NC Nutrient Criteria Development Plan – Scientific Advisory Council (meeting #12) 3/22/2017

Attendees

SAC members in attendance:

Lauren Petter
Bill Hall
Linda Ehrlich
Clifton Bell
Deanna Osmond
Michael O'Driscoll
Nathan Hall (alternate for Hans Paerl)
James Bowen
Martin Lebo
Marcelo Ardon
Bill Hall
Hans Paerl

SAC members online:

Astrid Schnetzer

SAC meeting facilitator:

Andy Sachs

NCDEQ DWR staff in attendance:

Jim Hawhee
Tammy Hill
Mike Templeton
Connie Brower
Pam Behm
Jing Lin
Christopher Ventaloro
Jeff Manning
Jucilene Hoffman
Cyndi Karoly
Bonghi Hong
Nora Deamer
Brian Wrenn
Rich Gannon
Joseph Smith
Raj Rjbhandari
Elizabeth Fensin
Christofer Vande Zande (DWR intern)

CIC members in attendance:

In person:
Andy McDaniel
Anne Coan

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** (Andy Sachs)
    a. SAC members, DWR staff and audience attendees provide names and affiliations.
    b. Facilitator asks for approval on meeting notes from October 19th, 2016 SAC meeting (meeting #10)
        i. No comments on meeting notes
2. **Staff updates** (Jim Hawhee/Brian Wrenn)
    a. Brian Wrenn, supervisor for DWR Ecosystems Branch will be taking over coordination of the NCDP beginning in May.
    b. On April 22, 2017 at 2:00 p.m., Astrid will present (via the web) the results of the cyantoxin analysis from the HRL summer study. DWR will host the presentation.
    c. The next CIC meeting will be held on April 17, 2017 from 9:00.
3. **Presentation of findings: High Rock Lake Dissolved Oxygen & Criteria evaluation and resolution: High Rock Lake Dissolved Oxygen** (SAC members)
    a. Clifton's proposal:
        i. Maintain existing water quality standard for fresh surface waters.
            1. All adjacent states have similar standards for lakes/reservoirs.
            2. Based on EPA's Quality Criteria for Water 1986 (EPA 440/5-86-001; "Gold Book")
            3. The instantaneous minimum of not less than 4.0 mg/L is appropriate to protect for acute exposures especially for protection for early life stages.
            4. Some choices to make regarding the daily average of 5.0 mg/L:
                - Keep the daily average as is → this may be more appropriate considering the way assessment monitoring is performed (sampling once/month during the summer season, typically)
                - Move to a weekly average of 6.0 mg/L.
            5. Probably not appropriate to establish a standard for hypoxic volume. Would be difficult to assess and regulate.
        ii. Questions/comments:
            1. Bill: Is DO a nutrient criterion?
                - Clifton: It is nutrient related, but is also related to other factors.
                - Bill: I don't disagree with the current numbers, but concerned that a failure to meet a DO standard should not trigger nutrient management, it should trigger further examination as to the cause of the problem.
                - Martin: DO is not a nutrient based criterion, but it is a nutrient influenced criterion.

2. Lauren: Based on the HRL summer study diurnal data there appears to be wide swings in DO. Is there interest in collecting more data to see if there needs to be a diurnal criterion? Also, do we need to address DO saturation?
    - Clifton: Some states have diurnal DO criteria, but I don't believe that there is evidence in the literature to support it.
    - Clifton: Regarding DO saturation, NC has an existing standard for total dissolved gases of 110%. When talking about total dissolved gases, it considers more than just dissolved oxygen. Even if you consider it to be all DO, toxics effects due to oxygen saturation don't tend to occur until at much higher levels than 110%. The chlorophyll-a criterion may better address this concern.
    - Bill: To address Lauren's questions:
        i. Should there be a DO saturation criterion? No. EPA does not have guidelines for this and the toxic effects are more associated with ~~mg/L~~minimum concentration exposures.

        ii. Do diurnal DO swings indicate a problem?
            1. Not necessarily. It is good information to have that can help to point out where a problem may be, but high saturation levels and DO swings are generally associated with high chlorophyll concentrations.
    - Jim H.: Even though the total dissolved gases standard is not the same as DO saturation we are seeing some high saturation levels (>200%) in HRL. Literature has mainly focused on exposures to fish. Is there concern for other organisms such as zooplankton?
    - Brian: Also, did the literature discuss behavioral impacts to aquatic life? Chesapeake Bay report indicated that low DO may impact striped bass feeding behavior.
        i. Martin: Are we going to consider managed species as we proceed with criteria development?
        ii. Jim H./Brian: We do have separate standards to protect waters with stocked trout populations.

b. Bill's slides:
    i. Slides depict graphs of data from the 2008 HRL study
    ii. During this study a period of extremely low DO was captured in one sampling event (~~May?~~September 17th). The previous month was fine and the following month was fine.

iii. Based on this data it can be shown that sudden, temporary excursions of the existing DO standard occur due to natural conditions (probably due to lake turnover and/or storm events).
iv. Based on this, it may be beneficial to modify the current DO standard to allow for these natural fluctuations in the epilimnion where DO may temporarily drop below the currently required minimum instantaneous value of 4 mg/L.
v. Comments/questions:
    1. Linda: Lake turnover is an annual occurrence. It is usually completed with one or two days. During this time surface DO can drop greatly.
    2. Mike O.: Do you look at data for the HRL tributaries at this time? Typically, the mainstem portion of lakes flip and the fish migrate to the tributaries where the DO is not as impacted.
    3. Hans: Thunderstorms and events that impact turbidity can produce this same effect.
    4. Lauren: A narrative statement would be OK to address this.
    5. Jing: Our assessment method allows 10% exceedance from the criteria. Based on the 2016 continuous dataset, such lake turnover or well-mixed situation occur much less than 10% of time. If narrative statement to be added to the standard to allow DO less than the criteria due to well-mixed situations as natural condition, are we adding allowed exceedance rate on top of the 10%? To what extent? If such natural condition occurs more frequently in the future, and surface DO is below the criteria in a higher frequency, to what extent these will not stress fish?
    6. Hans: Still thinks natural condition should be included in the standard, but may need to be stated more clearly.
    7. Clifton: Will come up with some draft language regarding this.

4. **Presentation of findings: High Rock Lake pH** (SAC members)
    a. No notes for the beginning of this discussion
    b. Bill's presentation - Presentation of pH data from 2016 sonde deployment to illustrate range and duration of elevated pH readings. Data show that periods of pH in excess of 9.0 can last for several days without any reported negative effect on fishery. This observation is relevant to how criterion is set with regard to magnitude and averaging period.
    c. Lauren's notes:
        i. Looked at different states to see if any had pH standards that went as high as 9.5.
            1. A few states did:
                - Georgia → went to 9.5 for some lakes
                - California → went to 9.5 for one lake
                - Virginia → went to 9.5 for some streams based on geology
            2. Colorado has a pH criterion of 6.5 to 9.0.

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- When assessing its waters, the state looks at the 85th percentile of a given data set for a waterbody/assessment unit and determines whether that exceeds 9.0.

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~~2.~~ When deriving a chl *a* criterion for Warm lakes, the state determined that reducing the threshold to 20 ug/L, as a summer average, does much to reduce the level of risk (i.e., compared to the 25 µg/L threshold that was recommended by some stakeholders). The state determined that bloom frequency is cut in half and the frequency of Secchi depths less than 1.0 meter is reduced by one-third. Also, the frequency with which summer pH exceeds 9.0 is reduced (to 13 days each summer, on average). Much more detail for the state's analyses can be found in Exhibit 13, e.g., see "Algal Abundance and Water Quality Impacts" pp. 63-88 and "Forecasting Water Quality Implications of Target Trophic Condition" pp. 94-98.~~Colorado has a pH standard of 9.0 at the 15th percentile based on chlorophyll a.~~

5. **Lunch**
   a. Duke University: Nicholas School of the Environment student Morgan Rudd
   b. Presentation of WRRI poster "An Evaluation of High Rock Lake Water Quality Patterns to Support Nutrient Criteria Development"
6. **Criteria evaluation and resolution: High Rock Lake pH** (Andy Sachs, SAC members, DWR staff)
   a. Comments/general discussion:
      i. Bill: May want to leave the standard as is, but indicate that it is an average over time or an average over depth.
      ii. Jing: In HRL we see very good correlation between pH and DO which appears to be related to algal growth. Diurnal pH changes of up to 2.7 units were also seen, which is pretty high compare with diurnal ranges found in similar lakes cited in the report (in addition to high pH values, diurnal swing of pH presents another stressor to fish).
      iii. Jing: One review report (RBI, 2004) stated that pH from 9.0 to 9.5 led to reduced populations of warm water fish and that carp actively avoid waters at this pH.
      iv. Jing: Most literature findings are based on laboratory tests. When deciding on criteria for pH we may need to take into consideration other risk factors such as natural stressors including high temperature, super-saturation, etc.
      v. Jing: Again, our assessment method allows 10% exceedance from the criteria. From the 2016 continuous dataset, we see that at station YAD152C, the 90th percentile for pH is 9.5, and the maximum is 10. So, by changing the criteria from 9.0 to 9.5 and using the current assessment method, we actually are allowing 10% of the data higher than 9.5, for example, to be up to 10 or even higher. Will that be a problem?
      vi. Martin: It may be difficult to establish a pH criterion base on chronic exposures as the assessment methodology may not be compatible.

vii. Clifton: Probably don't want to manage HRL based on pH as there is no model for it. It would be better to manage using chlorophyll-a. Also, the effect of multiple stressors (Jing) is interesting.
viii. Michael O.: Do we have ammonia data associated with the pH data from HRL?
    1. Bill: EPA's ammonia criteria is based on a 30-day average.
    2. Clifton: There is also acute data using a one-hour average, though it is at a much higher concentration.
    3. Martin: The high pH that we see in HRL is associated with algal production. The algae use ammonia as a preferred nutrient source so there should not be a high risk of ammonia toxicity.
    4. Hans: May be good to look at ammonia concentrations during period of high pH. Guessing that ammonia would be low.
ix. Bill: We need to consider duration with any pH criterion we recommend. It would likely be based on chronic exposure and employ an averaging period. Even if we see pH of 9.5 or higher in HRL, the averaging period would probably smooth that out and it would end up being less than 9.0 for assessment purposes.
    1. Connie: Just as a reminder, the standard is supposed to be protective of the uses independent of conditions in the water body. We do not want to modify the standard to fit the conditions we see in the lake.

b. Andy: Where is everyone at right now (this is not a vote)?
i. Marcelo: I'm not comfortable raising the pH criterion to 9.5. This would allow for greater occurrence of even higher pH values in the lake when taking into account the current assessment methodology (>10% exceedance with 90% confidence).
ii. Linda: I like the antidegradation approach that Clifton has talked about.
iii. Michael O.: I prefer to keep the current pH standard.
iv. Lauren: I think we should keep the current pH standard as there are other confounding factors that may play a role.
v. Deanna: (to Marcelo): Did you do a trend analysis for pH?
    1. Marcelo: Yes. It showed greater variability over time and greater exceedances over time.
    2. Deanna: Then we should keep the current pH standard as is.
vi. Bill: We can keep the current pH standard, but must specify chronic exposure and an averaging period.
vii. Hans: Keep the current pH standard, but we also need more rigorous assessment of waters. He noted that we should examine trends.
viii. Clifton: I'm concerned that the scientific support for maintaining the 9.0 pH standard is not there and that HRL may not be able to meet the 9.0.
ix. Martin: I'm not comfortable with raising the pH standard to 9.5. We need to look at averaging (spatial, temporal). Also, reduction of chlorophyll may make it easier for HRL to meet the current pH standard.
x. Marcello: Averaging period is not always appropriate

xi. James B.: None of the data suggests that the standard needs to be at 9.0. Antidegradation seems to be a reasonable approach.

c. Andy: So where do you go from here?
   i. Lauren: For those who recommended antidegradation, can you clarify what that might look like?
      1. Clifton: It would basically set the pH criteria to the existing levels in HRL. Since the uses seem to not be impacted at this level it would set the protection at that level so that conditions would not deteriorate.
      2. Martin: A site-specific approach based on the current conditions in HRL.
   ii. Martin: It would be worth further examining averaging periods.
      1. Andy: Who can do this?
      2. Clifton and Martin volunteer to examine averaging periods for pH criteria.
      3. Lauren: What chronic period will you be looking at?
      4. Clifton: I'm thinking of a percentile of seasonal data.
      5. Martin: We can present multiple approaches as well.
   iii. Hans: Need to be concerned with ammonia. Guessing it will be low, but we can estimate this. Also, high pH samples will tell us where higher levels of algae are occurring.
   iv. Bill: comment on ammonia:
      1. Ammonia criteria comes in different forms
      2. What Clifton has shown pertains to the presence of sensitive mussel species.
      3. Not sure if that would be appropriate for HRL.
      4. (Referring to a graph depicting 24-hour continuous monitoring data for YAD 152C): Do we average pH top to bottom, do we average it over time?
         - Brian: From a monitoring and assessment perspective we only take grab samples at the surface.
         - Jim H.: Also, we typically only collect 5 samples over an assessment period, maybe 10 if there is a special concern. We don't do 24-hour monitoring normally.

d. Jim H.: We will continue this discussion for the next SAC meeting. A few things:
   i. Timeline:
      1. Clifton and Martin will make available to the SAC their report on pH averaging periods by end of April.
   ii. We will weigh the following options going forward with regard to pH:
      1. Maintaining the current standard.
      2. Increasing the pH standard to 9.5 S.U.
      3. Going with something in-between (possibly based on Clifton and martin's report)