – SWAT
        2. Middle Cape Fear – CE-QUAL-W2
    ii. Questions/comments:
        1. Deanna: There have been at least two groups that have used SWAT on the Jordan Lake watershed (group at Colorado State, TetraTech). Will you use that work as a basis or will you redo SWAT?
        2. Pam: It would be for different time periods and we wouldn't be using the Jordan Lake watershed at all, it would just be as an input.
        3. Deanna: Will you be looking at The Nature Conservancy SWAT?
        4. Pam: Yes. There has been a lot of recent modelling work in these areas that we want to build off of.
j. Supporting Studies
    i. Bathymetry study – DONE (2015)
    ii. Rocky River special study – Summer 2016

1. Characterizing dissolved oxygen in the Rocky River

iii. SOD/Nutrient Flux behind locks and dams
1. Requesting assistance from EPA for this
iv. **Deep/Rocky Rivers monitoring gaps – Discussed in this presentation**
v. **Middle Cape Fear monitoring gaps – Discussed in this presentation**

k. Monitoring Gaps Study (See slides #10 -15)
i. NCDP Identified Task – due Dec 2014
ii. Monitoring targets
1. Identify monitoring gaps within the Cape Fear watershed
2. Where we would want to be calibrating and validating information
3. Want to make sure we had information that we could characterize in the headwater streams and tributary inputs to the main-stem of the Cape Fear.
4. For Deep/Rocky rivers, there is a draft study (not sure if it was finalized) that summarizes nutrient inputs from animal operations. This might help to get more targeting monitoring to help calibrate the models.
iii. Spatial view of monitoring gaps
iv. 9 Proposed monitoring sites
v. Parameters for proposed monitoring sites (see slide # 13-14)
vi. Storm event monitoring

l. Existing Stations (See slides # 16-18)
i. Current monitoring
ii. Additional monitoring

m. Summary

n. Questions/comments:
i. Connie: Mentioned the December 2014 animal operations study. Did that help you to determine where some of these addition monitoring sites should be?
ii. Pam: It did help. Raj took a look at the results to see where there were higher loads from sub-watersheds in the Deep & Rocky River.
iii. Mike O.: Is there flow data with the monitoring stations and does it correspond with USGS stations? Are there gaps in flow data from the tributaries?
iv. Pam: Yes, there are a lot of gaps with flow data, especially in the tributaries. There is some available USGS flow data.
v. Bill: Is the chlorophyll monitoring both planktonic and benthic?
vi. Pam: No, it's just planktonic. We could add that as there are some periphyton concerns in the system.
vii. Deanna: We're going to learn about this as you start monitoring. Will you be inviting USGS in to talk about the flow that they have seen relative to some of the blooms? I think they had an extensive report that suggested that the blooms are associated with the amount of water that was left out and with high temperatures. I'd like to better understand what they found.
viii. Pam: That's a great idea.

ix. Clifton: The Water Environment Foundation put together guidance on the use of nutrient modeling that may be helpful.
x. Astrid: How do you measure the different refractory carbon types and what does it do for you?
xi. Pam: I don't know. Raj has delved into that more, unfortunately, not here. He has used these measurements to help determine if swamp-like waters (not classified as swamps) were natural or based more on human impact.
xii. Andy D.: Have you decided on a baseline concept for modeling yet?
xiii. Pam: We had hoped to get monitoring going as soon as possible.

6. **Albemarle Update** (Jim Hawhee)
   a. Presentation - See Attachments, page 29
   b. We've been working on criteria development since August 2014.
   c. Working on concluding Phase I of our criteria development plan.
   d. Five of the SAC members are also on the Albemarle-Pamlico team: Martin, Hans, Marcelo, Clifton & Lauren. Anne is also part of the group.
   e. Project status (see previous presentations for details):
      i. Remote sensing evaluation (NASA): complete
      ii. DWR data classification and analysis (Tetra Tech): complete
      iii. National law and policy review (Sea Grant): complete
      iv. Literature compilation: complete
      v. USGS Albemarle Sound initiatives: some complete, one pending report
      vi. DWR supplementary data analyses: substantially complete
   f. January meeting: Case studies
      i. Review of 11 estuarine nutrient criteria case studies
         1. How criteria were developed in other estuarine systems around the country
   g. March Meeting: Data and Assessment
      i. Results of TetraTech report results
      ii. DWR assessment methodologies & monitoring approaches
      iii. Discussion of response variables for criteria development
         1. DO, clarity, and pH were especially of interest to the group
         2. No variables are off the table
   h. May meeting: Ecological Overview
      i. Various algal communities, fisheries, SAV
      ii. Background on benthics, geology, and system characteristics
      iii. Discussion of present modeling limitations
         1. Not a lot of flow data
         2. Challenges to developing a mechanistic model
   i. Planning Timeline:
      i. July: Evaluate response criteria proposals and associated research recommendations

1. Full day discussion on this

ii. September: Evaluate causal criteria proposals and associated research recommendations
1. Hope to have a cohesive list of criteria candidates/ranges and also ideas on what additional data may be needed.

iii. November: Draft report detailing Albemarle Sound proceedings and recommendations

iv. Winter 2016/2017: **SAC** and CIC review

v. Spring 2017: Final phase I report adopted

vi. Summer 2017: Research and Phase II proceed if necessary.

j. Albemarle Sound – SAC optional homework
i. Supporting materials presently on workgroup website for review.
ii. Criteria proposals will be posted on the workgroup website by July 6.
iii. Next Albemarle Sound meeting: July 20th

k. Questions/comments:
i. Clifton: The last meeting was really focused on the ecological status of the Albemarle Sound and was very enlightening as far as what are we managing the system for.
ii. Connie: It was one of the best meeting I've been to in a long time. It was a very informative meeting.
iii. Andy M.: I have a question regarding the distinction between the SAC here and the SAC subgroup that is participating in the Albemarle Sound workgroup. Is it still recognized as the SAC or is it something different?
iv. Jim H.: APNEP has a number of workgroups. This group seemed particularly well suited for a nutrient workgroup. I envision it as a separate, but parallel, workgroup. It's really important that any findings from this group go to both the full SAC & CIC. I'm no longer with APNEP, but going into phase II, we'll have to think about how to go forward. Hope by September we'll have a better idea of that.
v. Hans: One of the interesting challenges with Albemarle Sound is that it's one of the largest systems that we know the least about. One of the questions there is the productivity base in the system. What appear to be shifts from the benthic to planktonic dealing with eutrophication. There's a lot of good thinking about how nutrients are going to impact any potential shifts from the high SAV zones to more planktonic bloom phenomena. It is one of those systems that is experiencing insipient signs of eutrophication in the context of cyanobacterial blooms due it being a very fresh water influenced system. What's controlling the balance of planktonic vs benthic production in the system which is huge in terms of its benthic resources. The group is very well integrated in that regard.

7. Wrap-up
a. Meet again in August
b. Can expect approaches and indicators coming back

c. Last thoughts:
   i. Deanna: The conversation was very productive this week.
   ii. Lauren: I appreciate the points that were made on impairment status. I think that if we should keep focused on the indicators & ranges. That's the right goal as we move forward. Any future assessments we can deal with as we get them.
   iii. Bill: If you have information on impairments we need to see it. This is the first time we are hearing about some of these things and this type of information will be useful going forward.
   iv. Hans: I think we are making progress with the impairment issues
   v. Mike O.: I'm interested in that concentration vs. load for TN & TP.
   vi. Connie: For the presentation on approaches, Lauren has touched on it. There's another idea for the word approach. For the division, it doesn't matter if you come up with a single number as a criterion, some combination of numbers and narrative statements, multiple numbers based on specific caveats, etc. Even if it sounds complicated we are willing to work on that. We want it to work.

8. Attachments

Meeting agenda SAC-09-Agenda-June-2016.pdf	Indicator Summary 02-Hill-Summary_SAC20160614.pdf
NCDP SAC Update NCDP_SAC_Update.pdf	Middle Cape Fear Monitoring 03-Behm-2016_06_NCDP_MonitoringG…
Possible TN & TP Ranges 01-Petter-TN and TP Ranges for High Ro…	Albemarle Sound Update 04-Hawhee-Albemarle Sound Nutrient C…