

**Preliminary Comments from Members of the Chartered SAB on the SAB  
Draft Report *SAB Review of the Draft EPA Report Connectivity of Streams and  
Wetlands to Downstream Waters (August 11, 2014, Draft)***

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## Comments from lead reviewers

### Comments from Dr. Joseph Arvai

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

Yes, I believe the SAB committee did an exemplary job in terms of addressing the charge questions posed to them. The SAB review committee should be commended for their work in so thoroughly reviewing what is quite an extensive report.

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

In my opinion, *no*. If anything, the SAB committee's draft report goes above and beyond the call of duty in terms of the thoroughness in which it treats its review. Given the polarized political climate in which we work, and the potentially controversial nature of the report (in that that may influence interpretations of the Clean Water Act), I believe the SAB committee did an excellent job of focusing a very thorough review on the scientific attributes of the Connectivity Panel's report. The committee members, as well as the committee leads, should be commended for their very fine work.

#### **3. Is the draft report clear and logical?**

In my opinion, *yes*. The Executive Summary was especially well done, given both the complexity of the topic, and the length of the report.

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

In my opinion, *yes*. By way of just two examples, I agree strongly with the SAB committee's recommendations regarding the need for greater specificity surrounding the spatial and temporal scope for assessing connectivity in different water systems (pg. 21). I also agreed strongly with the SAB committee's conclusions and recommendations regarding the assessment of cumulative effects (pg. 24).

However, when it comes to the conclusions and recommendations regarding decision-making (and the use of the report by decision-makers), I had a few thoughts of my own; I share these thoughts here. I'd be pleased if the SAB committee would take these comments under advisement, though I fully respect their discretion when it comes to whether or not these comments fall outside the scope of their review.

As a starting point, I was very pleased to see that the SAB committee included a section entitled, *Improving the Usefulness of the Report to Decision-Makers* (pg. 9). However, when I read the ORD report for which the SAB review was conducted (entitled, *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence*), I was quite disappointed (and surprised) to discover that the word "decision" was only mentioned three

times in a 331 page report; moreover, each reference to decisions came in the Literature Cited section. Likewise, the ORD report did not set the stage for how the information contained in it might be used to support agency decision-making. It seems quite clear to me that the information in the ORD report could have real significance for decision-making being undertaken by the EPA; indeed, an emphasis in both the ORD and SAB reports on attributes and measures of connectivity signals (to me) that inputs to improved decision-making are desired by both bodies.

I understand that the stated purpose of the ORD report was to “review and synthesize available evidence” regarding connectivity. However, as a purely technical review, it struck me as disconnected from the realities of how it may be used (or its intended use) by the EPA. The same is true of the charge questions posed to the SAB committee; these questions were technical in nature, which makes sense given the need to review the underlying science. In the end, the absence of charge questions, or a focus on the ORD report, on how the technical information could be used by decision-makers is—in my view—an important shortcoming.

It also struck me as strange that the SAB committee’s report flagged decision-support as an important issue in the ORD report when, in my opinion, the ORD report gives this issue short shrift. If the ORD report is meant to inform decision-makers (and decision-making), it should clearly state this as an objective (or, at the very least, a sub-objective), and address it. The SAB committee’s report, in turn, should (in my opinion) flag this as an omission in the ORD report rather than treating it as if the latter gave it the attention it deserved.

Regarding the usefulness of the ORD report for decision-makers, the SAB committee writes (on pg. 9) that the “...*authors might consider an approach similar to that used in the report of the Intergovernmental Panel on Climate Change (IPCC 2007), which would provide an estimate of the relative certainty of connectivity or a downstream effect.*” This comment is in regards to the weaknesses of viewing connectivity as a binary property is exactly on-point in my opinion; a continuous variable would be more informative and flexible from the standpoint of informing decisions. However, I would cite work in the decision sciences as a justification for this comment, rather than the IPCC. Citations that the SAB committee may wish to review include:

- a. Gregory, R., L. Failing, M. Harstone, G. Long, T. McDaniels, and D. Ohlson. 2012. *Structured Decision Making: A Practical Guide to Environmental Management Choices*. Wiley-Blackwell, Chichester, UK.
- b. Keeney, R., and R. Gregory. 2005. Selecting attributes to measure the achievement of objectives. *Operations Research* **53**:1-11.

Finally, I had a more general reaction (also in the realm of decision-making) as I read both the ORD report, and the SAB committee’s review of it. That is, it seems there is a growing opportunity for the EPA to internally seek (and provide externally) greater clarity about how it pursues decision-making within (and by) the agency. In a most basic sense, information—like that outlined in *Connectivity of Streams and Wetlands to Downstream Waters*—is probably being sought to provide guidance to the agency about the classification of streams and wetlands across the United States so as to determine whether they are under the purview of the Clean Water Act.

If this were indeed the case, it would be beneficial for the agency—not to mention instructive for EPA committees—to provide an overview of the decision-making context (or contexts) for which it seeks inputs in terms of science advice.

My concern is that, in the absence of this kind of guidance around decision-making needs, it becomes increasingly difficult for committees to adequately frame and direct their efforts. The result, which I believe to be the case with this review, is a mismatch between—on the one hand—what the ORD report provides (i.e., a rather straightforward treatment of connectivity) and—on the other hand—what the SAB committee seems to seek (i.e., a more nuanced treatment of the issue).

While I agree with the SAB committee that a more nuanced treatment of connectivity is desirable, I personally would still like to know how the agency plans to use this information. Moreover, the time to let committees know is sooner, rather than later (i.e., when committees begin their work drafting reports, rather than during SAB reviews).

My observation seems to be underscored by the SAB committee's comment on pg. 56, which states, "*The challenge for the EPA is to describe the hierarchy of decisions and the tools necessary to assess the degree of connection necessary to warrant case-by-case analysis.*"

## Comments from Dr. Ingrid Burke

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

*“SAB was asked to comment on the clarity and technical accuracy of the Report; whether it includes the most relevant peer-reviewed literature; whether the literature has been correctly summarized; and whether the findings and conclusions are supported by the available science.”*

This is one of the most thorough, well-written, and thoughtful reviews of EPA reports that I have seen from the SAB to date. The charge questions were very thoroughly addressed. The table of contents for the review makes it very clear that each charge question is addressed for each element of the SAB review – it is easily navigable and the charge questions for each section are very clear and addressed at length.

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

No. I have read the report very carefully and I cannot find errors, omissions, or gaps.

- 3) Is the draft report clear and logical?

Extremely.

The most important recommendations have to do with the recognition of connectivity as a gradient, or really, a set of gradients (space, time, chemistry, biology, physical hydrology). Should this “recognition” be implemented in some way in the rule? This is perhaps not within the SAB’s charge, but it is the bottom line and most important conclusion of the report. I’m interested in hearing us discuss this.

It seems to me that the sections on floodplain and non-floodplain literature reviews are perhaps overly long. I realize that the charge questions included evaluating the literature review and whether it supported the conclusions. The review states that there is more literature needing review, and recommends both reorganization, and more explicit recognition of connectivity in these systems. While I agree with the review’s suggestions, the length of these sections suggests that these revisions are extremely important. I’m not sure they are, with respect to influencing the ruling.

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

Yes, very well.

## Comments from Dr. Peter Chapman

### General Comment:

The Panel for Review of the EPA Water Body Connectivity Report has done an outstanding job; I commend them for the effort they have put into advising EPA and for the quality of the report they have produced. My comments below are relatively minor in terms of improvements to the excellent report they have produced.

#### 1. Were the charge questions adequately addressed?

The charge questions have been more than adequately addressed with three relatively minor exceptions as follows, which can be easily corrected:

- Charge Question 4(a) included a request to identify “*any cited literature that is not relevant to the review objectives of the Report*” – this request has not been explicitly addressed.
- Charge Question 5(a) included a request to “*also comment on whether the literature has been correctly summarized*” - this request has not been explicitly addressed.
- Charge Question 5(a) includes a request to identify “*any cited literature that is not relevant to the review objectives of the Report*” – this request has not been explicitly addressed.

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

There are no major technical errors or omissions in the SAB report, and the Letter to the Administrator is aligned with and consistent with the SAB report; however, the following relevant issues are not fully brought out in the Report (where appropriate, this is noted by line and page of the SAB report [a,b]):

- The complexity inherent in the waters of the US, which is mentioned repeatedly, consistently, and correctly in the SAB report (e.g., recommendation for additional layers of complexity in the conceptual framework), should also be explicitly stated at the beginning of the Letter to the Administrator and at the beginning of the Executive Summary as inappropriate simplification of scientific realities will inevitably result in misallocation of resources and effort.
- Connectivity is almost always mentioned in terms of downstream movements, including biota. Upstream movements of biota also occur (e.g., fish) and should be more fully documented in the SAB report. For example, at (31,36) the line should be revised from “biota move throughout the lotic system” to “biota move throughout lotic systems in all directions”. (10,35-36) It is surprising here that movements of biota among systems do not include either fish or invertebrates and that transfers only refer to downstream waters, not upstream waters; fish and invertebrates need to be explicitly mentioned as well as the fact that transfers go in both directions (both downstream and upstream).

- Free-flowing freshwaters ultimately drain into the sea; between marine and freshwaters are transitional waters that cover a gradation from slightly salty to almost fully marine. Saltwater can move upstream under freshwater in salt wedge estuaries. Biota and substances move up-and down-stream differently in transitional waters than is the case in freshwaters. This point may be worth making in the SAB Report. One of many possible publications that could be consulted is: Chapman PM, Wang F, Caseiro SS. 2013. Assessing sediment contamination in transitional waters. *Environment International* 55: 71–91.
- The SAB report correctly points out the importance of considering anthropogenically altered waters and appropriately recommends an additional case study of such waters. As part of such a case study the reality of different sensitivities to stressors (e.g., physical, chemical) and the differential tolerances possible to such stressors needs to be documented; this should be included in the recommendation for the case study of anthropogenically altered waters. This case study should also consider the ecosystem services provided with and without alteration of waterbodies (ecosystem services are not currently mentioned in the SAB report). A recent publication of relevance in this regard is: Auerbach DA, Deisenroth DB, McShane RR, McCluney KE, Poff NL. 2014. Beyond the concrete: Accounting for ecosystem services from free-flowing rivers. *Ecosystem Services* 10: 1-5.

In addition:

- The SAB’s opinion as to how waters and wetlands should be defined is not provided, it should be - in Section 3.2.4 where SAB’s opinion regarding the scientific, not regulatory definition of waters and wetlands belongs.
- (27,30) Delete the word “toxic” before “metals” – per Paracelsus everything is toxic, the dose makes the poison. Copper and zinc for instance are essential metals – life would not exist without them. They are indeed toxic in the right form and dose, but they are not by definition toxic. Also, consider replacing the word “metals” with “inorganic”, which would include metals, metalloids such as arsenic, and non-metals such as selenium.
- (34,4) Fausch is a single author, not et al.
- (44,8) Kolm is not a single author, et al. needed here.

### **3. Is the draft report clear and logical?**

Yes, subject to the clarifications noted in questions 1 and 2, above. However, the following relatively minor points also need to be addressed, as noted by page and line of that page (a,b):

- (8,19-20) The EPA is advised in the SAB report to avoid “words that may denote particular legal or regulatory meanings (e.g., significant, adjacent) unless a definition is provided”. The two examples provided do not seem appropriate. The word “significant” has a statistical meaning while the word “adjacent” is in common usage. Better examples / clarity required.

- (9,15) For clarity, insert the sentence “This is not always the case.” after “waters.”
- (9,17) Replace “the” with “any” as consequences are not certain.
- (9,30) For clarity, replace “so as not to sound like” with “from”; (9,31) replace “but rather” with “to”.
- (10,18) For clarity, replace “consider including” with “include”; insert “appropriate” after “Report”.
- (11,32) HLRs are mentioned here for the first time; at least one reference citation is needed for HLRs - Wolock et al. (2004) is cited later for HLRs and could be appropriate here.
- (13,24-28) Delete this paragraph in its entirety, it makes no sense related to the text above and below, nor to the SAB report in general.
- (13,30) Replace “might” with “can” – this is certainly possible.
- (14,22) Replace “consider expanding” with “expand” – this should be done.
- (16,7) Replace “could” with “should” – this should be done.
- (18,2) Replace “will not be used as” with “will not use it as” – wording otherwise unclear.
- (20,36-38) The wording of this sentence is unclear – clarify how ignoring connections can result in listing of threatened and endangered species.
- (18,36 and 20,43) What is meant by “ridge to reef”? This term is not used elsewhere in the SAB report. Either explain/define or use easily understandable language.
- (27,44) “the topics summarized above” is too vague; provide details please.
- (28,5-6) Wording here is unclear; it is clear under the first Key Recommendation on this page – use that latter wording both here and in place of the earlier wording.
- Starting at (28,24) the SAB report uses the term “(and others that are similar)” many times to indicate that EPA should not consider the references provided as the only ones that should be consulted and possibly included in the EPA Report. This term is not clear; what does “similar” mean? Suggest at least replacing the word “similar” with the words “appropriate and relevant” globally.
- (32,39) Insert the word “other” before “modeling” – for clarity that the SAB is referring to other approaches.
- (34,34) Replace “could” with “should” – this should be done. Same at (45,23) and (46,6).
- (38,21) Add the following wording before the close parentheses: “as well as the additional recommended case studies”. The SAB report recommends two additional case studies, which should not be excluded from consideration. Similarly, at (51,11) add “, including the two additional case studies recommended by SAB” before the period.
- (39, 1<sup>st</sup> paragraph under Section 3.5) It is not clear what other literature is needed – clarification is required. For instance, is the only other literature required that listed in response to this charge question?

- (42,27-32) There is no answer to the “so what?” question that arises after reading this text; there needs to be an answer.
- (43,24) Which states?
- (43,32) “(cited below)” is unclear – where exactly?
- (46,2) “Many studies have shown that” is unclear without reference citations. Suggest simply deleting these five words, then the statement reflects SAB expertise and knowledge without explicitly requiring reference citations.
- (47,36) Add the words “and including” after “reviewing” – reviewing is not enough, EPA should consider including.
- (49,40) Replace “might prove to be” with “would” – this would be effective, no question.
- (51,40) Replace “may be” with “could be” – certainly possible. Same at (52,31).
- (53,40) Replace “if needed” with “as appropriate” – for clarity.
- (59,41) Replace wording “subsurface or groundwater” with “subsurface flowpaths, shallow or deep groundwater” – this is what you mean and this is four pathways, whereas before you did not clearly have four pathways in this wording.
- (61,1) Replace “several of the” with “the following” – specificity for clarity.
- (62,18) Similarly, here replace “several” with “three”.
- References need editing for clarity and completeness – see relevant points under Editorial Comment 44, below. However, compliments to the SAB report editor(s) - all references citations in the text are in the References and there are no citations in the References that are not in the text.

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

Yes, they are; however, I do have a concern with one recommendation as follows:

- The last recommendation on page 9 states “The Report should explain how the definitions used for rivers, streams, and wetlands differ from those in the Clean Water Act and associated regulations and discuss any implications this might have for those interpreting the conclusions.” My concern is that this recommendation does not have a strictly scientific basis and thus I am not sure such a recommendation is within the purview of the SAB review. I would suggest this recommendation be rephrased “The Report should clarify that the definitions used for rivers, streams, and wetlands are scientific and have no regulatory implications.”

In addition, two Key Recommendations are missing from Section 3.7.4. First, the important points made in the second paragraph of that section on page 56 need to be provided on page 57 as a second Key Recommendation. Second, the equally important points made in the first (incomplete) paragraph on page 57 need to be provided on page 57 as a third Key Recommendation.

#### **Editorial Comments**

The following editorial comments are referenced by page and line of that page (a,b):

1. (1,40) insert “the” before “end”.
2. (3,46) delete second “and”.
3. (5,21) semicolon not a comma.
4. (8,20) delete “quite” – qualitative words such as this have no place in scientific documents. Similarly, delete “very” at (30,12), “fairly” at (39,32), “quite” at (56,44), and “quite” at (61,17).
5. (11,29) arctic should be capitalized to Arctic.
6. (14,35) replace “include”, which indicates a partial list, with “are”, which indicates a complete list.
7. (15,1-2) Kinzel et al. 1999, 2005 – no need to list Kinzel et al. twice. Similarly, at (28,28) Kim et al. (1992, 1995). Similarly, at (40,26) Bestgen et al. (2006, 2007). Similarly, at (46,13) Bridghman et al. (2001, 2006). Similarly, at (46,15) Reddy et al. (1999, 2005, 2011).
8. (17,12) comma after “waters” for clarity.
9. (21,45-46) replace “it relates” with “they relate” – plural to match the sentence.
10. (22,23) “Although”, not “Though”. Same at (23,12) and (57,18).
11. (25,26) Dubé not Dube here and in the References.
12. (26,14) replace “and its” with “including” – reads better.
13. (27,37) delete period after “and”.
14. (28,20) replace “The review” with “This review and synthesis” – for clarity.
15. (29,16) comma not semicolon.
16. (29,32) insert “otherwise” before “are dry” – for clarity.
17. (29,45) insert “also” after “should” – for clarity.
18. (30,23) RWRD should be PCRWRD here and in the References so that the abbreviation is correct.
19. (30,35) replace “and its” with “including” – for clarity.
20. (32,19) Faulkner out of alphabetical order.
21. (32,40) insert “the” at the end of the line, after “from”.
22. (33,25) insert “also” after “but” – for clarity.
23. (34,27) delete “the” before “Section” – reads better. Also, replace “never” on next line with “not” – again reads better.
24. (36,2) replace “. These are” with a colon – reads better.
25. (38,43) Report, capitalized – consistent with the rest of the SAB report when referring to the EPA Report.
26. (39,45) This, not The – for clarity.
27. Sometimes “page” is written out, sometimes just “p.” – both at (42,5 and 12) – be consistent.
28. (43,35) comma not semicolon.
29. (46,26) comma between “nitrogen phosphorus”.
30. (46,28) Sections, plural.

31. (46,35) replace “in Section 3.5.4” with “provided in this section” – this is Section 3.5.4.
32. (46,37) Section capitalized.
33. (46,39) no semicolon before parentheses. And comma should be after “simple”, not “qualitative”.
34. (53,5) delete comma.
35. (56,47) comma not semicolon.
36. (57,16) Key Recommendations, plural – two additional recommendations suggested above.
37. (57,19) delete “the”; next line, delete “those” – reads better.
38. (57,26) colon after “of” to start the series separated by semicolons.
39. (58,12) whether, not if – more correct English.
40. (58,30) comma after “toads” – for clarity.
41. (58,46) delete comma after “Report”.
42. (59,39) comma after “that”.
43. (60,10 and 11) Kolm et al. – without unnecessary periods or commas.
44. References:
  - a. Do not always follow consistent format, for instance: in most cases titles of book chapters or journal articles are sentence case but in some cases title case or partial title case; pages for book chapter citations not always at end, sometimes no page numbers provided, sometimes just numbers and not clear these are pages; punctuation not always there (e.g., periods missing in many cases at end of references) or the same for author names and initials; locations for reports and books not always provided. All of these issues not listed individually below in the interests of this reviewer’s time, but I have noted all these on my hard copy of the SAB report and will pdf my hard copy notes re the References to the SAB.
  - b. Ali and Roy – pages missing.
  - c. Arrigoni et al. 2008 – replace whatever “WO9418” is and the DOI with the page numbers. Too many other references with the same issue. Do not use DOI after paper published and do not use together with page numbers after publication.
  - d. States for books sometimes but not always abbreviated; same for provinces. Abbreviated consistently.
  - e. Periods missing in many cases at end of references.
  - f. Bracken et al. 2013 – journal should be in italics.
  - g. Alphabetical order not always followed (e.g., Brooks et al. 2006 should come after, not before Brooks et al. 1998; Winter and Rosenberry 2008 should come before Winter and La Baugh 2003).
  - h. Brunet and Westbrook 2012 – why the word “Agriculture”?
  - i. Doyle et al. 2013 – period not comma before journal and only one page?
  - j. Dunne and Black 1970 – small dash between page numbers.
  - k. Ensign et al. 2008 – no comma before journal volume number.

- l. Huntington and Niswonger 2012 – page numbers please.
- m. Lancaster and Casebeer 2007 – “Reprint. Supplementary material”?
- n. Lenton 2011 – page numbers are wrong, should be 201-209. And all of journal title not in italics.
- o. Mason et al. 1982 – pages 305-311.
- p. McColl and Burger 1976 – pages 270-280.
- q. McDonough et al. 2011 – all of book title not in italics. Page numbers missing and delete “2011.” At end.
- r. Nelson et al. 2003 – UK not England.
- s. Polis et al. 1997 – journal title not in italics.
- t. Rapp and Abbe 2003 – how can this be “*Ecology* Final Draft Publication #03-06-027, 66pp”?
- u. RWRD should be, as previously noted, PCRWRD per the full name.
- v. Sawyer et al. 2011 – colon after journal volume, not comma and like so many others, what are page numbers?
- w. Schlosser and Angermeier 1995 – article title should not be in italics, journal title should be.
- x. Compare how Schumm et al. 1984 and 1987 are cited – inconsistent as per comment a, above.
- y. Stromberg 2001 – journal volume “49.1”?
- z. Sullivan and Watzin 2009 – only one page?
- aa. Thompson et al. 2008 – “325: 524-531” in a book?
- bb. Wolock et al. 2004 – pages “S71-S8”?

**Comments from Dr. Steven Hamburg**

(To be provided)

## Comments from Dr. James Sanders

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

Yes, the panel is to be commended for a well written and readable report. This is a complicated and important subject that EPA has undertaken, and the panel's comments, suggestions and recommendations will improve the final version of the Report. I concur with the panel's overall conclusion that the EPA should consider the concept of connectivity within a gradient, and not as a binary concept (connected or not connected). This is central to the entire discussion, and has been emphasized well within the panel review.

My recommendations and suggestions for this review are minor.

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

No. I found the review to be a thorough examination of the subject matter.

### 3. Is the draft report clear and logical?

For the most part, I found the report to be clear. However, I do have two comments that I believe would improve its readability.

The review refers to itself as a report (p. 7, lines 32 and 33, p. 9, line 29, p. 10, line 23, and elsewhere). Sometimes it is the SAB report, sometimes this report. They refer to the Connectivity draft report as the Report (capitalized). I find this confusing, and several times had to reread the paragraph to ensure I knew which "report" was being discussed. I suggest the authors consider replacing the "report" (uncapitalized) with the SAB review, or a similar title, to remove this confusion.

Section 3.2.2. Defining connectivity and isolation. This is a key section, which is well written. However, as the discussion evolves, the panel suggests that the EPA include a simple figure in their Chapter 3, and the panel offers an example, Figure 3 (page 55 of the SAB review). I agree with this idea, but strongly suggest the panel move Figure 3 up to this location in the review. This same figure is also referenced on p. 15, line 45, in section 3.2.3. Again, this figure's earlier appearance in this review would be beneficial.

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

Yes. However, I note the following:

P. 9. Sections 3.1.2. The second recommendation ("...explain how the definitions used...") is not explicitly supported by the discussion in the section. This is a valuable recommendation, and could be better supported with additional explanation in the paragraphs above.

In addition to the 4 questions above, I have a few suggestions and editorial remarks, which follow.

P.1, lines 10-11. Delete "to summarize the current scientific understand of connectivity". This was just said in lines 8 and 9.

P.3, line 46. "and indeed and" Need some adjustment here.

P. 4, line 12. Key, not keys

P. 11, line 19. Missing a period at the end.

### Comments from Dr. William Schlesinger

- 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?  
See my submitted comments
- 3) Is the draft report clear and logical?  
Yes, but somewhat repetitive
- 4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?  
Yes

#### Some comments on the SAB draft report on the Connectivity of Streams and Wetlands

p. 11, l. 27. For a demonstration of connections between ephemeral streams and desert vegetation, see

Schlesinger, W.H. and C.S. Jones. 1984. The comparative importance of overland runoff and mean annual rainfall to shrub communities of the Mojave Desert. *Botanical Gazette* 145: 116-124.

p. 13 A good, new book on that outlines physical transport processes in nature, see Reiners, W.A. and K. Driese. 2006. *Transport Processes in Ecology: Propagation of Ecological Influences Through Environmental Space* (2006) Cambridge University Press, Cambridge, UK. 302 p. ISBN 0-933280-46-7

p. 16, line 2. For bidirectional flux, you might want to mention the tidal influence on rivers such as the Hudson, that have a low gradient to the sea. Also line 18

p. 22, line 32. See comment for p. 11, line 27

p. 28 top. Changes in stream temperature due to climate change must also be factored out

p. 32, line 14. See comment for p. 11, line 27

p. 33, line 39. Various studies by Jon Cole have linked the availability of organic matter in streams, rivers and wetlands to primary production in the adjacent terrestrial ecosystems that drain into them.

p. 40, line 25. Might want to consult David Strayer's recent work and book on Pearly Mussels.

p. 42, line 37. Might want to mention that some regions, such as the Northeast, are expected to get wetter.

p. 44, line 22 Peter Groffman has shown substantial denitrification in vernal pools that act as hotspots of denitrification in the terrestrial landscape.

## **Comments from Dr. Jeanne VanBriesen.**

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

Yes, the draft report adequately addresses the charge question. The draft report provides a thorough assessment of clarity and technical accuracy (charge question 1) along with recommendations for changes that will improve the report.

The report provides particularly valuable input on charge question 2, focusing on the proposed conceptual framework. Recommendations to strengthen and clarify the framework are clearly presented and supported. Input on charge questions 3 and 4 focuses on the need for review of additional literature to support the conclusions of the EPA's report. Finally, input on charge question 5 makes strong recommendations related to the conclusions drawn from the literature review, including specific recommended language.

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

The committee is to be congratulated on attention to detail and terminology in the draft report. No substantive technical errors or omissions are noted. A few comments for improving clarity are provided, and a few possible additional suggestions to improve the EPA report are described.

Several places within the report mention the importance of providing quantitative rather than qualitative assessment of literature findings (e.g., p45 lines 33-34). The SAB might consider whether this recommendation rises to the level of other generalizations listed in 3.1.4. If so, its inclusion within that section will strengthen this recommendation and make it clear that this applies across all sections of the report.

The discussion in 3.1.4 of additional topics that require clarification is quite good. This provides a high level, integrative summary of areas that are insufficiently addressed throughout multiple sections of the EPA report. Some but not all of these critical points are woven into the discussion in the executive summary on page 2. A more explicit inclusion of these topics within the executive summary would ensure these important points are not overlooked.

Further related to the 'additional topics', many of these issues are repeated in response to each charge question (e.g., human impacts, aggregate and cumulative effects). This suggests that perhaps the SAB should recommend that the overall structure of the EPA report include sections on these cross-cutting issues rather than focus so strongly on geographical classifications for the sections. The SAB report suggests that such geographical classifications can work as long as they are strongly tied to the conceptual framework that includes flowpaths and a gradient model for connectivity (p. 19 line 8). Some additional guidance within the responses to each charge question as to how these component questions are linked to the conceptual framework would be helpful. Perhaps the figure envisioned and described at pg 19, lines 10-17 could be revisited in each geographically classified section of the report to enable the reader to link to the conceptual framework.

Similarly, the treatment of uncertainty is mentioned in a few places (e.g., p. 27, line 44f). The SAB should consider recommending a discrete section be added to the EPA report (perhaps as an appendix) on the methods used to characterize uncertainty. This would be particularly useful if the EPA follows the guidance given in the SAB report regarding preparing a matrix of recommendations with information on the confidence associated with each recommendation.

The conceptual framework proposed in response to charge question 2 and described as a ‘flowpath framework,’ is excellent. It sits within surrounding text that refers most often to ‘watershed’ as the structural unit of the conceptual framework (p12-L16, p18-L29, etc.). There is occasional use of the term “catchment” (p18-L14 and p35-L41). Do the authors mean distinctly different things when using the term catchment? As a comparison, the term basin is used sparingly and only with a modifier: i.e., “groundwater basin” or “detention basin.” Clarification of the term ‘catchment’ is recommended and if its meaning is identical to the more extensively used ‘watershed,’ the report should be modified to use only one term.

The term “landscape scale” is used several places, most notably pg 60, line 7, where it is mentioned as part of the evaluation of connectivity. Additional details of how this relates to the flowpath-driven conceptual framework would assist EPA in using the recommended ‘systems approach’ to evaluate connectivity.

The introduction of a second conceptual framework in section 3.7.3 (p.54) might cause confusion, coming late in the report. A visualization similar to Figure 3 created and presented much earlier (in section 3.2.6) where the over-arching conceptual framework is introduced would be very useful, particularly since the report notes that such a figure could easily become incomprehensibly complex. Further this section (3.2.6) includes extensive specific suggestions for the figure structure and content, thus it would be helpful for SAB to prepare this figure as a suggested structure. In section 3.7.3, a more complete explanation of how the second conceptual framework integrates with the overall framework would be helpful and avoid confusion.

Minor point on pg 25 “Geographically isolated wetlands (i.e., wetlands surrounded by uplands) . . .” While this phrase implies that wetlands surrounded by uplands are *an instance* of geographically isolated wetlands and thus is consistent with the language in the report, it could be misinterpreted to be a confirmation of the definition used in the EPA report, which the SAB report recommends changing (p. 17, lines 21-25). Removing the parenthetical comment does not change the sentence meaning and will avoid possible misinterpretation.

Minor point on pg 57 “For non-floodplain wetlands where the only significant connection is via the exchange of biota” I believe the SAB is referring to a subset of non-floodplain wetlands rather than stating that in general non-floodplain wetlands are only connected via biotic exchange. The wording could be misinterpreted; however, and a revision is warranted to make it clear that many non-floodplain wetlands have connections via other pathways. This is consistent with the bulk of the section.

Section 3.6.2 “chemical linkages” recommends additional literature review; however, unlike other sections of the report, it does not provide specific citations that should be reviewed by EPA in revising the report. Including specific citations would be helpful.

Similarly, section 3.7.5 recommends referencing the rich literature on historic wetland loss and its consequences but does not provide specific citations. Including specific citations would be helpful.

The final set of recommendations for changes where the SAB disagrees with the overall conclusions in section 1.4.3 of the report (p. 59) would benefit by additional references. The SAB's conclusion that the existing literature review supports a different conclusion than reached by the EPA is sufficient to support the recommendation of a change to this conclusion in the EPA report. However, additional references that EPA could use to expand the literature review in support of this conclusion would be helpful.

### **3) Is the draft report clear and logical?**

The report is clear and presents a logical, well-structured response to each charge question. The key recommendations summary at the end of each section is particularly notable for the clarity it brings to the document. The committee is to be commended for the attention to concise recommendations for improvement to the EPA report.

The letter to the administrator provides a suitable overview of the major recommendations, including when improvements in the EPA report are needed. Similarly, the executive summary provides an excellent summary of the key points and aspects of the report that require improvement.

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

Yes. The recommendations are well supported by clear text and extensive references.

## **Comments from other SAB Members**

### **Comments from Dr. George Alexeeff**

Quality review comments on “SAB Review of the Draft EPA Report Connectivity of Streams and Wetlands to Downstream Waters (August 11, 2014, Draft)” to determine if the draft Committee review is ready to be sent to the EPA Administrator. My comments are organized with regards to the quality review questions described in the quality review protocol.

#### **1. Were the original charge questions adequately addressed?**

The charge questions to be addressed fell into the following categories:

1. Overall Clarity and Technical Accuracy of the overall Draft Report
2. The clarity and technical accuracy of the conceptual framework describing the elements of a watershed and the factors that influence connectivity.
3. The relevance of the studies discussed in describing the directional connectivity and effects of ephemeral, intermittent, and perennial streams. They were also requested to comment on whether the conclusions and findings of the report were supported by the available science.
4. The relevance of the studies discussed in describing wetlands and Open Waters with the Potential for Non-tidal, “Bidirectional” Hydrologic Flows with Rivers and Lakes. They were also asked to identify any additional relevant literature and to comment on whether the major findings and conclusions from the literature are supported by the available science.
5. The relevance of the studies discussed in describing wetlands and Open Waters with Potential for “Unidirectional” Hydrologic Flows to Rivers and Lakes, Including “Geographically Isolated Wetlands”. They were also asked to identify any additional relevant literature and to determine if the findings and conclusions were supported by the available science.

The Committee’s review addresses the question of overall clarity and technical accuracy. The Committee found the EPA report to be thorough and technically accurate. The Committee did suggest improvements on clarity through greater editing and a more consistent use of terms and definitions. One overarching comment was the importance of considering connectivity as a gradient and not a binary property. The Committee also suggested that there be more examples representing different aspects of connectivity.

The Committee’s review discusses the general and specific charge questions, all of which are adequately addressed.

The Committee's review commented on the clarity and technical accuracy of the conceptual framework of the watershed structure and function. While the Committee found the literature review to be technically accurate, the Committee recommended that connectivity be described and discussed as a gradient. The Committee also recommended that spatial and temporal scales be considered as well as the influence of human alteration.

Regarding the relevance of the studies discussed in describing the directional connectivity the Committee's review suggested expanded discussion of several topics. While the Committee's review supported the EPA report's conclusions they suggested additional areas to consider findings and the need to incorporate additional examples.

The Committee found that the literature review supported the conclusions regarding waters and wetlands in floodplain settings. They suggested the addition of examples representing a broader range of conditions and additional literature references could bolster the findings and conclusions.

Regarding the literature review of waters and wetlands in non-floodplain settings the Committee's review suggested additional literature references and recommended that the conclusion be revised to reflect the degree of connectivity and to enumerate existing data gaps. Consequently, the Committee's review thoroughly addressed the original charge questions.

**2. Are there any technical errors or omissions in the report or issues that are inadequately dealt with in the Panel's report?**

I have not identified any technical errors or omissions in the Committee's review.

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

The Panel's review is clear and logically organized using the charge questions. The organizational structure of the review is also embedded in the Executive Summary making it easy to follow.

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

The conclusions drawn and recommendations provided are supported by the body of the Committee's review. In fact the conclusions and recommendations represent themes throughout

the review. The Committee's review found that the EPA report was an extensive summary of the literature and generally technically accurate. The Committee's review extensively discussed the issues of connectivity, functionality, temporality, and quantitation of information.

One of the major findings of the Committee's review is need to discuss connectivity as a gradient and not a binary property. The review raised concerns that connectivity is not defined early in the EPA report and isolation is not defined at all; this is an important structural suggestion. The review provides suggestions from the literature on which to draw the information. I agree with the Committee's recommendations that quantifying connectivity would further strengthen the EPA report.

The recommendation to better define the functional role of floodplains and riparian areas, as well as landscape elements is well supported by the need to provide greater clarity to the scope of the EPA report. The Committee's review documents the need to consider all of the dimensional aspects of hydrologic flow. The Committee recommended that the flow path framework be restructured and incorporate additional layers of complexity; this is a practical recommendation to integrate complexities of hydrology flow paths. Examples provided in the Committee's review include temperature effects, presence of debris, biota and the influence of human activity. The Committee review identified a number of published studies that support their recommendation to develop a new section in the EPA report that addresses aggregate and cumulative effects of headwater streams on downstream ecosystems.

Another major finding of the review is the need to provide a broader range of examples. The Committee's review found that the EPA report was unclear regarding how the case study examples were selected. The Committee's review recommended that the rationale for selecting case studies be described and that additional case studies were specifically suggested.

Another finding of the review is the need to improve the technical accuracy of the conceptual framework. One recommendation is the need to clearly incorporate the temporal component along with the hydrological, chemical and biological connectivity. Further, the Committee's review discusses the need to better define the groundwater mediated connectivity and the biological connectivity.

Regarding the connectivity of streams to downstream waters the Committee's supported the conclusion regarding the strong influence of streams on downstream waters, and suggested that the conclusion could be strengthened in several ways such as incorporating the concept of a gradient of connectivity with supporting examples. Another consideration was to include the strength and degree of downstream connection be discussed in the EPA report. Regarding waters and wetlands in floodplain settings the Committee's review strongly supported the conclusions on connectivity and made several suggestions, such as discussing fluxes of water, materials and biota and the impact of human activity, to strengthen the findings.

Regarding the waters and wetlands in non-floodplain settings the Committee's review agreed with summary of the literature. However, the review disagreed with the EPA report's conclusion that there was insufficient information to generalize about the about the degree of connectivity. The Committee discussed that the incorporation of the concepts of gradients and temporality to a greater extent in the report would allow for generalizations on the degree of connectivity.

## **Comments from Dr. Terry Daniel**

SAB Quality Review: SAB panel review of EPA report, *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence*.

Overall the SAB review panel did a fantastic job of evaluating the EPA Connectivity report. They provided insightful and detailed suggestions for improving the report. The review document, from the letter to the administrator to the executive summary to the main body of the review, are all very well written and represent careful and thorough analysis on the part of the panel. Everyone involved in this review is to be commended for a splendid job!

### ***1. Were the charge questions adequately addressed?***

Yes, all of the charge questions were addressed very thoroughly. In addition, the SAB review panel had many important and helpful suggestions for improving and strengthening the EPA report overall. Findings and recommendations of the panel are clearly presented and well organized.

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

There are no technical errors or omissions that this non-hydrologist/ecologist reviewer could discern. Indeed the panel is commended for the depth and breadth of their review and for the many useful insights into the science issues to be covered. The panel also made excellent suggestions for improving the organization and presentation of the EPA report.

### ***3. Is the draft report clear and logical?***

The SAB quality review document is very clear and understandable even to readers not expert in the subject matter. The suggestions for coverage of additional substantive issues related to connectivity of water bodies as well as suggestions for reorganization and revisions of the EPA's Connectivity report are clearly presented, with detailed suggestions for revisions and numerous additional references that could strengthen the scientific basis of the report.

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

Yes, the review is very well documented with detailed discussion of items to be addressed in a revision supported by citations and extended by lists of suggested additional citations for the EPA authors to consider in revising their report. The conclusions (findings and key recommendations) are very well organized and clearly presented and they are fully supported within the body of the SAB review document.

### ***Some more general comments about the SAB review follow:***

First, the distinction drawn between a science-focused report, which the EPA intends for their Connectivity report, and a policy focused report are very well taken. That having been said (☺), there is a sense in which science, especially under the auspices of a national regulatory agency, cannot really be segregated entirely from policy. The EPA's Connectivity report and the science that it chose to review, especially if revised and extended as the SAB panel has suggested, would

have been very unlikely in the context of policies in force just a decade or two ago. The report reflects the policy shift in the Agency toward a broader “systems” approach to environmental science and regulatory activities and to greater concern for cumulative effects of insults and protective actions over broader temporal and spatial scales. This is consistent with the shift toward “sustainability” (as opposed to “resources” or “cost/benefit” models, for example) as the basic paradigm for Agency science and management decisions/actions. The SAB review panel and the EPA authors of the Connectivity report might consider whether this report provides an appropriate opportunity to briefly and generally stimulate internal discussion within the Agency of the implications of adopting the sustainability model. Similarly, the report might provide an important opportunity to signal to the citizen/publics and the regulated communities the Agency serves how this shift toward sustainability will affect Agency policies and actions, and the science that supports them.

Another implication of the science-policy interaction for a regulatory agency like the EPA is that there must be concern about and special attention to the “levers” that can be pushed (or not) to affect changes (or to avoid changes) in aquatic (and other environmental) systems. That is, EPA has special interest in and explicit mandates to understand how these systems work for the purpose of protecting, sustaining and/or restoring them. Thus, it is appropriate for the EPA report to attend to and emphasize such levers, even if this necessarily “bleeds over” from (pure) science to policy. The SAB review panel’s advice to emphasize a graded/quantified analysis of targeted aquatic systems and their inter-connections (as well as the suggested use of predictive models) as opposed to the dichotomous classification approach (connected or not) is consistent with an emphasis on science, but also with the recognition that EPA science needs to support policy decisions and regulatory actions. The advice to extend the EPA report to add greater treatment of human alteration of wetlands is also consistent with recognition of the policy-science relationship appropriate to EPA.

There are several instances where the language in the SAB panel review violates their own advice to the EPA authors. For example, the panel cites the “listing of a threatened or endangered species” as an effect of concern—thus using “policy speak” instead of science speak (e.g., extirpation of species, etc.). In several other places the panel review suggests reporting findings in more quantitative terms, as they consistently show to be appropriate, but then uses the particular example of “X% of studies support connectivity,” which seems to fall into the dichotomous classification trap that the panel advises the EPA authors to avoid. Another term that seems somewhat out of place is chemical “contaminant.” Perhaps this term is used in a particular way in the subject fields of study (for example it seems to include nitrogen and phosphorus), but it seems to an outsider to signal something like “pollution” and to call up associated negative evaluations (and people/industries to blame) which may not always be appropriate.

In the conclusions of the panel review (and of the EPA report?) there is reference to the need to address particular wetlands “on a case-by-case basis.” This is almost certainly true, but there is a danger that this might be taken to signal that “every wetland is different” and encourage the conclusion that general (scientific) principles are not useful in “real world” situations. This is no doubt not what the panel intends. It would help if any such reference is followed with some recognition that in spite of individual differences among wetland instances there are useful (and

essential) general principles and “models” that can and should be relied upon for making predictions and for guiding policy decisions and actions.

## 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.

Question 2: I did not note any technical errors or omissions. Regarding the recommendation that EPA define connectivity as a gradient (vs. a binary connected/ not connected), I found this to be unclear as to what was intended. I can interpret this recommendation in two ways. The first is that how connectivity is defined would still be categorical (e.g., connected, a little connected, not connected; or connected but having little impact on downstream waters, connected and critical for downstream water quality, etc.). The second interpretation is that the committee is looking for something quantitative and/or probabilistic. The committee should clarify what it intends, and also provide a basis for doing either in a scientifically supportable way.

Question 3: The report was logical and reasonable.

Question 4: The conclusions and recommendations are supported by the body of the report.

### **Comments from Dr. Otto Doering**

I believe that the charge questions were addressed more than adequately.

I did not see technical errors or omissions in the quality review report or issues that were not dealt with adequately.

The draft report is clear and logical.

The conclusions and recommendations are well supported by the body of the draft report.

#### **Further Comments:**

This is one of the best Quality Reviews that I have seen while on the SAB. The scope of the task was broad and this is a critically important issue. A high proportion of the suggestions given in the review are concrete, specific, and can thus be more easily considered for implementation. The suggestion for a “Connectivity Gradient” is extremely important, both for distilling the evidence in the ORD report and for making the weight of the science and the conclusion in the report more accessible to stakeholders and policymakers. The recommendations to better describe and define what is meant by geographical isolation, to better recognize the temporal dimension, and to place more emphasis on biological connectivity are very valuable contributions to the ORD report. This is also true of the suggestion to broaden the examples of the case studies and present them in a more uniform format. One concern I have is how many of the suggestions can be effectively acted on in a reasonable period of time as the report is redrafted. There may have to be some prioritization of the recommendations made by the SAB review team to help the authors in their revision of the ORD report. Some of the recommendations, like the ones mentioned above are critical, but there are some others that will have to receive less emphasis.

The SAB review team is to be commended this work on a difficult topic and in effectively keeping the focus on the important science involved.

**Comments from Dr. Joel Ducoste**

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

Response: Yes

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

Response: No

3) Is the draft report clear and logical?

Response: Yes

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

Response: Yes

Overall the report is well written and thorough. There is clear consistency in the message given in the letter to the Administrator, the executive summary, and body of the report.

## Comments from Dr. Robert Johnston

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

The SAB review is detailed and comprehensive, and does a good job of responding to the charge questions. Where revisions are recommended, the review provides detailed guidance and extensive references to assist in these revisions.

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

There appear to be no technical errors or major omissions in the review. I concur with all of the review's primary findings and recommendations.

However, I would like to highlight the importance of one issue raised in the SAB review, but given relatively modest attention. As noted in the SAB Review, one methodological issue that warrants greater emphasis in original report is the selection of studies for the literature review and the types of evidence used to support findings and conclusions. The Draft EPA Report gives insufficient attention to these issues. I agree with the SAB review that "the approach used for screening, compiling, and synthesizing information should be made explicit. In particular, the "weight of evidence" approach used to evaluate multiple references should be described in more detail." I am concerned that the EPA report appears to take a somewhat unsystematic approach to their "weight of evidence" review. This concern is magnified by the report's reliance on solely peer reviewed literature, together with the lack of clearly described (and ideally systematic) selection and screening criteria. While peer review is the gold standard used to validate the quality of scientific publications, it is also well-established that peer reviewed literatures and associated literature reviews are often subject to some degree of publication and selection bias (see, e.g., Begg and Berlin 1988; Møller and Jennions 2001). In such contexts, unsystematic "weight of evidence" reviews can provide misleading results. I have no reason to question the validity of the connectivity report's findings, as most of these findings appear to be supported by broad and relatively uncontroversial evidence from the literature. Moreover, given the breadth and heterogeneity of the topics considered, standard tests and corrections for publication and selection biases may not be readily applicable. Nonetheless, the EPA report should include a separate section that details methods used to identify, screen, compile and synthesize evidence from the literature. This should address both the studies used to derive "weight of evidence" conclusions and those used for illustrative case studies. This section should include, as applicable, details such as databases searched, keywords used, screening criteria applied, additional approaches used to identify relevant literature, etc. Were any systematic approaches used to draw "weight of evidence" conclusions, or were these conclusions drawn from a more casual overview of the literature? These and related details would help engender confidence that the report's conclusions are based on an objective and systematic review of the available evidence. It would also clarify the extent to which potentially confounding issues (e.g., selection effects; Rosenberger and Johnston 2009) might influence the results of the report. While the inclusion of these methodological details seems unlikely to affect the overall conclusions of the EPA report, it can help clarify the methods used to draw these conclusions.

Most of these recommendations are consistent with those already included in the SAB review. However, I might suggest that additional emphasis and details be provided regarding the type of documentation that EPA should provide regarding its literature review, and the motivations for requesting this information.

Begg, C.B. and J.A. Berlin. 1988. Publication Bias: A Problem in Interpreting Medical Data *Journal of the Royal Statistical Society. Series A (Statistics in Society)*, 151(3): 419-463.

Møller, A.P. and M.D. Jennions. 2001. Testing and Adjusting for Publication Bias. *Trends in Ecology and Evolution* 16(10): 580-586.

Rosenberger, R.S. and R.J. Johnston. 2009. Selection Effects in Meta-Analysis and Benefit Transfer: Avoiding Unintended Consequences. *Land Economics* 85(3) 410-428.

3) Is the draft report clear and logical?

Yes, the SAB review is clear and logical, and does a good job linking responses/recommendations to specific charge questions and providing detailed guidance for revision of the EPA report. The SAB review is relatively long, but this length appears to be warranted by the extensive detail of the underlying EPA report.

As a minor suggestion, it might be helpful if the Executive Summary could somehow highlight the primary recommendations in a concise and easily-identifiable way (e.g., using bullets or bold type). The current narrative of the Executive Summary, while clear, makes it difficult for the reader to quickly identify the primary recommendations and conclusions, and link these to specific charge questions.

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

Yes, the conclusions and recommendations are supported by the body of the report. Where applicable, the SAB review also documents an extensive body of scientific literature to support these recommendations and conclusions.

## Comments from Dr. Nancy Kim

### General Comment.

This is not my area of expertise. However, the report is well written, understandable and adequately addresses the charge questions. The Committee handled the complex issue well and provided EPA with valuable suggestions. Some of the comments are repeated in different sections and become somewhat repetitious, but that may be a result of having to specifically address each charge question.

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?

Not that I noticed.

3. Is the draft report clear and logical?

Yes. A few comments are provided below for the committee's consideration.

Page 14, lines 9-10. Does the committee want to be stronger with this recommendation by changing could to should and add wording in the recommendation to include some examples/discussion about quantitative metrics?

Minor comments.

Page 9, lines 4 – 17. The committee may want to consider revising this paragraph to strengthen its connection to the first key recommendation (page 9, lines 29 -32). The recommendation is very direct whereas this paragraph isn't.

Page 16, lines 3-5. The committee should review this recommendation in conjunction with the recommendation on page 14, lines 9-10 to determine if any clarification or connection between the two recommendations would be useful.

Page 21, lines 46-47. If the committee wants similar figures created for chemical and biological connectivity, this sentence should be stronger and recommend that it be done.

Page 25, line 6. This sentence is unclear to me, but this is not my area of expertise. The word "all" sets a high bar on the definition of cumulative effects and as I understand the point, not all headstream waters would have to exhibit a property for cumulative effects to occur.

Page 45, lines 28-31. This sentence suggests adding a more recent assessment and cites papers published in 2003; however, a couple of sentences earlier, the draft report cites a 2010 reference. I may be misreading these statements, but they seem inconsistent. Perhaps the issue could be resolved by minor editing.

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

Yes.

**Comments from Dr. Elizabeth Matsui**

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?

I did not identify any, but this topic is also not my area of expertise.

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. Kristina Mena**

- 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. In particular, the comments addressing use of case studies are explained well, along with the suggestions about how ORD's document should more broadly summarize the peer-reviewed literature. This would allow the document to have the specificity needed to be more useful for decision-makers, yet the breadth to capture and effectively convey the overall conclusions from the literature.
- 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. Specific examples to support commentary are provided as well as additional references that need to be included in ORD's document (particularly those related to the non-floodplain wetlands).

In addition, the information presented in the Letter to the Administrator, the Executive Summary, and in the Draft report is consistent.

**Comments from Dr. Surabi Menon**

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

I believe that all the charge questions have been addressed fairly adequately. This is not in an area I know much about, but in general charge questions appears to have been addressed well.

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

It appears that the omissions and issues of concern have been addressed well.

3) Is the draft report clear and logical?

The recommendations on report structure, need for additional references, better definitions, etc. have been documented fairly rigorously. Including the six suggested metrics for defining connectivity through frequency, magnitude, timing, duration, etc. is really important and an excellent suggestion for allowing the concept to be explained clearly, though I thought some parts were repetitious, especially concerns regarding geographical isolation versus connectivity and how connectivity has been defined throughout.

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

The conclusions are well supported and suggestions for strengthening the draft appears to be well documented.

**Comments from Dr. Eileen Murphy****Were the charge questions adequately addressed?**

This was a long and complex report. The SAB adequately addressed the charge questions.

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

This reviewer is unaware of technical errors or omissions, though this is not my field of expertise.

**Is the draft report clear and logical?**

In the letter to the Administrator, 2<sup>nd</sup> page, beginning with line 34, the SAB recommends that the Report use more commonly understood terms that are grounded in the peer-reviewed literature. On page 3, this recommendation is expanded upon to refer to one specific term, “geographically isolated wetlands” rather than a group of terms. However, on page 17, this issue is raised again with the recommendation that “bidirectional” and “unidirectional” should be replaced with “waters and wetlands in floodplain settings” and “waters and wetlands in non-floodplain settings” as well as better defines “geographically isolated wetlands.” Perhaps these recommendations should appear together. This reviewer was confused by this recommendation until page 17. The sentence in the letter to the Administrator does not appear necessary by itself.

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

The authors provide thorough and logical justification for their recommendations.

## Comments from Dr. James Opaluch

### Comments on SAB Draft Report on Connectivity of Streams and Wetlands to Downstream Waters

James Opaluch

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?

The SAB Draft report makes a strong case that connectivity should be expressed as a continuum, rather than simply being present or absent. The purpose of the EPA Connectivity report is to provide the scientific basis to support the proposed rule that clarifies the definition of “Waters of the United States”.

The EPA Connectivity report should support the proposed rule by providing the scientific basis of determining whether a water body qualifies under the proposed definition of “Waters of the United States”. Of concern here is the line of demarcation for “other waters” that do not automatically qualify by their use for commerce, or are interstate waters, tidal water and territorial seas. In particular, the determination under the proposed rule is:

“(7) On a case-specific basis, other waters, including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, *have a significant nexus to a water identified in paragraphs (s)(1) through (3) of this section.*” (p. 22263; italics added)

The proposed definition goes on to define significant nexus as:

Significant nexus. The term significant nexus means that a water, including wetlands, either alone or in combination with other similarly situated waters in the region (i.e., the watershed that drains to the nearest water identified in paragraphs (s)(1) through (3) of this section), significantly affects the chemical, physical, or biological integrity of a water identified in paragraphs (s)(1) through (3) of this section. For an effect to be significant, it must be more than speculative or insubstantial. Other waters, including wetlands, are similarly situated when they perform similar functions and are located sufficiently close together or sufficiently close to a “water of the United States” so that they can be evaluated as a single landscape unit with regard to their effect on the chemical, physical, or biological integrity of a water identified in paragraphs (s)(1) through (3) of this section. (p. 22274)

In order to provide scientific support under the proposed rule, the EPA report should provide a scientific basis for whether a water body “significantly affects the chemical, physical or biological integrity of a water body”. A reasonable scientific basis for a rule would define a method for determining whether or not a water body has a “significant effect on the chemical,

physical or biological integrity” of navigable waters, interstate waters, tidal waters or territorial seas, and the effect should not be “speculative”.

The SAB Draft report could provide a more specific focus on the purpose of the Draft EPA Connectivity report. For example the material on page 9, lines 6-9, indicates “...the Report there could be greater focus on the literature that addresses various aspects of quantifying the frequency, duration, magnitude, predictability, and consequences of connectivity”. I would argue that the report should go a step further to the extent possible to help make the determination of whether a water “taken alone or in combination with other similarly situated waters ... significantly affects chemical, physical or biological integrity”. Certainly duration, frequency, magnitude, etc are among the essential determining factors of whether there exists a “significant nexus” as defined in §401.11(3)(vii) of the proposed rule. But the quantifying the impact on chemical, physical and biological integrity of a water body is a science issue, and the Report could provide guidance on this—not simply on frequency, duration, etc. of connectivity. This also might argue for a binary determination—what are the conditions that determine whether a water body does it not “significant affect” integrity of qualifying waters.

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, except as indicated above.

## Comments from Dr. Richard Poirot

### Pre-Discussion Comments on Draft SAB Review of EPA “Connectivity” Report

While the subject matter of the EPA Connectivity report and draft SAB review lies primarily outside my area of expertise, the draft SAB review appears to be exceptionally thorough, with helpful recommendations that should help the Agency improve the quality, clarity and utility of its final report. The SAB review is directly responsive to the specific charge questions posed by EPA. There don't appear to be technical errors or omissions, nor are there any major issues I'm aware of that are not adequately dealt with in the draft review. The review is logically organized, and its conclusions and recommendations are all well-supported by details, examples and references in the body of the draft review. For the most part, the review is very clearly written, and should be quite helpful to as the Agency develops its final report.

I have one minor comment on the clarity of the presentation – which likely just reflects my general ignorance of the subject area and its common terminology. I found it difficult to understand the exact intended meaning of the recommended “gradient” approach, and more specifically, the dimensions, characteristics or functions of connectivity to which it's recommended that this gradient approach be applied. Since consistent application of this connectivity gradient approach appears to be one of the major recommendations of the review, I think it would help to describe it as clearly as possible.

The draft report employs the word “gradient” over 30 times (not counting its separate usage and meaning in “downgradient”). On at least 7 occasions, the intended meaning of the recommended “gradient” approach is further explained in terms like “a gradient of connectivity, that is a function of the frequency, duration, magnitude, predictability, and consequences of physical, chemical, and biological processes” – although sometimes the “physical, chemical and biological processes” part of this is dropped, and on other occasions only the “frequency, duration and magnitude” functions are retained. On one occasion, (p 9) a gradient approach is recommended “whereby the consequences to downstream waters are determined by the frequency, duration, predictability, and magnitude of connections.”

Elsewhere, the review states (p 15) that “connectivity can be described using six metrics commonly used in hydrology and disturbance ecology – frequency, magnitude, timing, duration, rate of change, and predictability” – similar to, but not identical to the previous list of five (or three?) metrics (or functions or dimensions – what are these things anyway, and can we use consistent terms when describing them?).

Some excellent examples of the intended application of the “gradient approach” are provided in Figure 3, and these are very helpful to the understanding of the recommended gradient application (for these examples). But the reader doesn't encounter these until page 54, and the accompanying text refers only to three aspects of the “degree of connectivity pathways (e.g., magnitude, duration, frequency)”, leaving it unclear how or if it's intended that similar gradients be used to characterize the relative predictability and consequences functions. A footnote to this statement advises that, “in this context, frequency, magnitude, and duration apply to all five functions used to describe connectivity in the Report and not to hydrologic connectivity alone”. The previous page lists “five functions used to describe connectivity in the Report (i.e., source, sink, refuge, lag, transformation)” – but does not refer to “hydrologic connectivity”.

I think to would be helpful to add, near the beginning of the review document, a clear, comprehensive summary of exactly what's intended by the recommended gradient approach, and including an inclusive list, table or matrix that makes clear exactly those aspects of connectivity (or of specific connections and their associated functions or biogeochemical processes) for which we are recommending this gradient approach be applied. If there are key papers describing the preferred approach, maybe they could be highlighted here. Possibly this summary could be embedded within a description of the recommended conceptual model that we are suggesting EPA employ, and/or maybe including a glossary of key terms to be used in the review report. Subsequent sections of the report, could then simply refer to "the gradient approach, as described on page X", without need to keep redefining the general intended meaning, but allowing a more detailed focus on the specific applications for which a gradient approach is being recommended in different sections of the review.

One other really minor comment is more of a question of the intended meaning of the term "beneficial" chemical flowpaths on lines 39-40 on page 54. Might there also be detrimental chemical flow paths, or beneficial or detrimental or just plain neutral hydrological or biological flowpaths provided by non-floodplain wetlands to downstream waters?

**Comments from Dr. Peter Wilcoxon**

1. Were the charge questions adequately addressed?

Yes. The response to charge question 2 is particularly thorough and provides strong, clear guidance on suggested revisions to the Report.

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

Not to my knowledge.

3. Is the draft report clear and logical?

Yes. The text is clear and well organized. The concise highlighting of key recommendations at the end of section is especially helpful.

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

Yes, all of the conclusions and recommendations are supported in detail.