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

11/14/2018

Attendees

SAC members in attendance:

Lauren Petter
Bill Hall
Linda Ehrlich
James Bowen
Clifton Bell
Astrid Schnetzer
Marcelo Ardon (morning)
Katie Martin (Marcelo's alternate, afternoon)
Michael O'Driscoll
Martin Lebo
Nathan Hall (Han Paerl's alternate)
Deanna Osmond

SAC meeting facilitator:

Jenny Halsey (Triangle J Council of Governments)

NCDEQ DWR staff in attendance:

Jim Hawhee
Connie Brower
Christopher Ventaloro
Nora Deamer
Brian Wrenn
Mike Templeton
Qaise Banihani
Pam Behm (via phone)
Leigh Stevenson
Tammy Hill

Criteria Implementation Committee (CIC) members in attendance:

In person:

Andy McDaniel
Anne Coan
Douglas Durbin

Participating audience members:

Jay Sauber (Sauber Water Quality Consulting)

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

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Meeting notes

All questions, comments and answers are paraphrased

1. **Convene** (Jenny Halsey, Brian Wrenn)
    a. Jenny H. introduces herself as the new facilitator for North Carolina Nutrient Criteria Development Plan (NCDP) meetings.
    b. Desired outcomes for today's meeting:
        i. Shared understanding of the High Rock Lake (HRL) schedule.
        ii. Shared understanding of exceedance frequency vs. confidence level.
        iii. Shared understanding and resolution of criteria development sequence.
        iv. Shared understanding and resolution of Chlorophyll-*a* criteria.
    c. Administrative business (Brian Wrenn)
        i. Meeting notes from the September 2018 SAC meeting are not ready yet. They will be distributed soon.
        ii. Will post meeting dates for 2019 SAC meeting soon.
        iii. Reminder that the next SAC meeting is scheduled for December 3rd and December 4th. This is a two-day workshop to focus on finalizing SAC chlorophyll-a criteria recommendations for HRL.
        iv. Update on October 2018 CIC meeting:
            1. Met to discuss the SAC response to the questions that CIC members had regarding the two pH proposals for HRL.
            2. There was consensus that pH proposal #2 was the preferred proposal from an implementation perspective.
            3. CIC is drafting a response document to provide their views to the SAC members.
2. **Schedule for High Rock Lake Criteria Completion** (Brian Wrenn)

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

a. Comments/questions:
    i. Doug D.: Concerned that the CIC is only going to be advising on a final product and not during the process of criteria development.
    ii. Brian W.: That is not the intention of the schedule. The CIC will still play a role in providing information regarding the implementation of the criteria that the SAC recommends to DWR.
    iii. Bill H.: This schedule is too optimistic, especially for chlorophyll-a. We don't have all the information that we need to decide. Ex: we have looked at chlorophyll-a criteria established for different lakes in different states, but we don't know why those numbers were chosen.
    iv. Brian W.: The SAC has been working on chlorophyll-a criteria for a long time now. Throughout this process staff have repeatedly asked SAC members to tell us the types of information that you need to make decisions. We are happy to provide any information that we can to help you answer any questions that come up. The SAC needs to let us know sooner rather than later what supporting information you need.
    v. Bill H.: Ex: Let's say a chlorophyll-a criterion of 15 ug/L was selected for a lake by another state. Which use was that number based on and why? This information is necessary if we are going to make comparisons to HRL.
    vi. Lauren P.: The information is there. We have discussed the designated uses for lake criteria set by EPA Region IV states. I can write up a summary of this.
    vii. Clifton B.: There will be a mix of information regarding this. Most of these numbers are based on best professional judgement of the state of a lake ["what feels right"] due to lack of data. For HRL it is better to use existing data.
    viii. Bill H.: What feels right is not enough of a justification when people might be spending millions of dollars as part of a management strategy.
    ix. James B.: The sequence of tasks is good.
    x. Astrid S.: We discussed this at the last SAC meeting and agreed that this timeline was possible.

3. **Chlorophyll-a – Considerations on Use of Exceedance Frequency vs. Confidence Levels** (Clifton Bell)
    a. See: "*Considerations on Use of Exceedance Frequency vs. Confidence Levels*" presentation slides
        i. Frequency is a fundamental part of water quality criteria:
            1. Acknowledges natural variability and use resiliency
            2. Allowable exceedance rates also a part of assessment methodology
                - Assessment hard to separate from frequency, need to consider both together.
            3. Acknowledges uncertainty related to: representativeness, persistence and sampling/analysis uncertainty

ii. Assessment errors:
    1. Type I error – water body not impaired but is listed as being impaired (false positive)
    2. Type II error – water body is impaired but is not listed as impaired (false negative)

iii. Current NC assessment methodology
    1. 10% exceedance with 90% confidence
    2. The 90% confidence limits occurrence of Type I errors
    3. Minimum sample size limits occurrence of Type II errors
    4. This works ok for not-to-exceed criteria

iv. Other assessment options
    1. Set a conservative magnitude
    2. Use the screening approach as proposed by Clifton Bell
        - Established an upper bound of 40 ug/L as geometric mean (limits type I error)
        - Established a lower bound of 25 ug/L as a geometric mean (limits type II error)
        - Uses narrative criteria to determine chlorophyll-a concentration for water bodies based on site-specific sampling data and use attainment. (addresses both type I and type II error)

v. Potential approaches
    1. Explicit approach
        - Uses not to exceed more than once in three years (1-in-3) frequency. Ex: Florida and Virginia
        - Calculate seasonal geometric mean each year.
        - The 2nd year of impairment results in the water body being listed as impaired
        - The 3rd year of data breaks a tie where there was one year of impairment and a second year that was not impaired.
        - Requires a minimum of two years of data
    2. Running multiple year average approach
        - All data is pooled
        - Extremes are averaged out
        - Can use statistical tests to reduce error
        - Need to determine a minimum number of years of data to have confidence
    3. Statistical basis for the 1-in-3 method
        - Important to note that this use of the 1-in-3 method is different from the use of a 1-in-3 frequency for toxics. For toxics the 1-in-3 is based

on recovery of aquatic populations following impacts to the ecosystem. For nutrients, Florida developed a 1-in-3 frequency based on statistical analysis using reference conditions. It is just a coincidence that they are both not to exceed more than once in three years

4. Considerations for applying the screening approach (with 1-in-3 frequency) to a chlorophyll-a criterion
    - Can address type II error rate when establishing the magnitude and the narrative components
    - 20% exceedance probability would mean uses attained in most years.
5. Considerations for applying a multiple year rolling average
    - Good for defining long-term averages
    - Need to set a minimum data requirement to have confidence
6. Concerning statistical tests
    - Small datasets limit the power of statistical tests to reject null hypothesis
    - Can get wide confidence levels with limited data. Makes it difficult to de-list impaired waters as management strategy would need to bring the chlorophyll-a levels down very far from the central tendency (geomean) of the water body
7. Regarding the comparison slide (pros & cons)
    - Important to recognize the different meaning of the magnitude for each approach:
        i. 1-in-3 – about the same as the 80th percentile
        ii. Multiple year average – about the same as the 50th percentile
8. Clifton's preference
    - Leaning towards a 1-in-3 approach as it has statistical basis and confidence using the upper bound-narrative-lower bound process.

vi. Comments/questions:

1. James B.: Regarding the use of the 1-in-3 frequency by Florida: Florida had reference sites and a lot of data to use in establishing the 1-in-3. We don't have that information for HRL. Can we do this for HRL?
    - Clifton B.: We can't calculate the 80th percentile from the data we have. If we use a target range it will work better. Ultimately it will be based on best professional judgement, but if we use a consistent framework (referring to the proposed screening approach) we will be able to establish magnitudes for each lake.

2. Linda E.: Which method better addresses type II errors?
    - Both methods (multi-year averaging & 1-in-3) work well. If considering the screening approach, those lakes that fall in the gray zone (between the upper and lower bounds) will be where the confidence lags.
3. Bill H.: The 1-in-3 frequency was established by EPA based on the time it takes aquatic ecosystems to recover from impairments. The discussion of type I and type II error has more to do with determining when there is an exceedance of criteria.
    - Clifton B.: Important to remember that the 1-in-3 frequency we are talking about here was established by Florida based on data and reference sites specifically for the consideration of nutrients. It is not the same 1-in-3 frequency that was established by EPA for toxics.
4. Marcelo A.: Which type of error is better to avoid?
    - Clifton B.: Best to limit both. The approaches presented here address both types of error. This can also be accomplished by establishing a very conservative magnitude, however that can cause other problems.
5. Martin L.: The 1-in-3 frequency approach works well for data rich systems. For data limited systems a 5-year assessment period may be better. If we go with an overall framework for selecting chlorophyll-a criteria in different lakes, we will need a framework that can be used for systems with limited data as well as those with more data.
    - Clifton B.: In NC we might only have 1-year of data in a five-year window. In that case, the assessment would need to consider older data to be able to determine impairment.
    - Nathan H.: When doing multi-year averaging, using older data can result in inaccurate assessment of impairment as trends change over time. If the data being used is too old, you are not getting an accurate picture of what the current situation is.
    - Bill H.: States typically set a limit on how far back in time they will look for data. Common limit is not farther back that 10-years.
    - Deanna O.: It is too confusing to use both methods. Should select one or the other.
6. Connie B.: Just to be clear are you discussing frequency or assessment methodology?
    - Clifton B.: The two are tied together.
    - Connie B.: Just a reminder, it can be very difficult to put assessment methodology into rule as part of a water quality standard. In the past

EPA has disapproved of us adding assessment language into our standards. Just want to make sure that the SAC understands that.

- Clifton B.: Both the 1-in-3 and multi-year averaging approaches can be written as the criteria frequency. Some of our decisions on how assessment might be done would not be written as part of the criteria.
- James B.: Florida has elements of assessment (seasonal average, geomean) in their criteria.
- Connie B. That was very prescriptive. Assessment methodology provides some balance to standards that are very prescriptive. Ex: The current chlorophyll-a standard is 40 ug/L. If you take a sample and is comes back as 40.1 ug/L would you consider the water impaired? Based on the standard the answer would be yes, but realistically it is unlikely that the water is impaired. The assessment methodology allows us to address this. If 9 out of 10 samples are below the standard, even if sample 10 is over the standard, the water body would not be considered impaired.
- James B.: We need some prescriptiveness. How we average will impact the selection of the magnitude.
- Lauren P.: Distinction between magnitude, frequency & duration vs. assessment is that magnitude, frequency & duration are all things that will affect use support whereas things such as sampling requirements or choosing how to combine data are more on the side of assessment.
- Linda E.: Concerned with putting the state in a box regarding how to determine impairments. Referring to Connie's example of a chlorophyll-a value of 40.1 ug/L: the precision of the testing itself is limited. I don't think making a decision on a 40.1 being an exceedance is valid because of this lack of precision.
- Clifton B.: With seasonal average approach you will never have a 40.1 causing you to exceed the criteria. The 40.1 would have multiple numbers beneath it.
- Andy M.: Regarding modeling results: I think that falls in the realm of assessment and it can make a big difference in the selection of a magnitude, duration and frequency.
- Michael O.: An important step here would be to look at past data for HRL and compare that with the frequency approach we select. Then we will have an idea of how the new approach compares with how DWR has been assessing waters and how the new approach might

impact the occurrence of impairments. Is the new approach more protective, less protective, the same?

- Jenny H.: Does everyone agree with that?
- SAC members agree.

7. Nathan H.: What happens if you set the standard at 40 ug/L and the geometric mean comes back as 40.1 ug/L?
    - Clifton B.: Still feel confident in the impairment because the standard of 40 ug/L was set high enough that there is a very low probability of having a type 2 error.
    - Bill H.: To avoid issues with rounding, let's say that the geometric mean was 41 ug/L and the standard was 40 ug/L. You get what you get. That would be an exceedance of the value that was selected. The question is then do you want to use a confidence interval when doing the assessment to help address this issue? We live with the value that we pick.
    - Clifton B.: Concerning the confidence intervals determined from the geometric mean for the different lakes in NC (see slide #11): The confidence intervals are very large. If we set site-specific standards based on the geometric mean for individual lakes it will be hard to both prove an actual impairment and to prove that conditions are suitable to remove a lake from the impaired list. Ex: from the perspective of being protective, if a lake is considered impaired based on assessing vs the geomean, it may be hard to prove an actual impairment because the confidence interval is so large. Likewise, from the perspective related to the cost and effectiveness of management strategies, trying to prove a lake is unimpaired would also be difficult because the lake would need to meet a value that is far below the geomean. The screening approach and narrative assessment might be better at addressing confidence.
8. Brian W.: There has been a lot of discussion related to implementation today. Want to remind the SAC that implementation and cost should not be a part of the discussion concerning development of criteria. Your role is to develop scientifically defensible criteria. The CIC will consider implementation concerns in their discussions.
9. Jenny H.: Does the SAC need to decide on this today? Do we need to get the SAC the past data from HRL as was requested by Michael O.?
    - Brian W.: These discussions will inform the discussion for this afternoon.

4. **Chlorophyll-a Frequency/Duration drives Magnitude vs. Magnitude drives Frequency/Duration** (Lauren Petter)
    a. See the document titled "*Compilation and Writer Up for Possible Flow Chart Scenario Formats*" here
    b. Sent out an email in mid-October that contained scenarios based on the flowchart discussion from the previous SAC meeting.
        i. This exercise highlighted the duration & frequency first approach.
        ii. Wanted to take a few minutes to discuss why all three criteria components are important to consider as opposed to just focusing on frequency and duration.
        iii. Traditionally come up with an endpoint (magnitude) that will protect the uses. That then drives decisions going forward. Start with endpoint of concern.
        iv. Included reminder of how this is done. Use literature, reference conditions, other existing knowledge. Ex: Clifton's presentation discussed Florida's use of a 1-in-3 frequency, but there was a magnitude for chlorophyll-a that served as a starting point for that decision. This magnitude was 20 ug/L based on shifts in trophic conditions and it guided the development of TN & TP criteria. That became the criteria we discussed today.
    c. We've been chasing different points in our discussions (treatability, what HRL actually has, etc.). That is good information to know but I wanted to go through the exercise of writing down the endpoints that we are interested in (without going back through everything we've already discussed). With that list we can see if we are noticing similarities with the way we've talked about things or if there are things we need to make group decisions or things that might influence our decisions.
    d. Not wrong to come up with a value that is inherently protective.
    e. A good example of this being done comes from the decision document from Texas (this has been sent to SAC members). Outlines the work EPA did to independently validate the assumption that existing conditions were ok. Looked at: 303(d) list, increasing trends and microcystin occurrence.
    f. Example: Paper by Lester Yuan (Lauren will provide to SAC) discusses figuring out chlorophyll-a and TN concentrations associated with specific microcystin concentrations and exceedances over the 1 ug/L microcystin benchmark. We can do something similar. Example language: "*A 10% occurrence of microcystin greater than 1 ug/L results in total nitrogen concentrations of x and y and pairs with chlorophyll-a concentrations of x and y. All values are instantaneous.*"
        i. This considers chlorophyll-s, TN and microcystin. All things we need to consider for HRL.
    g. Also want to talk about something I heard during the last CIC meeting where one of the CIC members mentioned that they were aware of lakes downstream of HRL being 303(d) listed for pH. Implies that the downstream uses are being impacted. Need to keep this in mind as

we proceed. Suggests that a tighter number than the existing chlorophyll-a standard may be appropriate.

h. Want to compile a list of magnitudes that we feel are reasonable options for protection of uses in HRL.

i. Comments/questions:
    i. Martin L.: Not necessarily true that the number we would select will be lower than the current standard because HRL is not meeting it.
        1. Lauren P.: Agree, meant to say lower than the existing condition.
    ii. Marcelo A.: Like talking about endpoints. Not clear to me what a protective endpoint is? What does it mean to have a lake where the uses are being protected? Easy to say there are fish kills, algal blooms. These are not protective and if we get there we have gone way too far. Is there a way we can say what a reservoir meeting its uses looks like?
    iii. Clifton B.: That's something we've struggled with. About two meetings ago I put up a chart that showed what use attainment and non-attainment looked like. This was determined numerically and narratively. There were some primary causes of impairment (things that results in direct impacts to the uses) and some secondary causes of impairment (things such as cyanotoxins). Do we want to look back at this?
    iv. Marcelo A.: I want to hear from DWR staff what this means. Is there a description of this?
        1. Nathan H.: Would like to hear what this is without invoking current water quality standards.
        2. Brian W.: There are different ways to look at this. There's a range of what is a healthy lake based on comparing different lakes. Also, within HRL there are a range of conditions that would suggest what is healthy or not healthy. The spread of that range is largely in debate by the SAC. Standards are used because they are based on scientific information and decision processes that inform us whether something is working. We then implement that at 10% exceedance with 90% confidence to let us know if we have exceeded these conditions and whether we are confident that that is true. Some wiggle room built in. We also use bioconfirmation to support decisions.
        3. Connie B.: This is challenging to answer because the availability of uses will vary. One day the water may look clear and people would swim in it, but on a different day there may be a bloom and people might decide not to swim. It can be somewhat of a judgement decision as to whether a lake is "impaired" at any given moment.
        4. Bill H.: Criteria are established to protect the uses. If criteria are met there should be no observable impairments. Challenge comes from being able to

correlate values to direct impacts to uses. Ex: cyanotoxins can cause a direct impairment of uses but at what concentration of toxin does that occur? Also, what concentration of chlorophyll-a correlates to that level of toxin?

5. Marcel A.: But you don't want to reach a level of impairment.
6. Bill H.: You can build in a safety factor but, per EPA 1985 guidelines, you can't be over or under protective. (references the EPA Stephen et al. 1985 "*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Life and Their Uses*" PB85-227049)
7. Astrid S.: 1985 was a long time ago. We know more about algal ecology and toxins now and we need to consider that information.

v. Bill H.: We first need to pick an impairment threshold.
   1. Connie B.: Wouldn't that threshold also be a judgement call?
   2. Bill H.: Ex: if using clarity to determine recreation use impairment we would need to show that a Secchi depth did or did not result in an impairment.
   3. Michael O.: We went through this exercise a few years ago. Evidence from other states indicated a Secchi depth that correlated to people not wanting to swim in lakes. That was a Secchi depth of about 1 meter.
   4. Bill H.: I agree with Mike. James B. and I did a presentation on this earlier and determined that the Secchi depth associated with the desire to swim in a lake varied by location. User surveys were not found to be useful because of this.
   5. Lauren P.: Regarding the screening range: the lower bound would be the criterion.
   6. Clifton B.: I have a fundamental disagreement with that. The NCDP calls for the SAC to develop a framework for developing criteria not for coming up with a numeric value that applies to all lakes in the state. Because of this it is easier to develop a range of criteria with upper and lower bounds. This can then be used by the state to determine criteria for specific lakes.
   7. Jim H.: Setting a state-wide chlorophyll-a standard would be difficult. The NCDP plan is focused working on site-specific criteria. The lesson learned from that process would then be used to develop broader criteria.

vi. Astrid S.: I'm not sure what we are talking about anymore. Are we looking to develop a single value or multiple values?
   1. Brian W.: Jim H. laid it out well. We wanted to use site-specific projects to inform the broader development of state-wide criteria for nutrients.

vii. James B.: I like the idea of a range. When Lauren is talking about coming up with a number to apply to multiple systems wouldn't that be the low end of the range?

1. Clifton B.: Site-specific criteria are specific values. For the range, the bound describe the extremes. That means, based on my proposal, we wouldn't set criteria higher than 40 ug/L (geomean). For specific lakes we would use a narrative process to develop a criterion specific to the conditions in that lake.

viii. Astrid S.: My interpretation was that we need to look at multiple criteria to assess impact of synergistic effects. Maybe the value determined by the synergistic effects would be the lower bound?

1. Clifton B.: The lower end would not be the criteria for a lake unless the potential for impairment exists.
2. James B.: Are we at a point of using multiple indicators to tie to chlorophyll-a to establish the upper and lower bounds? Don't we need to consider all endpoints that provide a positive outcome? That would be the low end. Then do something similar for the high end. We would need to do this first and then come back to HRL to select a site-specific criterion.
3. Clifton B.: Our proposal provides the process for this.
4. James B.: But first we need a methodology for establishing the upper and lower bounds. For the low end we need to look at all the endpoints and to determine what is protective. We then need to do the same thing to determine where impairments begin to establish the upper end of the range.
5. Clifton B.: Agreed. The literature can inform the low end. Upper end of the range would be based on best professional judgement.
6. Astrid S.: Did you have in mind a range for synergistic effects? Maybe weigh the criteria based on potential for impairment?
7. Clifton B.: Intention was to have a range for each indicator. We could suggest guidelines for determining impairment of waters based on multiple criteria.
8. Marcel A.: Would the criteria be the range?
9. Clifton B.: The criterion is not expressed as a range. We would select the criterion from the range and it would be a single number. Question is how do you get to that number within the range? Range is to decide what the criterion should be.
10. James B.: We would look at the site-specific conditions to determine the appropriate criteria to apply.
11. Bill H.: Criteria are not additive. They are independently applied.
12. Connie B.: The SAC has talked about including biological confirmation as part of the process in the past. Biological confirmation would be a measure of additive effects.

13. Bill H.: If biology is determined to be impaired it is impaired. If we measure pH and DO and either are above the criteria, then the individual parameter is considered impaired. They are not combined to determine impairment.

ix. Clifton B.: We spend a lot of time working on the flow chart that James put together during the last few meetings and we agreed to follow that flow chart to determine chlorophyll-a criteria for HRL. I recommend sticking with that flow chart. Does everyone agree?
    1. James B.: Agrees that magnitude and assessment methodology are linked but thinks that SAC can at least select the low end without needing to know the assessment method. If going through conversation about each of the different indicators it may not fit in the flow chart process.
    2. Clifton B.: I can't agree to a number unless I know how it's calculated. The flow chart puts the selection of magnitude at the end of the process.

x. Linda E.: Are we looking at working on state-wide standards or developing the framework to make that determination.
    1. Jim H.: The NCDP plan is laid out to develop site-specific criteria for HRL. This will inform how to develop state-wide criteria.
    2. Astrid S.: As I understand it we are working on developing a process which we can use to develop state-wide criteria.
    3. Clifton B.: We agreed to move forward with the framework. We should do that.
    4. Deanna O.: Agreed.

xi. Bill H.: Criteria usually developed using data related to an impairment. That is used to come up with a magnitude. This drives the averaging.
    1. Clifton B.: If basing the magnitude on quantitative relationships then yes.
    2. Martin L.: Do we focus on the data or on whether the uses are being met? How is the chlorophyll-a data best integrated to determine that?

xii. James B.: When it comes time to address magnitude, we will need to address the frequency as well. Do we talk more about the assessment method for HRL or begin a range setting discussion?
    1. Bill H.: The range numbers need to be reconciled.
    2. Lauren P.: I was trying to point that out. We need to be able to discuss magnitude before we go much further. Concerned that it will be difficult for us to address magnitude once we start making decision about frequency. We had this issue with the pH proposals. Once the proposals were structured it made it harder to go back to address concerns about the pH magnitude options.

xiii. James B.: Clifton's proposal has a seasonal geomean with a 1-in-3 frequency. This is workable.

1. Clifton B.: Makes a non-binding motion to move forward with seasonal geomean and a frequency of not to exceed more than once in three years (1-in-3).
2. Nathan H.: A seasonal geomean is a good measure of central tendency, works well for modelling and can incorporate statistical methods.
3. SAC defines pros & cons of using the proposed duration & frequency for chlorophyll-a criteria

Pros	Cons
Log normal	Not a good measure of biomass
Models predict geomeans better than arithmetic means	Temporal averaging loses distribution data
Easier to apply statistical methods	
Better for long-term tends (chlorophyll-a is concern for chronic effects not acute effects)	
Good measure of central tendency	

xiv. Brian W.: Will there be criteria for outside the April to October averaging period? Clifton mentioned possibly using narrative criteria to determine this. What would that look like? There has also been concern expressed about the smoothing out of the high and low chlorophyll-a vales when using a geometric mean. The high spikes are a concern. How will that be addressed?

xv. Lauren P.: What is meant by chlorophyll-a not being an acute issue?

1. Nathan H.: The long-term chronic effect related to excessive biomass is the concern.
2. Astrid S.: I don't agree with chlorophyll-a not being an acute concern. Harmful algal blooms are ephemeral acute events.
3. Nathan H.: HABs cannot be addressed through traditional management strategies.
4. Lauren P.: Can this be addressed with a separate criterion?
5. Martin L.: This can be addressed by choosing a lower chlorophyll-a magnitude. That will keep the overall levels of chlorophyll in the lake on the low side which should help prevent blooms.
6. Astrid S.: There a big difference in the upper end of the range though. Chlorophyll of 60 ug/L is a lot different than chlorophyll of 150 ug/L which can easily be reached in blooms.
7. Bill H.: This is how it is done in other states. The standard lowers the overall level of chlorophyll-a in lakes which reduces the occurrence of high peaks. This can also be addressed with narrative criteria.
8. Brian W.: Another approach would be to assign a not-to-exceed component.

9. Astrid S.: Can we amend the proposed geomean to account for the extremes?
10. James B.: Switching to an arithmetic mean gives weight to the higher values.
11. Clifton B.: We are targeting distribution. Set the geomean at a level that will limit the high end. We can add a high-end value as well.
12. Katie M.: Have the group discussed using a median?
13. SAC members: Not sure.
14. Astrid S.: I don't generally think about using a geomean with low availability of data. Can we adjust this to account for acute?

xvi. James B.: I propose using a geomean with a statistical test. This would account for distribution. The null hypothesis would be rejected if data points are too scattered.

xvii. Bill H.: What is seasonal. Need to state that.

1. Clifton B.: April 1 through October 31 with at least five months of data available.

xviii. SAC agrees to move forward with Clifton's non-binding proposal as follows:

1. Seasonal (April 1-October 31 with at least 5-months of data) geomean and a frequency of not to exceed more than once in three years (1-in-3).

j. Discussion returns to the 1-in-3 topic.

i. Martin L.: How does the 3-year component work with the current 5-year sampling period?

1. Clifton B.: It would be up to DWR. Would need at least 2-years of data with at least 5-months of data available for each year.
2. James B.: So, since sampling is only done once every five years they would need to look back to older data to get the required 2-years of data for the initial assessment. Then they would need to go back even further to get a third year of data if the first two years disagreed (1 below criteria, 1 above criteria).
3. Astrid S.: Is there a limit to how far back in time staff could go to get useable data?
4. Mike O.: HRL has a short residence time. Would not want to go too far back because conditions can change quickly.
5. Lauren P.: They would need to go back as far as necessary to be able to meet the data requirements.
6. Doug D.: It sounds like you are discussing assessment and implementation rather than frequency. It's hard to do this without having the data to see what this would mean in the real world. Can this exercise be done?
7. Brian W.: DWR has provided HRL data regarding geometric mean vs. arithmetic mean. This exercise wouldn't result in anything without a defined magnitude.

8. Doug D.: Could apply the existing chlorophyll-a standard (40 ug/L) to illustrate effects of these decisions.
9. Clifton B.: We will get to the magnitude.
10. Jay S.: The EMC has recently determined that DWR can go back to the previous 5-year period.
11. Pam B.: Want to remind the SAC that the EMC determines what the assessment methodology is. There is no guarantee that the existing methodology will not change. Good to keep this in mind during your discussion.
12. Astrid S.: We should consider adding a component that addresses years with extreme conditions.

5. **Magnitude Discussion** (SAC members)
    a. Clifton B.: Do most SAC members agree with the screening approach (Clifton's proposal using an upper and lower bound for chlorophyll magnitude and a narrative component to determine site-specific chlorophyll-a magnitudes)?
        i. Connie B.: To be clear are you asking for the screening approach to be used to develop criteria?
        ii. Clifton B.: Yes.
        iii. All Sac members agree to the use of the screening approach.
    b. Jenny H.: Does the SAC want to start with establishing what the lower bound of the screening range.
        i. Lauren P.: I want to further discuss the magnitude related to the low end of the range.
    c. Nathan H.: Presents some ideas related to establishing a relationship between cyanotoxin concentrations and chlorophyll-a concentrations. Information is based on a published paper.
        i. Cyanotoxins are a direct measure of a lake meeting the designated uses.
        ii. Current EPA draft microcystin for protection of recreational use = 8 ug/L.
        iii. Can use existing data from the National Lakes Assessment to relate cyanotoxins to chlorophyll-a, though the confidence levels will be high.
            1. Jay S.: Agree with this approach but want to caution using the national lakes data. That data is dominated by natural lakes. Not sure if the same relationships would exist in HRL.
            2. Connie B.: Did they look at cylindrospermopsin as well?
            3. Nathan H.: Not in this paper.
            4. Bill H.: There are caveats with this. Is the 8 ug/L the threshold? NC should adopt the value as a water quality standard first to give it more strength. EPA has guidance for how to establish these stressor-response relationships. If this can be done so that it meets the requirements of the EPA guidance it would be good to use.

5. Nathan H.: True. Not sure if the 8ug/L is the best number. I would hope we would be able to determine this together.
6. Nathan H. Offers to look at this with HRL data and using data from the national lakes assessment that corresponds to southeastern reservoir systems.
7. Nathan H.: This relationship may be able to inform on the potential risk associated related to the developing problem of harmful algal blooms.
8. Martin L.: I would feel better about this approach if the other southeastern reservoir systems in the national lakes assessment report are similar.
9. Astrid S.: Only a few of the lakes sampled (~15%) had detects for microcystin.
10. Linda E.: This goes back to algal populations. High chlorophyll-a may occur with the potential for algal toxin production.

iv. Clifton B.: We've done this work already. Can we go back and review it?
   1. DWR staff pull up the chlorophyll-a range presentation from June 2016.
   2. Clifton B.: This is where the lower bound of 25 ug/L was taken from.

v. Jenny H.: So where do we go from here?

6. Wrap-up

a. Next SAC meeting is a 2-day workshop focused on finalizing a recommendation for chlorophyll-a criteria for HRL. The workshop will be held on December 3rd and 4th, 2018. The agenda for this workshop will be made available soon.

b. Brian W.: assigns homework:
   i. Each SAC member will come up with a number (or numbers) that they feel are appropriate to use as a magnitude.
   ii. The choice of the magnitude needs some scientific basis that it is protective of the uses.