

**Comments from Members of the Chartered SAB on the SAB Draft Report: Early Advice
on an Ensemble Modeling Approach for
Developing Lake Erie Phosphorus Objectives (2-10-15)**
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Comments from Lead Reviewers

Comments from Dr. Sylvie M. Brouder

Q1) Charge questions adequately addressed?

Overall assessment is that the Draft Consultation Report gives good and fairly comprehensive coverage to the general essence of all four charge questions and highlights the specific issues that are major limitations of the Draft Technical Approach (dated 11/4/2014). Specifically, the Draft Consultation Report highlights that:

- Lake biogeochemistry appears to have changed and therefore relevance of traditional indicators should not be assumed and indicators may need to be expanded to include other characterizations including monitoring changes in lake biology;
- The Draft Technical Approach does not provide sufficient evidence that P content of Cladophora is a useful / meaningful indicator;
- The Draft Technical Approach assumes that P remains the primary limitation / driver and does not appear to adequately consider potential synergies of P with other nutrients or factors (especially nitrogen); this assumption has driven both the selection of indicators and models and should be carefully examined for its validity, and
- The Draft Technical Approach provides no substantive details on technical protocols for combining models or actually using models in aggregate versus individually to inform the objectives.

Specific suggestions regarding the charge questions are as follows:

Charge Question 1 on suitability and scientific robustness of the proposed indicators for Lake Ecosystem Objectives, other metrics, availability of methodology...

- Under the Load and Concentration Targets section of the Draft Consultation Report (and elsewhere in the document) understanding the nutrient balance of the lake is mentioned and N loading is specifically mentioned (pg. 3, lines 7-8). To the extent that nutrient loads may be synergistic as implied by the comments, should the recommendation on monitoring biological communities – made under Eutrophication Response Indicators section (pg. 1, line 34) – be expanded to be more inclusive of other potential important aspects of biogeochemistry and nutrient cycling?

Charge Question 2 on appropriateness (best available scientific knowledge) of selected models for evaluation of eutrophication response...

- While the text of the Draft Consultation Report does call attention to the Draft Technical Approach's assumptions regarding P as the primary driver and consequent selection of indicators and drivers, it does not directly comment on the fact that the Technical Approach provides relatively little information on how models (and indicators) were

selected. Should the authors of the Technical Approach be requested to provide greater detail on the model (and indicator) selection process to substantiate that the models do, in fact, represent the best available scientific knowledge? Were other models considered and jettisoned as inferior? What were model inclusion / exclusion criteria and was it driven by the selection of indicators or vice versa?

Charge Question 3 on appropriateness of the ensemble modeling approach and sufficiency for P load targets...

- The Draft Consultation Report raises the issue of “regime shift” and that process models may be more relevant than empirical or statistical models (pg. 2, lines 37 - 40) but the comment is not really followed with a recommendation or question / challenge to the Draft Technical Approach. Does this point warrant further clarification regarding a recommendation, caution, challenge, etc.?

Charge Question 4 on efficacy of establishing target values for both phosphorus loads and concentrations in order to meet Lake Ecosystem Objectives...

- The charge question itself seems somewhat ambiguous on the question of concentration versus loads making the formulation of response challenging. Nonetheless, the coverage of the question in the Draft Consultation Report seems a bit meager, incomplete and does not seem to directly address the question. The question seems to be about the models and whether they provided a scientifically grounded basis for load targets and the answer is about biological response to concentrations and loads (pg. 3, line 7-9).

Q2) Technical errors or omissions / issues not adequately addressed?

In addition to the comments noted above, the question of sufficiency of data per se seems an omission in the Draft Technical Report and may be worth commenting on in the Consultation Report even though it does not appear as a direct charge question. It seems a reasonable expectation that the quality and/or quantity of data available for this effort may be at least as restricting as the limitations of the models themselves. How will that potential limitation be understood and/or addressed?

Q3) Draft report clear and logical?

Overall, the Draft Consultation Report is clear and easy to read / follow. Comments above under the Charge Questions highlight a couple of points that may require additional clarity.

Additionally, the clarity might be enhanced by consolidation of all comments relevant to suitability of indicators under that heading. For example, direct and indirect comments on indicators appear throughout Selection of Models section (e.g. pg. 2, line 42 – 43) and it may be more logical to consolidate all comments on indicators under the response to charge question 1.

Q4) Conclusions drawn / recommendations provided supported by body of draft report?

The Draft Consultation Report generally endorses the overall approach of ensemble modelling and adaptive management while clearly highlighting major gaps in the Draft Technical Approach

regarding protocols and methodology. The comment that “at this stage, there was insufficient information available to the SAB to provide specific recommendations about the efficacy of individual models...” is accurate and could be extended to encompass the use of these individual models in the ensemble approach.

Comments from Dr. Ingrid Burke

1. Were the charge questions adequately addressed?

The report is pithy. It is hard to write much of a review of a 3 page document that is that clear! It addresses all of the relevant questions though at times I wondered if more detail was necessary:

- The report suggests that P content of Cladophora may not have a sufficient history of data. This seems a bit short. What would be necessary?
- On the top of page 2, the report comments that there should be “monitoring of biological communities”. An elaboration here would be good. Would this be a functional group approach? A simple citation might be sufficient.
- It is unclear what the sentence means “The agency should be mindful that factors such as nutritional status and physical environment can add uncertainty to predictions...”. This seems incomplete. What does “being mindful” mean for the agency (doing different work? Being careful with interpretation?), and further, “nutritional status” is unclear – meaning multiple nutrient levels within lakes, or within organisms?

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report? (see above)

3. Is the draft report clear and logical? Yes,

Very much so.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes.

Comments from Dr. David A. Dzombak

1. Were the original charge questions adequately addressed?

Yes, the original charge for the Consultation is addressed adequately in this letter report summary.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the Panel's report?

I found no technical errors or omissions. I would recommend, however, that the letter report be a bit more careful in referring to different forms of phosphorus. Specifically, on page 2, lines 27-29, and on page 3, lines 7-9, the letter report should be clear to distinguish between total phosphorus and dissolved phosphorus. As noted in some of the individual expert comments provided as part of the Consultation, the chemical form of the dissolved phosphorus may influence the biology of the lake. There is no need to get into that level of detail in the letter report summary, but the letter report text should be careful to distinguish total phosphorus and dissolved phosphorus.

3. Is the Panel's draft report clear and logical?

The draft letter report is clear and logical.

In lines 21-29 of page 1 the charge to the committee is summarized. In line 29 the statement is made that "The charge questions are attached." This statement will suggest to some that the charge questions are not going to be given in the letter (an approach which some would find problematical), when in fact the charge has already been summarized. I suggest that the statement in line 29 be changed to "The formal charge to the SAB, summarized above, is attached."

4. Are the conclusions drawn or recommendations provided supported by the body of the Panel's report?

The recommendations presented in the letter report summary of the Consultation are well explained, and also supported by the individual expert comments referenced in the letter report.

Comments from Dr. Amanda D. Rodewald

1. Were the charge questions adequately addressed?

Yes.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

I did not find any technical errors or omissions.

Additional detail would be helpful on page 2, lines 4-9, where the report cautions that (a) traditional indicators should be supplemented by monitoring changes in the biological communities and (b) other factors (e.g., nutritional status and physical environment) can add

uncertainty. If the panel has more specific recommendations on the most important metrics of community changes or mediating factors to measure, that would be helpful to include.

3. Is the draft report clear and logical?

Yes. It is well-written and well-conceived.

There was one part that struck me as a bit of a contradiction. On page 2, lines 10-20, the paragraph makes a strong case that total phosphorous loading is not a particularly useful indicator because its effect is strongly mediated by other factors. However, on lines 28-29, the report states that phosphorous is a robust measure, but other factors may need to be considered. Based on the earlier statements, it seems that more definitive language could be used – that phosphorous alone is not a robust measure and other factors must be considered.

Lines 39-40: I was not clear why the regime shift meant that empirical or statistical models would not be useful.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes

Comments from other SAB Members

Comments from Dr. Joseph Arvai

1. Were the charge questions adequately addressed?

For the most part, yes.

However, I wonder about the connection between phosphorus concentrations and loading targets, and management interventions. Specifically, how will these concentrations and targets be used to inform management decisions for the Lake Erie ecosystem? In the absence of context about how the concentrations and loading targets will be used, it is difficult to assess their *a priori* value for management purposes.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

The letter to the administrator deems appropriate the planned use of adaptive management (AM) to revisit and, presumably, recalibrate phosphorus concentrations and loading targets. I find this confusing because in my experience, AM is a management tool, and not a monitoring tool.

Applied to the Lake Erie case, AM may be more appropriate for determining appropriate management responses in light eutrophication. Resetting threshold concentrations and loading targets may be an offshoot of such a process, but is unlikely to be at its core.

For example, a phosphorous concentration of X may activate a specific management response, A , selected from a set of possible responses, $A-Z$. Later, if the system does not respond as predicted to the management intervention, A , another management response from the set ($B-Z$) may be selected for implementation; its selection would be based on an updated consequence matrix (because new data would have been collected during the time that management response was implemented) outlining the anticipated performance (according to carefully specified management objectives) of the remaining management responses in the set, $B-Z$, (as well as, potentially, new management responses, $A'-Z'$).

As part of this adaptive process, managers may conclude that threshold concentrations are not appropriate; e.g., because the management responses being implemented are not ambitious enough, or because they are too ambitious. As part of this process, new phosphorus concentrations and loading targets may be set. However, to do so would require much more integration between monitoring and management that is hinted at in the report.

(In the end, I suppose I agree with the report that EPA should “include more detail on the monitoring, data, and analyses needed to implement an adaptive management strategy for the phosphorus objectives.”)

3. Is the draft report clear and logical?

Yes.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes.

Other comments:

On page 2, line 10, I find the phrase "...has not changed markedly during the past couple of decades,..." to be colloquial. Consider revising?

Comments from Dr. George Daston

We were asked to address four specific questions as part of the quality review.

1. whether the original charge questions to SAB Standing or Ad Hoc Committees were adequately addressed;
2. whether there are any technical errors or omissions in the report or issues that are inadequately dealt with in the Committee's report;
3. whether the Committee's report is clear and logical; and
4. whether the conclusions drawn or recommendations provided are supported by the body of the Committee's report.

Question 1: I believe that the charge questions were adequately addressed if one considers not just the letter report but the totality of the comments on the SAB website (hyperlinked in the letter to Administrator McCarthy). There was a wealth of information in the individual written comments from panelists, only some of which appears in the letter report. It is not clear whether the individual comments should be considered as part of the report (and as such reflect the consensus of the committee) or as individual comments that may or may not be a majority view. It would be more helpful to the Agency if the 75 pages of individual comments had been summarized so that EPA could distinguish between major comments that the panel believes are critical to improving water quality from other comments.

Question 2: The report provides guidance on phosphorus, and also states that nitrogen load is probably important in algal blooms. However, it tees up a couple of other potential problems but does not provide guidance on what to do about them. The two that struck me were 1) the probable role of invasive species (quagga and zebra mussels) in changing the dynamic relationship between P load and algal growth; and 2) the possibility of an ecological regime change in the lake. Regarding the invasive mussel problem, can the report be expanded to provide guidance as to whether the presence of these species changes the output and reliability of the models being used to estimate the relationship between P and algal growth? If so, then what additional information needs to be gathered to make the models adequate? The report suggests

that the way to deal with the algal problem is a direct limitation of P input, but if the invasive mussels are part of the problem, does this suggest a different strategy (mussel control) that could be effective, either by itself or along with P decrease?

As for the second question, it would be helpful to the Agency if the report provides more of a description of what the regime change consists of (are there different species present, or are they in different places, or different ratios to each other), and how it might change the way the Agency approaches the problem of managing algal growth. If it matters to the way the models predict, or the way the lake is expected to respond, then it deserves more attention in the report. If it doesn't, then is it worth speculating on in such a short report?

I also wondered about whether the data being collected and the management steps being considered include Canadian input? I realize this is not a scientific question, but would help clarify whether EPA can do enough to control the algal problem by changing P inputs from the US side of the lake, or this needs to be an international exercise.

Question 3: The report was logical but as noted above, insufficient in detail.

Question 4: The conclusions and recommendations are supported by the body of the report but may be incomplete depending on the response to my comments above

Comments from Dr. Joel Ducoste

- 1) Were the charge questions to the committee adequately addressed?
Yes
- 2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?
No.
- 3) Is the draft report clear and logical?
Yes,
- 4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?
Yes

Comments from Dr. Robert J. Johnston

- 1) Were the charge questions to the committee adequately addressed?

Yes, the report has adequately addressed the charge questions.

- 2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

No, there are no technical errors or omissions that are not adequately addressed by the draft report

3) Is the draft report clear and logical?

Yes

4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes

Comments from Dr. Nancy K. Kim

The charge to the SAB for this review is “to provide early advice on the modeling approach being applied to inform the updated phosphorus targets for Lake Erie.” A subsequent review will ask for advice on the process to develop targets and if the recommended targets reflect the best available information. Given the charge, the SAB advice is direct and limited.

1. Were the charge questions adequately addressed?

Yes.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

Not that I noticed although this is not my area of expertise.

3. Is the draft report clear and logical?

Yes for the most part.

- a. A sentence in the 4th full paragraph on page 2 of the letter states, “Also, there are questions about the efficacy of the specific models included in the ensemble, some of which do not include much of the lake’s biology.” I was unsure how important this problem is and what recommendation may be worthwhile making. Should a specific recommendation be added or to address the “questions about efficacy?”
- b. Page 3, paragraph beginning line 5. Does the SAB want to make a recommendation about loadings versus concentrations? See last sentence in the charge. If the adaptive management approach is the answer, should the letter state that directly on page 3?

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes. See comments under charge question 3.

Comments from Dr. Kristina D. Mena

1. Were the charge questions adequately addressed?

Yes

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

The draft report adequately highlights issues related to the eutrophication response indicators, and the modeling described in EPA's Draft Technical Approach for Lake Erie Phosphorus Load-Response Modeling (2014). Regarding the comments of the modeling approach, perhaps peer-reviewed references could be included to provide helpful information, and the importance of sensitivity analyses should be emphasized. In addition, based on this stage of the Technical Approach document, does the modeling approach address issues of consistent model output interpretation and appropriate application?

3. Is the draft report clear and logical?

Yes, the draft report is logical. Clarity (or example questions) may be helpful, however, regarding the comment that there are questions about the combining of models. Also, in the statement – "The SAB notes that there are methods to conduct uncertainty and sensitivity analyses individually and across the models, yet at this stage, there was insufficient information available to the SAB to provide specific recommendations about the efficacy of individual models" – it isn't clear what the SAB is suggesting or requesting.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes

Comments from Dr. James R. Mihelcic

- 1) Were the charge questions to the committee adequately addressed?

The three charge questions were adequately addressed except my comment below. The first charge question asks that during the SAB's evaluation of the eutrophication response indicators, that they would identify other metrics appropriate for measuring eutrophication response in Lake Erie and other Great Lakes. It was not clear to me if the three reasonable indicator choices were applicable to "other Great Lakes."

- 2) Are there any technical errors or omissions or issues that are not adequately dealt with in

the draft report?

See my comment on charge question 1.

3) Is the draft report clear and logical?

The draft is clear and logical

4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes

Comments from Dr. Daniel O. Stram

1. Were the charge questions adequately addressed?

Yes

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

Not that I am aware

3. Is the draft report clear and logical?

Yes

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes

Comments from Dr. Jeanne VanBriesen

Were the charge questions adequately addressed?

The SAB report was very short and expressed high-level general responses to the charge questions. The individual comments from the SAB members are extensive and will provide additional valuable (although not consensus) advice to EPA in response to the specific questions about indicators and models chosen. The SAB committee members are to be commended for their thorough and well-referenced individual responses.

The EPA report that was being reviewed was also very short, making it difficult to answer the charge questions and therefore difficult to assess how well the charge questions were addressed in the SAB report. For example, the original report did not provide much detail on the eutrophication response indicators. Few references were provided, and little justification for their selection was included in the original report. No historical context or details of prior information

on how they have responded to P loading was provided for assessment. By comparison, the models were described in some detail (although still lacking in many details of assumptions). Thus, addressing charge question 1, which required evaluation of the eutrophication response indicators, is complicated by the lack of material to evaluate within the draft EPA report. The SAB response to charge question 1 --assessment of suitability of the eutrophication response indicators (p. 1 line 34 to p. 2 line 30) -- does not include any details of the spatial or temporal limitation of measuring and predicting these eutrophication response indicators, which I think would be relevant. The EPA report does not provide much discussion of this point, but I was surprised it wasn't discussed in the SAB response to this charge question, given the attention to this point in many of the individual comments. I would suggest at least a mention of this complication within the SAB report.

The report does not address the component of charge question 1 on identification of "other metrics appropriate for measuring eutrophication response in Lake Erie." I think this would be difficult to do given the small amount of detail in the original report, and this limitation should be specifically noted in the SAB report. I recommend the SAB ask the EPA to provide more detail in the next revision of the primary report on the choices of eutrophication response indicators, including criteria for their selection and adequate peer-review literature citations to allow assessment by the reviewers. The absence of microcystin concentration as a metric is not discussed in either the EPA or the SAB report, but given recent challenges in Lake Erie as a drinking water source, I was surprised not to see it mentioned, at least with some explanation of why it would not be an adequate metric. The SAB report does note that supplemental data collection related to composition of biological communities (p 2 line 5) would provide additional information; however, it is not clear how this could be used for a eutrophication response indicator. And, it is not clear how this might be estimated by any of the proposed models.

The SAB report is very brief in its assessment of selected models. The potential for limitation by components other than phosphorus is mentioned (p.2, line 28), but it is not clear if the SAB is recommending that models that assume only P limitation be included in the ensemble or if some weighting should be made for models that include additional possible limiters. Which models adequately deal with the other factors "that may need to be considered to minimize hypoxia and algal blooms"? Which eutrophication metrics could be predicted from these more comprehensive models? Should models that consider additional factors in prediction of the four eutrophication metrics (or others, such as microcystin) be prioritized for use over models that are more traditionally grounded in the P-limitation assumption? The issue of spatial and temporal limitations of the models is not adequately addressed. If N limitation or N&P joint limitation is known (or expected) to occur at certain times of year, does this make the models less useful during this time period due to their assumption of P limitation?

The SAB report describes the significant challenge of using an ensemble approach when some of the models are statistically-based and depend upon a historical record that may not be a good representation of future, altered conditions. However, again, the original report was quite brief so the review could not review details that were not available in the original report. The EPA should provide additional details on how the models will be combined in the ensemble method.

Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

Only as noted above, the discussion of the eutrophication metrics and model suitability should include some mention of spatial or temporal limitations of the metrics or models.

Is the draft report clear and logical?

Yes. It is very brief, but it is clear.

Are the conclusions drawn or recommendations provided supported by the body of the draft report?

There are no particular conclusions or recommendations called out specifically at the end of the letter. In the body of the report, the only conclusion I could find is a request for the next iteration of the EPA report to include more details. One can presume from the relatively general and high-level nature of the report that a conclusion of needing more details from EPA is supported, but a statement specifically calling for additional details on the metrics and models and the methods for integration of data and models in the ensemble would be a good addition to the report near the end of the document.

Comments from Dr. Charles Werth

1) Were the charge questions to the committee adequately addressed?

Yes, the committee clearly addressed the charge questions.

2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

The report appears technically sound and thorough. I found only one potential error that is likely a typo:

Page 2, line 8: Should this be phytoplankton mass and not cyanobacterial mass, because the indicator above is "phytoplankton as represented by chlorophyll a"?

3) Is the draft report clear and logical?

Page 2, line 5: Is this macrobiological communities, or microbiological communities? If the former, are there specific communities to monitor that are more important? If the latter, is there enough research to support such an effort or is it experimental?

Page 2, line 28: Is there sufficient data to support considering nitrogen in models? Are there unique indicators for nitrogen limited biological growth? Increasing complexity of models without needed data might not be adequate.

I wonder if a little more explanation of regime shift is needed to help the EPA. From my perspective, it's not clear what this means, if or how process models would capture (or be modified to capture), and why empirical or statistical models would fail to capture.

Page 3, line 8: It's not clear from the text here if the report is making a recommendation here. For example, is there a recommendation that the EPA should more directly relate nitrogen and phosphorus loadings to concentration.

4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes, the conclusions drawn and recommendations provided are supported by the body of the draft report.

Comments from Dr. Peter J. Wilcoxen

1. Were the charge questions to the committee adequately addressed?

Yes. One minor point is that Charge Question 2 requested comments on *each* of the models and the SAB report discusses broad *classes* of models. However, the SAB response appears to address the Agency's underlying concern and does not need to be revised.

2 Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

Not to my knowledge.

3. Is the draft report clear and logical?

Generally yes. The only exception is the discussion related to the last part of Charge Question 3 (embedded in the paragraph below the numbered charge question): "Please comment on efficacy and value of establishing target values for both phosphorus loads and concentrations in order to meet to the Lake Ecosystem Objectives. How can we ensure the phosphorus concentration and loading targets are internally consistent with respect to the eutrophication response indicators of concern?" The response seems to be that concentration and loading targets serve different purposes and both are needed, and that adaptive management will be needed to update the targets over time. However, the link between the response and the questions could be clearer.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes.

Comments from Dr. Dawn J. Wright

(1) The charge questions were adequately addressed.

(2) In terms of technical errors or omissions in the report itself, I was a little confused by the section on lake bathymetry data on p. 18. If 1-m resolution data are indeed available for the lake, maps should be available at scales less than 1:100,000 or 1:50,000 (e.g., maps should be

available at 1:24,000 or more detailed). And in terms of the varying data sources used as inputs to the models, it would be helpful to have a table provided at some point indicating not only what the available data are (e.g., phosphorus loads, water quality data, tributary flow and nutrient data, meteorological data, biological data and bathymetry), but where these datasets are available digitally for inspection (including any descriptive metadata) and download.

(3) I find the draft report to be mostly clear and logical.

(4) I find the conclusions drawn to be supported by the body of the draft report.