

Comments from individual members of the Science Advisory Board (SAB) Panel for the Review of the EPA Water Body Connectivity Report to assist meeting deliberations. These comments do not represent consensus SAB advice or EPA policy. DO NOT CITE OR QUOTE

Panel Member Comments on the Draft (6-5-14) SAB Review of the Draft EPA Report *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence*

(As of 6/18/14)

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Dr. Genevieve Ali

Many thanks for pulling the revised SAB report together. I only have two minor comments.

1) On page 53 L17-24, we can read:

"In addition, the SAB recommends that the EPA review and, if needed, add to the Report the following selected references that are particularly pertinent to the discussion of non-floodplain wetlands: Brunet and Westbrook (2012); Croke et al. (2005); Conly et al. (2001); Fang and Pomeroy (2008); Gray et al. (1984); Hayashi and Van der Kamp (2000); Hayashi et al. (2003); Montgomery (1994); Shaw et al. (2012); Spence (2007); Spence and Woo (2003); Stichling and Blackwell (1957); Thompson et al. (2008); Van der Kamp et al. (2003); Van der Kamp et al. (2008); Wemple et al. (1996); Wemple et al. (2001); Wigmosta and Perkins (2001); Winter and LaBaugh (2003); Woo and Rowsell (1993); and Yang, et al. (2010)."

There was a mix-up there, as the list includes works about pothole wetlands but also works about the influence of roads on connectivity. The references that have to do with road connectivity (i.e., Croke et al. (2005); Montgomery (1994); Thompson et al. (2008); Wemple et al. (1996); Wemple et al. (2001); Wigmosta and Perkins (2001)) should be moved to the section that deals with human impacts on stream connectivity. So far, roads are only mentioned on page 11 of the SAB report.

2) On page 53 L5 and L29: There are references to Bracken et al., 2013 but we did not touch on any wetland-related studies in this review paper. The reference to Bracken et al., 2013 would be best located in section 3.2.2 (Measuring or Otherwise Quantifying Connectivity).

Dr. David Allan

Comments on SAB Connectivity Panel Draft Report 6_5_14: David Allan

The SAB Draft Report is extremely well reasoned and well written. I am completely comfortable with the document as written. I did, however, have queries regarding some specific points in the document. These are described below as possible points to consider by the lead authorship team in finalizing this report. Overall – very, very well done.

All page and line references are to the pdf version.

Letter to Administrator McCarthy: no changes

Executive summary:

P 3 line 12: “The term “geographically isolated wetland is misleading because...” the rest of this sentence flatly states that all wetlands are connected at some point in time. I wonder if this is a remnant of earlier thinking, as the body of the document offers a more nuanced view including the gradient and possible case by case evaluation (eg, p 13 Line 8-9). Might this sentence conclude, “... because the term geographically isolated refers to landscape setting, rather than functional connectivity that may be mediated by ground water or movements of biota; in addition, many apparently isolated wetlands will be connected episodically by surface water”.

P 4 line 2-3: sentence structure feels not parallel, suggest “and more attention be given to..”

Report body:

P 13 line 1: reference to entire landscape – this might feel like “everywhere”. A more subtle and specific wording might be “the entire contributing drainage area”. See also p 13 line 40.

P 14 around line 31: this material is quite dense – perhaps simplify?

P 16 line 12: again, the declaration is made that no truly isolated wetlands exist, followed by recognition of gradient. Here as with p 3 line 12, we have the opportunity to put the focus on the gradient, at one end of which the functional connectivity needs to be evaluated and may be minimal, vs the stronger statement that no truly isolated wetlands exist. To me, the statements of absolute connectivity feel inconsistent with the recognition that functional connectivity diminishes greatly at one end of the gradient. In other words, we may not yet have arrived at a consistent message.

P 41 line 42: typo

P 55 figure 3: suggest “Transfers mediated by biota to downstream waters” (just above lower horizontal line)

P 56, lines 17-20: I like this statement as worded (see also p 59 lines 16-18). I see a contrast with p 3 line 12 and p 16 line 12

P 59, line 30-31: this feels like a new idea.

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Dr. Robert Brooks

Tom, Iris and Amanda.

I have two comments here for consideration.

1) In the letter to the Administrator, the bullet on p.3, lines 14-16 states: "...additional information on biological connections should be included." I suggest adding one more short sentence stating: The panel has provided numerous additional citations addressing the role of multiple biological taxa, with annotations to guide the authors in their revision.

2) In the Executive Summary, p.12, line 24, I would suggest deleting ...thorough and... The current report is technically accurate, but this section was most lacking with regard to the literature, and hence, the reason we supplied the detailed lists. We should make sure the message of adding considerably more citations is strongly worded - in my opinion. This point is more strongly stated in the next section, p.12, lines 46-47, so we want our message to be consistent.

I'm satisfied with the remaining statements and recommendations. Great job synthesizing all of the technical comments!

Dr. Michael Josselyn

ISSUES FOR DISCUSSION AT PANEL TELECONFERENCE CALL

MICHAEL JOSSELYN

I am recommending that the Connectivity Panel consider several overarching issues related to the June 5, 2014 Draft.

- There still seems to be some inconsistency in how the Panel's recommended gradient approach to assessing the strength of the connectivity between waters/wetlands to downstream waters is described in the various sections. The Panel reached an important decision and concurred that for all topic areas, e.g. tributaries, floodplain wetlands/waters, and non-floodplain wetlands/waters, that there were gradients in connectivity and indeed that is reflected in the first recommendation to the Administrator (lines 43-45). However, the draft Panel report discusses that low levels of connectivity can be ecological meaningful and that there are no "geographically isolated wetlands". I would view these as being on the low end of the gradient. In addition, we state that we disagree with the EPA Report conclusion that "unidirectional wetlands" need to be evaluated on a case-by-case basis because of the uncertainty in the scientific literature whereas we later state that such wetlands exist on a gradient of connectivity and need to be evaluated based on frequency, duration, and magnitude of effect. I believe that the Panel Report should emphasize that the presence of any connection is not the only issue that the EPA Draft Report was intended to discuss; but whether that connection had an effect on biological integrity of downstream waters. I do agree with the statement in our report:

The Report should state that connectivity is a scalable quantity ranging continuously from fully connected to completely isolated, rather than a binary condition of either connected or isolated. Page 14 Lines 10-14

The EPA Draft Connectivity report states that the purpose is to assess the scientific literature on both the nature of the hydrologic, chemical, and biological connections and their effect on downstream waters. The Panel has correctly stated that the EPA should analyze the scientific literature to provide a more quantitative basis for assessing the degree of connectivity. I would ask that the Panel confirm as we review the recommendations that the gradient approach needs to be evaluated within each of the sections of the EPA Draft Report more clearly in terms not just the connection itself, but the level of scientific information on the degree of influence of such a connection on downstream waters. The EPA report already did this type of analysis for unidirectional wetlands when it concluded that case-by-case analysis is necessary; but should also evaluate whether that is true using the gradient approach for the tributaries and floodplain wetlands.

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- The Panel discusses aggregation in a number of areas when referring to watersheds and how to scale impact analysis. However, the analysis of how aggregation could be done and how such an analysis would inform decision makers is not evaluated in the EPA Draft Report using the scientific literature as a tool. I believe that the Panel should consider a stronger language in its letter to the Administrator that the EPA Report should discuss this issue more thoroughly through a review of spatial analysis tools.
- The Panel report uses the term “recommends” over 180 times in the document. This is a substantial number of recommendations. While our bulleted recommendations are less, they are still substantial, not just in number, but in the content contained within them including changes in the conceptual framework, restructuring the connectivity discussion to a gradient analysis, and many other detailed changes. While I believe some degree of editing can be useful to avoid repetitive recommendations from the Panel (e.g. two repeated discussions on disturbance ecology), I still think we will have a large number of recommendations. This would suggest to me that the EPA Draft Report will require substantial revision to address these recommendations, should the EPA choose to accept them. I believe that this level of change should be recognized in the letter to the Administrator.
- I would like to discuss with the Panel the process of editing this document. I believe that there remains much repetition, areas where recommendations are made in different ways, inconsistency in terminology, and readability for the public. I am not sure how changes will be made in subsequent drafts and would appreciate a discussion on how the Panel will be involved with those changes.

I look forward to discussing the report sections and will share my thoughts on these issues in those sections during our discussion.

I have also attached my edits to the Letter to the Administrator when we reach that portion of discussion on Thursday.

EPA-SAB-14-xxx

The Honorable Gina McCarthy
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Subject: SAB Review of the Draft EPA Report *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence*

Dear Administrator McCarthy:

The EPA's Office of Research and Development (ORD) requested that the Science Advisory Board (SAB) review the draft report titled *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence (September 2013 External Review Draft)* ("Report"). The Report is a review and synthesis of the peer-reviewed literature on the connectivity or isolation of streams and wetlands relative to large water bodies such as rivers, lakes, estuaries, and oceans. The Report was developed by ORD to inform an EPA and U.S. Army Corps of Engineers rulemaking to clarify the jurisdiction of the Clean Water Act.

In response to the EPA's request, the SAB convened an expert panel to review the Report. The 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. The enclosed report provides the SAB's consensus advice and recommendations.

The Report is a thorough and technically accurate review of the literature on the connectivity of streams and wetlands to downstream waters. The SAB agrees with two of the three major conclusions in the Report. The SAB finds that the review of the scientific literature strongly supports the conclusions that streams and "bidirectional" floodplain wetlands are physically, chemically, and/or biologically connected to downstream navigable waters; however, these connections need to be better analyzed in terms of a connectivity gradient from fully connected to isolated. The SAB recommends a substantial number of some revisions to improve the clarity of the Report, better reflect the scientific evidence, provide more quantitative measures, and make the document more useful to decision-makers. The SAB disagrees with the conclusion that there is insufficient information available to generalize about the connectivity of wetlands in "unidirectional" non-floodplain settings. In that case, the SAB finds that the scientific literature supports a more definitive conclusion that numerous functions of "unidirectional" non floodplain wetlands sustain the physical, chemical, and/or biological integrity of downstream waters; however, the magnitude of those connections is not universal. The SAB's major comments and recommendations are provided below.

- The Report often refers to connectivity as though it is a binary property (connected versus not connected) rather than as a gradient. In order to make the Report more technically accurate, the SAB recommends that the interpretation of connectivity be revised to reflect a gradient approach that recognizes variation in the frequency, duration, magnitude, predictability, and consequences of those connections for tributaries, wetlands, and other waters. The SAB notes that in certain systems, such as headwater streams and tributaries and floodplain wetlands, relatively low levels of connectivity can be ecologically meaningful in terms of impacts on downstream waters.
- The SAB recommends that EPA clearly set forth the definitions used in the Report to be consistent with definitions proposed for rulemaking and that any differences between

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regulatory and scientific terminology be explained and described in terms of how it may affect interpretation of the conclusions reached.

- The SAB recommends that the EPA consider expanding the brief overview of approaches to measuring connectivity. This expansion would be most useful if it provided examples of the dimensions of connectivity that could most appropriately be quantified, ways to construct connectivity metrics, and the methodological and technical advances that are most needed.
- The Report presents a conceptual framework that describes the hydrologic elements of a watershed and the types of connections that link them. The literature review supporting the framework is technically accurate and clearly presented. However, to strengthen and improve its usefulness, the SAB recommends that the framework be expressed as spatially continuous physical, hydrological (surface and subsurface), chemical, and biological flowpaths that connect watersheds. The water body classification system used in the Report (i.e., classification of waters according to landscape settings) should be integrated into the flowpath framework to show that continuous phenomena interact across landscape settings. In addition, the SAB recommends that each section of the Report be clearly linked to the conceptual framework.
- The SAB recommends that the Report more explicitly address the scientific literature on cumulative and aggregative effects of streams, groundwater systems, and wetlands on downstream waters. In particular, the Report should contain a discussion of the spatial and temporal scales at which streams, groundwater systems, and wetlands are functionally aggregated and how the scientific literature can be used to evaluate the scale of aggregation on the watershed level. The SAB also recommends that, throughout the Report, the EPA further discuss several important issues including the role of biological connectivity, biogeochemical transformation processes, and the effects of human alteration of connectivity.
- In the Report, the EPA has classified waters and wetlands as having the potential for either “bidirectional” or “unidirectional” hydrologic flows with rivers and lakes. The SAB finds that these terms do not adequately describe the four-dimensional (longitudinal, lateral, vertical, and temporal) nature of connectivity and the SAB recommends that the Report use more commonly understood terms that are grounded in the peer-reviewed literature.
- The SAB commends the EPA for the comprehensive literature review in the Report, though additional citations have been suggested to strengthen it further. To make the review process more transparent, the EPA should more clearly describe the approach used to screen, compile, and synthesize the information.
- The SAB finds that the review and synthesis of the literature describing connectivity of streams to downstream waters reflects the pertinent literature and is strongly grounded in current science. The literature review provides strong scientific support for the conclusion that ephemeral, intermittent, and perennial streams can exert a strong influence on the

character and functioning of downstream waters depending upon the gradient of connectivity associated with specific regional settings and that all tributary streams are connected to downstream waters. The SAB also recommends that the literature review more thoroughly address hydrologic exchange flows between main channels and off channel areas, the influence of stream temperature on downstream waters, and the movement of biota throughout stream systems to use critical habitats.

- The SAB finds that the review and synthesis of the literature on the connectivity of waters and wetlands in floodplain settings is somewhat limited in scope (i.e., focused largely on headwater riparian wetlands) and should be expanded. However, the literature review does substantiate the conclusion that floodplains and waters and wetlands in floodplain settings support the physical, chemical, and biological integrity of downstream waters. The SAB recommends that the Report be reorganized to clarify the functional role of floodplain systems in maintaining the ecological integrity of streams and rivers and that the Report more fully reflect the literature on lateral exchange between floodplains and rivers.
- The SAB finds that the review and synthesis of the literature on the connectivity of non-floodplain (“unidirectional”) waters and wetlands is generally thorough and technically accurate. However, additional information on biological connections should be included.
- The SAB disagrees with the EPA’s conclusion that the literature reviewed did not provide sufficient information to evaluate or generalize about the ~~degree of~~ connectivity (absolute or relative) or the downstream effects of wetlands in “unidirectional” non-floodplain landscape settings. The SAB finds that the scientific literature supports a more definitive statement about the functions of “unidirectional” non-floodplain wetlands ~~that sustain the physical, chemical, and/or biological integrity and their connection to~~ downstream waters; however recognizes that these connections can vary with frequency, duration, and magnitude. -In this regard, the SAB recommends that the EPA revise the conclusion to better articulate: (1) what is supported by the scientific literature and, (2) the issues that still need to be resolved.
- The SAB recommends that the EPA further evaluate the concept of aggregation of tributaries and wetlands by examining the scientific literature on spatial analysis and to provide better guidance to decision makers on how such aggregation may be applied in a practical manner.
- The SAB also recommends that the Report clearly indicate that all aquatic habitats have some degree of connection to downstream waters through the transfer of water, chemicals or biota, although such connections may not be relevant if they do not have important effects on the physical, chemical, and/or biological integrity of downstream waters though the magnitude and effects of these connections vary widely across wetlands.

The SAB appreciates the opportunity to provide the EPA with advice on this important subject. We look forward to receiving the agency’s response.

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Dr. Kenneth Kolm

**Comments Regarding the Revised (6-5-14) Draft of the Connectivity Panel's Draft report:
*Connectivity of Streams and Wetlands to Downstream Waters:
A Review and Synthesis of the Scientific Evidence***

**Kenneth E. Kolm, Ph.D.
Submitted on June 17, 2014**

As an opening statement, I think the current Draft Report comments is an excellent synthesis of much of the teleconference discussions. I have cross referenced the original Draft Report comments with the current Draft Report comments, and I have a few topics that are brought forward for the Panel's consideration. Please find attached Comments Regarding the Revised (6-5-14) Draft of the Connectivity Panel's Draft report: Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence.

LETTER TO ADMINISTRATOR MCCARTHY

NO ADDITIONAL COMMENTS.

EXECUTIVE SUMMARY

Page 6: Line 20; Suggest: **The SAB recommends that the systematic approach be taken to determine the structure and function of non-floodplain ("unidirectional") wetlands as used by hydrogeologists, surface water and groundwater hydrologists, and watershed scientists and engineers. Investigators in these disciplines have developed the quantitative tools and conceptual models to determine the connectivity of both surface and subsurface hydrological systems, and have applied this approach and mathematical modeling tools to settings like unidirectional wetlands, and can be extended to include biological connections. The systematic approach characterizes 1) surface elements of the landscape: topography (slope steepness and aspect, degree of dissection, etc.); geomorphology and soils (processes and resulting surficial deposits); surface water type, amount, and distribution (springs, seeps, streams, lakes, etc); vegetation and habitat type, amount, and distribution; climate (precipitation type, magnitude, and distribution, temperature, etc...); and 2) subsurface elements of the landscape: geology (lithology and materials); geologic structure (faults, fractures zones, karst features); geomorphology; geochemistry; hydrogeology), and combines these elements into a surface water, groundwater, sediment, biological and chemical flowpath network that defines the connectivity of the systems (ASTM, 1996; Kolm, et. al, 1996; Heath, R. C., 1983; Winter, T. C., Harvey, J.W., Franke, O.L., and Alley, W.M, 1998), and has been extended to include biological connections and HGM wetland classifications (for example, Kolm et.al., 1998). Each of these systems can be quantified and assessed for connectivity by the various techniques defined by the individual system**

components (Healy, R.W., Winter, T.C., LaBaugh, J.W., and Franke, O.L., 2007), such as surface water quantity and quality modeling (including chemical and biological tracers)(Conaway, J.S., and Moran, E.H., 2004; McDonald, R.R., Nelson, J.M., and Bennett, J.P., 2005; Nelson, J.M., Bennett, J.P., and Wiele, S.M., 2003) and sediment transport modeling (chemical and mineralogical tracers)(Kinzel, P.J., Nelson, J.M., Parker, R.S., Bennett, J.P., and Topping, D.J., 1999; McDonald, R.R., Nelson, J.M., and Bennett, J.P., 2005; Nelson, J.M., Bennett, J.P., and Wiele, S.M., 2003), ground water quantity and quality modeling (including chemical and biological tracers)(Appel, C.A., and Reilly, T.E., 1994; Sun, Ren Jen, and Johnston, R.H., 1994; Cunningham, W.L., and Schalk, C.W., comps., 2011; Parkhurst, D.L., Kipp, K.L., and Charlton, S.R., 2010; Harbaugh, A.W., 2005); watershed and biological/habitat/landscape modeling (Kinzel, P.J., Nelson, J.M., and Parker, R.S., 2005; Hunt, R.J., Walker, J.F., Selbig, W.R., Westenbroek, S.M., and Regan, R.S., 2013); and integrated surface water ground water modeling (Markstrom, S.L., Niswonger, R.G., Regan, R.S., Prudic, D.E., and Barlow, P.M., 2008; Ely, D.M., and Kahle, S.C., 2012; Huntington, J.L., and Niswonger, R.G., 2012; Woolfenden, L.R., and Nishikawa, Tracy, eds., 2014).

INTRODUCTION

RESPONSES TO EPA'S CHARGE QUESTIONS

- 3.1. Overall Clarity and Technical Accuracy of the Draft Report**
- 3.2. Conceptual Framework: An Integrated, Systems Perspective of Watershed Structure**
- 3.3. Review of the Literature on Ephemeral, Intermittent, and Perennial Streams**

P 34. Line 37:

3.3.11 Role of Sediment Transport

The physical, chemical, and biological effects and quantification of sediment transport, as related to surface water connectivity, need to be included. Discussions on sediment transport need to be coordinated with the geology and sedimentology literature, which is well established. There are 3 types of sediment described, characterized, and quantified in the geologic and hydrology literature: dissolved, suspended, and bedload (based on type of movement and size). Combining the sedimentology literature with the current literature, including contaminant transport, is recommended to establish connectivity in these surface water systems.

- 3.4. Review of the Findings and Conclusions Concerning Ephemeral, Intermittent, and Perennial Streams**
- 3.5. Review of the Literature on Waters and Wetlands in Riparian/Floodplain Settings**

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3.6. Review of the Findings and Conclusions Concerning Waters and Wetlands in Riparian/Floodplain Settings

Page 49; Line 40:

Quantification of Groundwater Linkages

The role of groundwater movement and storage (Heath, R. C., 1983), including the effects of "flood pulses" and the differences between "slope wetlands and riverine wetlands" given HGM-type classifications (Kolm et.al., 1998), and the role of chemical/contaminant movement and storage related to groundwater systems in floodplains has been documented (characterized) and quantified (flow and transport modeling)(Winter, T. C., Harvey, J.W., Franke, O.L., and Alley, W.M, 1998; Markstrom, S.L., Niswonger, R.G., Regan, R.S., Prudic, D.E., and Barlow, P.M., 2008; Woolfenden, L.R., and Nishikawa, Tracy, eds., 2014).. Quantification of floodplain systems can be conducted in both steady-state and transient analysis to simulate the temporal changes (Appel, C.A., and Reilly, T.E., 1994; Winter, T. C., Harvey, J.W., Franke, O.L., and Alley, W.M, 1998; Harbaugh, A.W., 2005; Conaway, J.S., and Moran, E.H., 2004; McDonald, R.R., Nelson, J.M., and Bennett, J.P., 2005; Nelson, J.M., Bennett, J.P., and Wiele, S.M., 2003; Markstrom, S.L., Niswonger, R.G., Regan, R.S., Prudic, D.E., and Barlow, P.M., 2008; Huntington, J.L., and Niswonger, R.G., 2012).

3.7. Review of the Literature on Non-floodplain ("Unidirectional") Waters and Wetlands

3.8. Review of the Findings and Conclusions Concerning Non-floodplain ("Unidirectional") Waters and Wetlands

REFERENCES

APPENDIX A: THE EPA'S CHARGE QUESTIONS

APPENDIX B: TECHNICAL AND EDITORIAL CORRECTIONS FOR THE FINDINGS AND CONCLUSIONS

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DR. MARK MURPHY

To: Dr. Amanda Rodewald, Chair
Connectivity Ad Hoc
Committee Science Advisory
Board
U.S. Environmental Protection Agency

Dr. Thomas Armitage, Designated Federal Officer,
Connectivity Ad Hoc Committee
Science Advisory Board
U.S. Environmental Protection Agency

From: Dr. Mark T. Murphy, Member
Connectivity Ad Hoc Committee
Science Advisory Board
U.S. Environmental Protection

Agency Date: June 10, 2014

Subject: Final Comments - SAB Report to the EPA Administrator

I have reviewed the subject document and I am very pleased. The SAB report represents our deliberations excellently, reads very well and emphasizes the major points clearly. Because I am so happy with the document, my final comments are few and fairly pointed. I felt it important to review one more time some of the more substantive public comments and felt two of the contributions were not entirely represented in the SAB report. Two other comments are small changes in the placement of text that I think will add to the clarity of the discussions

Although I think these changes will improve the document, I am satisfied with the report as it stands and commend the effort and talent you both have put into this important National issue.

1.0 COMMENTS:

Section 3.3.6, page 31, Line 21-31 – Several public comments were made that the report did not clarify where WOUS began in the watershed, specifically the transition for erosional features like rills and gullies to integrated drainage channels. I think that this issue was not clear in the Report because of the lack of a general discussion of the

temporal scale of connectivity, which I hope the report will have in the next draft. We should therefore include in this section (or somewhere in our Section 3 comments) something like: “Consideration of appropriate temporal scales and disturbance ecology could help the Report provide direction on discrimination between short-term, erosional features like rills and gullies, which are initiated by human or natural disturbance, and longer-term, integrated headwater channels with more ecologically effective connectivity to downstream waters.” Two good surveys of the transition from gullies to headwater streams are Poesen et al 2003 and Schumm et al 1987.

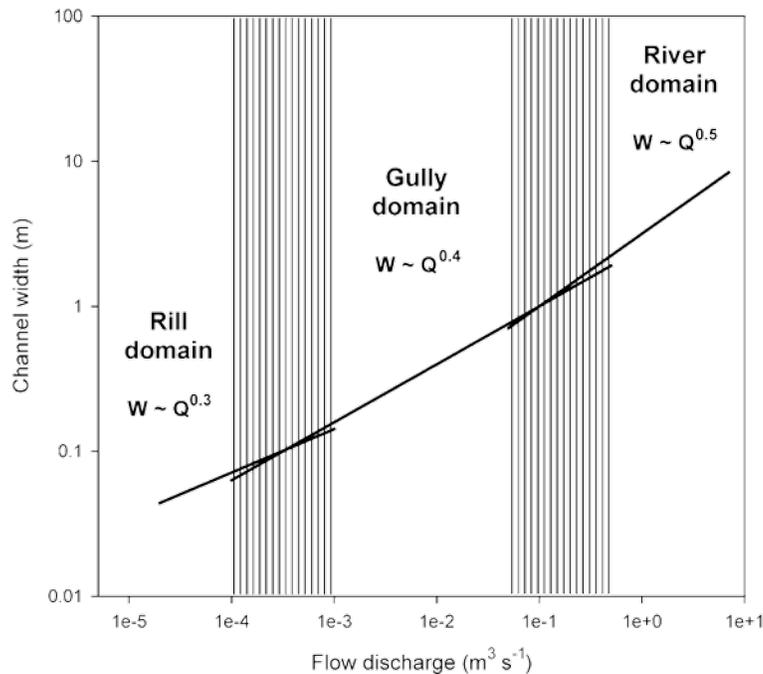


Fig. 4. Power relation between concentrated runoff discharge (Q) and mean eroded channel width (W) for various types of eroded channels. Note the change in exponent b from 0.3 for rills to 0.4 for gullies and 0.5 for small river channels. Vertical bars indicate transition zones between the established relations (after Nachtergaele et al., 2002a). From Poesen 2003

Section 3.4.1, pg 36, line 36 - Although we ask them to use the definition of interrupted streams, we don't indicate where it should be used. I think this section is the right place. It would be helpful to have a stand-alone paragraph that follows line 35 saying something like, “In many streams that experience flow regulation, ground water capture or any rapid, longitudinal change in discharge, riverine habitat can become discontinuous and aquatic and riparian communities can lose connectivity. For example, in the arid Southwest, the San Pedro and Santa Cruz Rivers include long reaches of ephemeral flow, bounded by intermediate to perennial sections. In the volcanic terrains of the Snake River Plain in Idaho or the Hawaiian Islands and karst regions of central Kentucky, stream flow can be captured by bedrock aquifers. These streams, defined as *interrupted*, can be strongly or very weakly connected

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depending upon a variety of biological and physical factors and the Report should discuss ways to spatially and temporally characterize the impacts to riverine habitat of natural and human interruption of flow.”

Section 3.5.3 Recommendations, pg 44 line 16-18 – One of the public comments requested that the Report better represent connectivity in tropical/Hawaiian wetlands. I am not an expert on these systems; however, my limited work in on the islands of Hawaii and Oahu suggested that coastal lowland wetlands function as an important barrier to sediment and nutrient loading upon critical seagrass and coral reef habitat. As such, this is a case where *isolation* is required to protect downstream ecosystems. I’m sure that there are other connective aspects of Hawaiian and tropical island wetlands that also need to be part of the Report. Greg Bruland (2008) at U of Hawaii is an authority on Hawaiian wetlands and the Report should evaluate his recent publications.

Section 3.7.3 page 55, line 1-8 – I still think that Figure 3 should be moved up and integrated into Chapter 2 where it is first cited. The accompanying discussion is too general to be in the non-floodplain wetlands section.

2.0 REFERENCES CITED

- Poesen, J., Nachtergaele, J., Verstraeten, G., & Valentin, C. (2003). Gully erosion and environmental change: importance and research needs. *Catena*, 50(2), 91-133.
- Schumm, S. A., Mosley, M. P., & Weaver, W. (1987). Experimental fluvial geomorphology.
- Bruland, G. L. (2008). Coastal wetlands: function and role in reducing impact of land-based management. Coastal Watershed Management. WIT Press, Southhampton, UK, 85-124.

Dr. Judith Meyer

Dear Tom and Amanda

You and the other authors did a marvelous job of incorporating our comments and revising this report. It is greatly improved over earlier versions and has been sensitive to the concerns raised. I have only two places where I disagree with what has been written (under A below) and three suggestions (under B below) for clarification or improvement. Other than those two disagreements, I approve of the document as written and would be reluctant to see any more added (or subtracted) from it. The letter and Executive Summary did an excellent job of presenting our major points. Kudos for a job well done!

Judy

Page and line numbers from pdf

A. Two disagreements with what has been written:

56, 10-14: I disagree with the following: “Whether those connections are sufficient to warrant protections under the Clean 10 Water Act requires that the exchange of water, materials or biota is of sufficient magnitude to impact the physical, chemical, or biological integrity of downstream waters. It is not sufficient to establish the mere existence of a connection, but rather, the magnitude and the impact of those connections should be considered.” These lines step over the boundary between science and policy. As currently written, they are not appropriate for this document.

56, 44-47: I disagree with the following: “however, there has been insufficient scientific research to date to predict the magnitude of these connections and their effects on downstream ecosystems. A case-by-case evaluation will be required to establish whether these biological connections are of sufficient magnitude to affect the integrity of downstream waters.” Other parts of our report cite studies showing the significance and magnitude of these connections. It is not clear to me that a case by case analysis will always be necessary or that we should be stating that.

B. Some suggestions for improvement:

15, 40 : “Approaches ... COULD be drawn...” A minor point, but I like the way this material is presented in the text (i.e., insights from ...) and think we are suggesting these would be useful as EPA thinks about this. COULD better reflects this as a suggestion rather than SHOULD.

16, 1-15: Somewhere in this paragraph I think we should say that EPA’s decision to use the Cowardin definition seems appropriate to us.

37, 27-29: It is not clear to me that conclusions drawn at a broader regional scale would have more certainty than conclusions drawn at a local scale. In fact, I could argue the opposite because conclusions at a local scale would presumably be based on a set of findings where there

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would be a more limited set of varying conditions leading to greater certainty of outcome whereas broader regional conclusions could have a wide array of varying conditions leading to less certainty of outcome. The example seems to confound spatial scale with level of certainty, which doesn't make sense to me. A better example is needed.

55, 16-18: suggest changing to "EPA should use Figure 3 in this SAB report (or something similar) to frame..." They may be able to come up with something better along the same lines, so I added the parenthetical expression.

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Dr. Mazeika Sullivan

Mazeika Sullivan – Discussion points for June 19 teleconference

1. P1, line 33 – “Receiving” waters is also used at some points in the Report. Suggest either adding “receiving” waters as another term used in the report to the footnote on P1 or replacing “receiving” with “downstream” throughout the report.
2. We have introduced additional gradients/metrics of connectivity (i.e., in addition to magnitude, duration, and frequency) within a disturbance framework in Section 3.2 of the Report (P20, lines 21-33 and P15, lines 9-32) but these additional metrics are not consistently mentioned throughout the report: e.g., P5, line 35; P52, lines 33-34; P55, Figure 3 and line 17. It might be helpful to either include the additional metrics throughout or to be clear that we are using magnitude, duration, and frequency as examples of connectivity gradients.
3. We have suggested that EPA use a “riverine landscape” framework as the conceptual backbone of the Chapter on Waters and Wetlands in Floodplains. We should also suggest that this concept be introduced in the Conceptual Framework. This could be easily accomplished in Section 3 of the Report (P16, lines 11-12 and 22-24).
4. P32-33 – It is not clear that the term “riverine landscape” as used here is consistent with its use in other sections of the Report. Given the focal points of 3.3.8 (e.g., streamside vegetation, food-web connections between streams and their adjacent riparian zones), would a focus on connections with the terrestrial landscape be more appropriate here?
5. P39, lines 13 and 31 – Suggest replacing “riparian wetlands” with “riparian zones”. Same suggestion for Bullet #8 of letter to Administrator McCarthy.
6. Should we be attempting to prioritize recommendations?
7. In addition to prioritizing specific recommendations, should we consider a logical ordering for our general issues in the Report (i.e. alphabetical, in order of appearance in EPA review)? For example, in 3.6.2 (starts on P48) there is no specific rationale behind the ordering of the subsections.
8. Even though there was no charge question explicitly targeting Chapter 6 – Conclusions and Discussion, should there be any general recommendations made in the Report?

Minor notes:

1. P31, line 22 – change “land use” to “land-use”
2. P31, line 32 – change “excluded” to “excludes”
3. P40, line 21 – remove “on” after “selected”
4. P41, Line 42 – correct font
5. P53, line 5 – remove “,” after “Bracken”