

**Summary Minutes of the
U.S. Environmental Protection Agency Science Advisory Board
Panel for the Review of the EPA Water Body Connectivity Report
Public meeting
December 16 – 18, 2013**

Date and Time: Monday, December 16, 2013, 9:00 am – 5:45 pm; Tuesday, December 17, 2013, 8:30 am – 5:30 pm; and Wednesday, December 18, 2013, 8:30 am – 12:45 pm

Location: Washington Plaza Hotel, 10 Thomas Circle, N.W., Washington, DC, 20005

Purpose: The purpose of the meeting was to conduct a peer review of the EPA draft report, *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence (September, 2013 External Review Draft, EPA/600/R-11/098B)*

Participants:

Members of the EPA Science Advisory Board (SAB) Panel for the Review of the EPA Waterbody Connectivity Report (Panel roster is provided in attachment A):

Dr. Amanda Rodewald
Dr. Allison Aldous
Dr. Genevieve Ali
Dr. J. David Allan
Dr. Lee Benda
Dr. Emily Bernhardt
Dr. Robert Brooks
Dr. Kurt Fausch
Dr. Siobhan Fennessy
Dr. Michael Gooseff
Dr. Judson Harvey
Dr. Charles Hawkins
Dr. Lucinda Johnson
Dr. Michael Josselyn
Dr. Latif Kalin
Dr. Kenneth Kolm
Dr. Judith Meyer
Dr. Mark Murphy
Dr. Duncan Patten
Dr. Mark Rains
Dr. K. Ramesh Reddy

Dr. Emma Rosi-Marshall
Dr. Jack Stanford
Dr. Mazeika Sullivan
Dr. Jennifer Tank
Dr. Maurice Valett
Dr. Ellen Wohl

SAB Staff:

Dr. Thomas Armitage, Designated Federal Officer
Ms. Iris Goodman, Designated Federal Officer
Mr. Christopher S. Zarba, Acting Director, EPA SAB Staff Office

EPA Representatives:

Dr. Laurie Alexander
Dr. Jeffrey Frithsen

Other Attendees:

A list of others who were present at the meeting or requested access to the meeting by teleconference or webcast is provided in attachment B.

Meeting Summary:

MONDAY, DECEMBER 16, 2013

Opening of the Public Meeting

Dr. Thomas Armitage, Designated Federal Officer (DFO) for the SAB Panel, convened the meeting. He stated that the Panel was meeting to conduct a peer review of the EPA draft report, *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence* (the “Report”). He noted that the SAB Panel was a federal advisory committee and that by EPA policy, its meetings and deliberations were held as public meetings that met the requirements of the Federal Advisory Committee Act (FACA). He noted that the Panel operated as part of the EPA Science Advisory Board, which is a chartered Federal Advisory Committee under FACA and is empowered to by law to provide advice to the EPA Administrator. He noted that the meeting had been announced in the Federal Register¹ and summary minutes of the meeting would be prepared and certified by the Panel Chair and become part of the public record. Other meeting materials available on the SAB website included: the meeting agenda², charge to the Panel³, EPA review document⁴, EPA briefing material⁵, preliminary comments from Panel members⁶, and Congressional correspondence⁷. Dr. Armitage noted that 22 requests had been received from members of the public to provide oral comments at the meeting. The list of public speakers⁸ and presentation material provided by speakers⁹ were posted on the SAB website. In addition, Dr. Armitage stated that over 128,000

written public comments had been received through the EPA docket and that the written comments were available to the public on the EPA docket website¹⁰. Dr. Armitage also noted that the SAB Office had determined that members of the Panel were in compliance with federal ethics and conflict of interest laws that pertained to them. In addition, Dr. Armitage pointed out that some members of the public were listening to the meeting by teleconference or through a live webcast.

Mr. Christopher Zarba, Acting Director of the SAB Staff Office welcomed the members of the Panel, EPA staff, and members of the public to the meeting. He indicated that the Panel had been asked to review a draft EPA science report developed by the agency's Office of Research and Development to help inform an EPA and Corps of Engineers rulemaking to clarify Clean Water Act jurisdiction. He noted the great depth of expertise represented on the panel and indicated that Panel members had been chosen because of their scientific expertise.

Mr. Zarba indicated that the Report being reviewed by the Panel had been developed to support an important regulation and that there was considerable public interest in the meeting. He noted that members of Congress had requested that the EPA provide the draft regulation to the Panel. Mr. Zarba stated that the draft regulation was being reviewed by the Office of Management and Budget and had not been released to the public or the SAB Panel. He indicated that when the draft regulation was released, it would be provided to the Panel. Mr. Zarba also noted that members of Congress had asked the Panel to address a number of specific charge questions. He indicated that the SAB operated under a charter that required the EPA Administrator to transmit charge questions to the SAB, and that the EPA was reviewing the request from Congress in accordance with agency procedures. Mr. Zarba encouraged the Panel to develop a robust consensus report of its findings and recommendations and to be open minded and impartial in deliberating on the responses to EPA's charge questions.

Review of Agenda and Purpose of the Meeting

Dr. Amanda Rodewald, Chair of the SAB Panel welcomed the Panel members and others. She asked the Panel members to introduce themselves and reviewed the meeting objectives and agenda.

Dr. Rodewald stated that the Panel had been charged with reviewing EPA's Report on the connectivity of streams and wetlands to downstream waters and responding to the agency's charge questions. She noted that the review would focus on scientific and technical, not policy, issues. Dr. Rodewald indicated that the Panel should answer EPA's charge questions but it was also free to provide comments on other scientific issues and concerns. Dr. Rodewald also indicated that she had received a letter dated November 6, 2013 from Representative Lamar Smith, Chairman of the House Committee on Science, Space and Technology and Representative Chris Stewart, Chairman of the House Subcommittee on the Environment. She noted that the letter, which had been given to all Panel members, requested that the SAB respond to a number of additional specific charge questions. Dr. Rodewald reiterated that the SAB operated under a charter requiring that

charge questions be transmitted to the SAB by the EPA. Dr. Rodewald stated that she understood EPA was in the process of reviewing the requests in the letter.

Dr. Rodewald reviewed the meeting agenda. She indicated that the Panel would first hear a presentation on the EPA Report from Drs. Jeffrey Frithsen and Laurie Alexander of EPA's Office of Research and Development. The Panel would then review the charge questions, hear oral public comments, and discuss responses to each of the charge questions. She indicated that lead discussants and lead writers had been assigned for each of the charge questions (the assignments were identified on the agenda). She stated that the lead discussants would begin the Panel's discussion of the response to each charge question by providing brief initial comments before opening the discussion to the entire Panel. She asked the lead writers to keep track of the key points raised in the Panel's discussion. Dr. Rodewald noted that following the discussion of responses to the charge questions there would be a second public comment period to provide an opportunity for the Panel to hear brief clarifying comments. She asked members of the public who wished to speak during the second comment period to register with the Dr. Armitage. Dr. Rodewald indicated that after the second public comment period the Panel would break into subgroups to discuss key points in the responses to the questions, and on the third day of the meeting the entire Panel would discuss the key points developed by the subgroups.

Dr. Rodewald noted that, after the meeting, the lead writers would work with the members of their subgroups to develop written responses to the charge questions and send them to the DFOs. She would then work with the DFOs to develop the first draft of the Panel's report which would be sent to the entire Panel for review and discussion on a public teleconference. Dr. Rodewald indicated that after the Panel approved the report it would be sent to the Chartered SAB for review and final approval.

EPA Presentations

Dr. Jeffrey Frithsen, Senior Scientist and Special Project Manager in EPA's Office of Research and Development (ORD) and Dr. Laurie Alexander, Research Ecologist in EPA's ORD made a presentation to the Panel on the Report. Their presentation slides are included in the meeting materials available on the SAB Web site (see materials cited).

Dr. Frithsen indicated that EPA's Report was a review and synthesis of over 1,000 publications in the scientific literature on the relationships of streams and wetlands to downstream water bodies. He noted that this synthesis would provide a scientific foundation for an EPA and Army Corps of Engineers rulemaking to clarify jurisdiction under the Clean Water Act.

Dr. Frithsen explained that one role of ORD was to provide science to support the activities of EPA Program and Regional offices. He indicated that the EPA's Office of Water had asked ORD to develop the Report. He also indicated and that no new original research projects had been conducted to inform development of the Report. In addition, Dr. Frithsen briefly described how research programs were organized in ORD.

Dr. Alexander reviewed the purpose and scope of the Report. She indicated that it: 1) described a conceptual framework for understanding watershed connectivity; 2) reviewed the scientific evidence pertaining to connectivity or isolation of non-tidal streams, wetlands and certain open waters in riparian zones and floodplains, and wetlands outside riparian zones and floodplains, including geographically isolated wetlands; 3) identified mechanisms by which these types of waters can alter the condition or function of downstream ecosystems; and 4) the Report pointed out landscape and climate factors that influence connectivity. Dr. Alexander also indicated that the Report was not a policy document and that it did not outline policy options.

Dr. Alexander described the conceptual framework for understanding hydrologic components of a watershed and summarized three major conclusions in the Report: 1) All tributaries, regardless of size or flow duration class (ephemeral, intermittent, or perennial) are connected to and have important effects on downstream waters and have important effects on downstream waters; 2) Wetlands and open waters in riparian areas and floodplains are integrated with river networks via bidirectional exchange of water, materials, and organisms; and 3) Current literature is insufficient to generalize about the connectivity or downstream effects of waters in unidirectional landscape settings (often referred to as geographically isolated wetlands).

Dr. Frithsen concluded EPA's presentation by briefly reviewing how the Report had been developed and the intended use of the Report. He also identified the authors of the Report. He noted that an external review had previously been conducted and that after that review the Report had been revised before it was submitted to the SAB for review. He indicated that the Report provided technical information to inform rulemaking but it did not consider or make judgments regarding legal standards for Clean Water Act jurisdiction. Dr. Rodewald thanked Drs. Frithsen and Alexander for their presentation and asked whether Panel members had questions for EPA.

Panel members asked questions about the previous peer review of the Report. A Panel member asked whether the previous external reviewers had looked at the entire Report. EPA staff responded that some of the reviewers had looked at the entire Report. A member asked whether the goals of the Report had changed after the previous review. EPA staff responded that the goals had not changed; it was developed as a review and synthesis of the scientific literature. A member asked why the Report did not include methods for evaluating connectivity. EPA staff responded that the Report was not intended to be a methods manual.

Panel members asked questions about the meaning of various terms used in the Report and the conclusions in the Report. A member commented that the Report was a remarkable achievement and observed that it frequently used the term "degree of connectivity." He asked whether this implied that EPA had concluded that there was a scale of connectivity. EPA staff responded that a gradient of connectivity might be considered to determine whether systems were more or less connected. EPA staff noted

that particular metrics of connectivity might not provide complete information needed for an evaluation.

A member asked EPA staff to explain the wetland definition that was included in the Report. EPA staff explained that in the attributes of the Cowardin definition of a wetland were used in the Report (i.e., it should exhibit at least one of three attributes: inundation or saturation at a frequency sufficient to support, at least periodically plants adapted to a wet environment; undrained hydric soil; or non-soil saturated by shallow water for part of the growing season). Rather than defining a wetland as having all of these attributes, wetlands were more broadly defined as having at least one of them.

Another member noted that the Report was comprehensive and asked whether the EPA had reviewed papers that were not cited in the Report. EPA staff responded that many papers had been reviewed and that some were not used. Some papers were not used because they were not directly related to the questions that defined the scope of the Report (i.e., what are the physical, chemical, and biological connections to and effects of ephemeral, intermittent, and perennial streams on downstream waters? what are the physical, chemical, and biological connections to and effects of riparian or floodplain wetlands and open waters on downstream waters? and what are the physical, chemical, and biological connections to and effects of wetlands and certain open-waters that lack bidirectional hydrologic exchanges with downstream waters on downstream waters?)

Members asked EPA to explain how the agency had made decisions about the scope of the Report. EPA staff responded that the scope had been developed in consultation with the EPA Office of Water and the U.S. Army Corps of Engineers.

Members noted that the term “significant” was used in the Report when referring to connectivity. They asked EPA staff to explain the meaning of this word in the Report. EPA staff responded that in the Report the word significant was used to indicate strength of connectivity but not to indicate whether connectivity was legally jurisdictional.

Members asked EPA staff to explain the rationale underlying the differences between conclusion 2 (referring to riparian/floodplain waters) and 3 (referring to unidirectional wetlands) in the Report. EPA staff explained the basis for the conclusions. EPA staff indicated that the conclusions were based on the preponderance of evidence in the literature. Unidirectional wetlands had been less well studied and this made it difficult to generalize about their connectivity.

Review of the Charge Questions

Following EPA’s presentation, Dr. Rodewald reviewed the charge to the Panel and asked whether members had any clarifying questions for EPA staff about the charge. The Panel briefly discussed the charge. Following the discussion, Dr. Rodewald indicated that the Panel would hear oral public comments.

Public Comments

Dr. Rodewald next called for presentations from those who had registered to provide oral public comments. She noted that speakers would present their comments in the order in which the requested to speak had been received by the SAB Office. She indicated that each speaker should limit his comments to no more than five minutes and that if Panel members had questions for a speaker she would try to allow time for one or two questions. Public commenters presented oral statements before and after a lunch break in the following order:

- Karen Hobbs of the Natural Resources Defense Council expressed support for the first two conclusions of EPA's Report. She also commented that the Report could be strengthened by considering additional information not limited to the peer-reviewed literature.
- Jan Goldman-Carter of the National Wildlife Federation commented that the EPA's Report was generally clear, technically accurate, and largely comprehensive in its literature review. She commented that the report provided information to inform policy.
- James Perry of the Virginia Institute of Marine Science on behalf of the Society of Wetland Scientists commented that EPA's Report was well written, factually correct, and well referenced. He expressed support for conclusions in the Report but commented that, in cases where unidirectional wetlands had been studied, these wetlands provided important ecological functions to downstream systems.
- Scott Yaich of Ducks Unlimited commented on the overall clarity and technical accuracy of EPA's Report. He indicated that the conclusions in the Report were generally technically accurate, commented on birds as a mechanism of connectivity, and provided some recommendations for strengthening the Report.
- Jennifer Peters of Clean Water Action expressed support for the first two conclusions in the Report but did not agree with the third conclusion. She noted that it was important for the EPA to have the best scientific information available to support decisions and commented that the Panel should stay focused on science.
- Jeane Christie of the Association of State Wetland Managers commented that EPA's Report provided an extensive and detailed compilation of the peer reviewed literature on the impact of headwater streams and wetlands on downstream waters. She expressed general support for the major conclusions and key findings of the Report but suggested including additional information in the Report.
- Ally Fields of Environment America commented that the Report was generally grounded in the best available science and expressed support for conclusions in the Report. She disagreed with the conclusion that there was insufficient evidence of the connectivity of isolated wetlands to downstream waters.

- Amanda Aspatore of the National Mining Association commented on limits that the Supreme Court had placed on Clean Water Act jurisdiction. She commented on the need for additional scientific inquiry to inform the determination of jurisdiction and recommended expanding the charge questions.
- Diedre Duncan of Hunton and Williams LLP on behalf of the Waters Advocacy Coalition commented that EPA should complete the Connectivity Report before the agency developed its rule on Waters of the U.S. She also commented on the need for further information to support the rulemaking. A Panel member asked Ms. Duncan to provide information on the status of EPA's rule. She responded that the rule was under review at the Office of Management and Budget and would soon be proposed. The Acting Director of the SAB Office commented that when the rule was released to the public it would be provided to the Panel.
- Don Parrish of the American Farm Bureau federation commented on the importance of agricultural production to provide food for the world's population. He commented on the need for science to help determine which water body connections were significant and on the need to avoid unnecessary interference with food production.
- Leah Miller of the Izaak Walton League of America commended EPA for producing the Report. She expressed support for the Report conclusion that all tributary streams, including perennial, intermittent, and ephemeral streams were physically, chemically, and biologically connected to downstream waters. She commented that the literature cited in the Report supported this conclusion. She commented on the need to monitor stream water quality and described volunteer monitoring activities of the Izaak Walton League.
- Jimmy Hague of the Center for Water Resources at the Theodore Roosevelt Conservation Partnership commented on the economic benefits of hunting and angling and on the loss of fish, wildlife and sporting access as streams were polluted and wetlands drained. He expressed support for using watershed scale as the context for assessing connectivity and commended the EPA Report for recognizing the importance of aggregating the effects of small water bodies in a watershed. He recommended that the final Report provide more clarity on the connectivity of unidirectional wetlands.
- Eric Shea of the Florida Power on behalf of the Utility Water Act Group commented that the EPA Report did not help the agency in determining when a water body connection was significant. He commented that the Report did not account for variability in stream size and it failed to recognize that some connections with downstream waters were de minimus.
- Anthony Francois of the Pacific Legal Foundation commented on the importance of clarifying the issue of Clean Water Act Jurisdiction and recommended changes in the Report. His recommendations focused on changing the definition of wetlands,

explaining the technical wetlands vocabulary, limiting the discussion of cumulative effects to wetlands, and refocusing the discussion of tributaries on identifying characteristics of major tributaries.

- Robin Reasch of American Electric Power on behalf of the Edison Electric Institute commented on the need for the EPA Report to inform rulemaking on Clean Water Act Jurisdiction. He commented that the Report was not instructional in a regulatory context. He pointed out a number of issues that needed to be addressed or clarified in the Report. In particular he noted that it was important to address spatial and temporal aspects of connectivity and the significance of ditches.
- Nick Goldstein of the American Road and Transportation Builders Association commented on clarifications needed in the Report to inform Clean Water Act jurisdiction rulemaking. In particular, he commented that roadside ditches should not be regulated and noted that the current draft of the Clean Water Act jurisdiction rule did not address roadside ditches.
- Steve Moyer of Trout Unlimited commented on the importance of the Clean Water Act to trout conservation. He indicated that headwater streams were essential trout habitat. He noted that the EPA's Report underscored the importance of protecting streams and indicated that without protection this important habitat would be at risk.
- Susan Bodine of Barnes and Thornburg LLP on behalf of the Federal Water Quality Coalition commented on a letter that had been sent to the Panel from the House Science Committee. She indicated that the letter identified important questions for the Panel's consideration. She further commented on the relevancy of some studies cited in EPA's Report. In particular, she commented that some studies related to the integrity of populations were not policy-relevant.
- Ashley McDonald of the National Cattlemen's Beef Association commented on the importance of using science to inform the development of policy. She commented that EPA had developed the Clean Water Act jurisdiction rule before the completing its draft science synthesis report. She noted that the draft rule had been sent to the Office of Management and Budget. She commented on the importance of understanding the regulatory context of water body connectivity. She commented that the Report did not consider the issue of significant nexus and recommended that the SAB expand its review to address this issue.
- Tom Crafford of the Alaska Department of Conservation acknowledged EPA's effort to develop its Report but commented that it was hard to understand how Alaska wetlands had been considered in the Report. He commented on the features of Alaska's wetlands that were uncommon or absent in the rest of the United States and he noted that Alaska's wetlands comprised a large percentage of the nation's total wetlands. He recommended that the EPA use terms and definitions that had previously been established and accepted for analysis of wetland connectivity. He

also expressed concern that the Report had been written after EPA had developed its Clean Water Act jurisdiction rule.

- Margaret Palmer of the University of Maryland indicated that the Panel should focus its review on science. She commented on the connectivity streams and wetlands to downstream addressing in particular the movement of organic carbon and sediment and connectivity between flood plains and streams.
- Jon Devine of the Natural Resources Defense Council commented that EPA had completed high quality work to develop its Report. He commented on the large amount of literature reviewed to support conclusions in the Report. He commented that some information presented in the Report was not connected to the conclusion on unidirectional wetlands and noted that the case studies in the Report illustrated the connectivity of unidirectional wetlands.

Discussion of Panel's Responses to EPA's Charge Questions

Dr. Rodewald thanked the speakers for their input and said that the Panel would begin its discussion of the responses to the charge questions. She explained the Panel would discuss charge questions 2 - 5 before discussing charge question 1, which asked about the overall clarity and accuracy of EPA's entire Report. She asked the lead discussants assigned to each charge question to provide their summary comments before opening the discussion to the full panel.

Charge Question 2 – Clarity and Technical Accuracy of the Conceptual Framework

For charge question 2: (Clarity and technical accuracy of the conceptual framework) Dr. Rodewald noted that the lead discussants were Drs. Rains, Kalin, Kolm, and Meyer. Some Panel members expressed support for the use of a systems approach in the conceptual framework as applied within a watershed context. They observed that alternative frameworks could have been used, perhaps to advantage, but noted that this framework was designed by the Report authors as a way to accurately organize and categorize the wide range of literature they reviewed. Members also observed that the framework illustrated that from ridge-top to outlet, all waters were connected -- but it missed the opportunity to describe the degree of connection and why this connection mattered.

During deliberations the following observations were made:

Some panelists commented that hydrologic connectivity was oversimplified and under-emphasized, e.g., hydrologic connectivity is fundamental to all other types of connectivity. Other components of connectivity were treated unevenly, e.g., connections via groundwater were oversimplified and inadequate; more explanation of baseflow, quickflow, overland flow was needed; and the effect of climate and land use change on groundwater should be expanded. With respect to biological connectivity, several Panelists said it was overstated, implying everything was connected but a number of

others thought it was understated and should be revised to clarify functions and mechanisms that support biological connectivity.

Differing opinions were expressed on the framework's use of two categories to describe flow directions for wetlands, i.e., unidirectional and bidirectional wetlands. Some thought this distinction oversimplified connectivity, since the literature shows these wetlands were connected in four dimensions; others thought the addition of figures to explain uni- and bi-directional wetlands would suffice to clarify their intended use.

Panelists commented that connectivity could not be fully characterized without considering multiple spatial scales (including stream order) and multiple time scales. These dimensions were important to all aspects of connectivity, including biological. The time dimension of connectivity could be clarified using the concepts of hydrologic residence times and its effects on different mechanisms; e.g., a long residence time equals greater chemical transformation.

Panelists commented that scale issues were at the intersection of science and technology, e.g., map-scale improvements, could be enhanced by simulations or by remote sensing. New technologies were driving increased awareness of scale effects and also driving the science. Similarly, the concept of aggregate and cumulative effects was important, since these effects may determine the issue of significance. The concept of cumulative effects was novel in policy and law, but not in science. The Report needed to explain how including these factors affected the analysis and conclusions about connectivity and its effects. There could be a separate section on these topics to emphasize the importance of these interrelated topics.

Some panelists commented that the agency's decision to include only peer reviewed materials in the Report was too restrictive; technical reports by state agencies and interdisciplinary systems analyses (such as the U.S. Geological Survey - Regional Aquifer Systems Analysis, and similar work by other agencies) could be used to inform the framework.

Panelists noted that the Report used a watershed framework to place water bodies on the landscape, whereas the main issue of the Report was that of movement, e.g., water movement and movement of fish and other animals.

Panelists commented that framing the discussion of connectivity as movement via flowpaths was important. Panelists noted that there was a large literature on flowpaths within ecology and hydrology which would help to link flowpaths with the subsequent effects of connectivity to downstream waters. Panelists also commented that the Report should note that hydrologic flowpaths are actually down-gradient, not downstream. This distinction was important because it held true for surface and groundwater flows. For surface water "downgradient" was the same as "downstream" in that water flowed downhill. In contrast, for some groundwater systems the direction of flow was actually "uphill". Yet these flows were always down-gradient in terms of the forces that created hydraulic head and thus forced water to flow.

Panelists commented that Figure 1 in the Executive Summary put many of these pieces together; Figure 1 could be repeated in the Framework chapter.

Panelists noted that the definition of terms in the glossary sometimes did not match their use in the Report. The definition of floodplains lacked criteria (e.g., flood magnitude or frequency).

Panelists commented that it may not be possible for any single framework to address all needs. Thus, the conceptual framework for the Report may need two tiers: a very deep framework to represent the state of the science, and a simplified framework abstracted to meet the needs of policy makers. For any framework, it was important to think in terms of “context dependency,” i.e., when was it possible to generalize and when was not. Finally, there were many ways to construct different frameworks, so the issue was whether the current framework sufficed well and if not, to determine what needed to be revised.

Dr. Rodewald thanked the panel for the discussion and noted that a subgroup of the Panel would work further on Question 2 in order to identify the key points for the full Panel to consider.

Charge Question 3(a) – EPA’s review and Characterization of the Literature on Downstream Connectivity and Effects of Ephemeral, Intermittent, and Perennial Streams

Dr. Rodewald said the Panel would next discuss charge Question 3 which addressed the topic of downstream connectivity and effects for ephemeral, intermittent, and perennial streams, otherwise referred to as lotic systems. This question was divided into two parts, 3(a) and 3(b).

Dr. Rodewald asked Dr. Rosi-Marshall to begin the discussion of question 3(a). Dr. Rosi-Marshall and lead discussants Drs. Fausch, Hawkins, and Harvey presented their summary comments. The Panelists commented that connectivity of lotic systems to downstream waters was widely accepted and generally non-controversial. They noted the draft text presented a good synthesis of a diverse literature and provided multiple perspectives foundational to stream ecology.

The Panelists also identified some topics in the Report that needed strengthening:

- The discussion of groundwater connections to intermittent and ephemeral streams could be expanded to note that ponded water does not indicate disconnection, especially with respect to physical and chemical functions and effects.
- Relationships between upland areas and intermittent and ephemeral streams could be expanded, e.g., to include variable source areas as sources of ephemeral flows. The Report could also include the effects of ditches, gullies, and swales, e.g., to discuss the types of effects would constitute elements of downstream connectivity.

- The coverage of stream temperature and its biological effects could be further developed based on the rapidly expanding literature on this subject, including the effects of channel morphology and spatial distribution of temperature profiles.
- The connections between water movement and biota were complementary and essential. The text could develop a more complete model to explain the biological effects of this interaction, especially for fish and amphibians. Their habitats were dispersed and animals moved upstream; e.g., even 2-3 inch minnows needed several miles of habitat. If these waters were cut off, the animals were also cut off. Intermittent and ephemeral streams, which responded extremely quickly to water, also provided critical habitat for many species.
- Natural water chemistry was critical for biota; this topic could be expanded, including discussion of how geology and hydrology combine to influence water chemistry.

Dr. Rosi-Marshall then opened the discussion to the full panel and the following points were raised:

Panelists commented that the temporal dynamics of connectivity were significant enough to warrant a separate section in the Report; i.e., a connection of short duration did not imply an insignificant connection. Similarly, infrequent, high-intensity events often dramatically changed lotic systems. The implications for connectivity were important and obvious, but were not discussed in the text. The text could highlight issues of stream function in terms of what was most affected by changes to connectivity. Currently, all functions were treated equally in the text, thus the reader did not know which functions would be affected and in what way.

Panelists commented that aspects of temporal scale also needed to be conditioned on the spatial scale of analysis and the duration of effect. The consideration of the duration of particular incidents also needed to be strengthened, e.g., mudflows had long lasting effects on many stream functions. Such issues could be treated probabilistically, not deterministically.

Panelists suggested that literature describing effects of human activity on connectivity should be added and discussed. Many examples were suggested: development or other alterations to headwater streams; effects of tile drainage in midwestern stream; other underground piping; man-made effects on nutrient spiraling, especially with respect to nitrogen, phosphorus, and biological transformation; and groundwater pumping that creates “interrupted streams” through depletion of baseflow.

Panelists commented that the text could distinguish among effects of connectivity or its disruption that are determined by field work and by modeling, because this information was needed for determining how this information should be used, e.g., for scaling up estimates of effects. The text could also include additional citations on use of modeling to estimate effects on connectivity.

Panelists commented that the text could describe the uncertainty in the current science, e.g., how use of differently scaled input parameters, such as the National Hydrologic Data set, affected the estimated effects on connectivity. Also, wetter sites were studied more than other sites, and this disparity in data availability affected ability to estimate effects. The text could go beyond saying what is known to suggesting what research should be done.

Panelists commented that the Report authors could clarify what they mean when they refer to “weight of evidence,” e.g., the phrase could be used colloquially or with reference to risk assessment methods. If so, the Report could describe their intended use of this concept. Dr. Alexander clarified that the authors were not referring to strict risk assessment methods.

Panelists commented that several terminology issues needed to be resolved and terms needed to be used consistently throughout the Report. e.g., definitions of ephemeral, intermittent, and “interrupted streams,” (which referred to stream reaches that expand or contract due to weather, groundwater pumping, diversions for water supply, etc.), and terraces. In addition, the effects on connectivity associated with these stream features could be described and considered within the Report’s conceptual framework (e.g., a possible 4-dimensional framework).

Dr. Rodewald thanked the lead discussants and the Panel for their thoughtful discussion. She said the Panel would recess for a 15 minute break and return to discuss Charge Question 3(b), which asked the SAB to comment on the findings and conclusions about downstream connectivity for lotic systems.

Charge Question 3(b) - EPA’s Findings and Conclusions Concerning Downstream Connectivity and Effects of Ephemeral, Intermittent, and Perennial Streams

After the break, Dr. Rodewald asked Dr. Tank and lead discussants, Drs. Stanford and Wohl, to summarize their comments in response to charge question 3(b).

The panelists noted that the conclusions for lotic systems were strongly supported as written, including its emphasis on cumulative effects within a watershed framework. Further comments from the panelists focused on three major themes: (1) draft conclusions as related to conceptual framework and case studies, (2) adding a matrix to summarize the evidence and the uncertainty in conclusions drawn from it, and (3) strengthening the discussion of conclusions as they apply to different scales of analysis. Panelists commented that the conclusions in section 1.4 should relate explicitly to the Report’s conceptual framework. At present, they did not.

Panelists suggested that the following phrase be added to the conclusions: “A substantial body of evidence shows that both structural and functional connectivity occurs both above and below ground.” That is, headwaters, intermittent, and ephemeral streams were interconnected in 4 dimensions from the ridge to the ocean; this concept could also include biological connections and functions. These aspects of connectivity were

summarized in Table 4-1 (Examples of functions by which streams influence downstream water) but could be better related to the 5 functions summarized in the Report, i.e., source, sink, refuge, transformation, and lag functions. The function “connectivity” was currently not explicit in the Table 4.1 (and is similarly missing from Table 3.1) and could be added to both.

Panelists commented that the conclusions related to hydrologic connectivity could be clarified and, where possible, stated quantitatively (e.g., strong connections were found in X% of studies) and include reported findings about uncertainty of estimates. Panelists identified several mechanisms that affected lotic connectivity, including overbank flooding, groundwater recharge from losing streams, and suggested that these be strengthened.

Panelists also discussed how findings from case studies were reflected in the draft conclusions. One panelist noted that the case study conclusions were identical to conclusions for the full text and that this indicated the general conclusions did not account for geographic differences. Another said the case studies generally supported the draft conclusions, except that the Midwestern case studies highlighted disconnection rather than connection. Another said the case studies were not thorough enough to cover the full range of connections, while another disagreed, stating the case studies highlighted examples of connectivity at the ends of spectrum; thus, if connections are evident at the extremes, then connectivity would also be present in the intermediate cases.

Panelists commented that, the conclusions in the Report were stated broadly for discrete types of lotic systems. Members noted that to better address the issue of evidence and uncertainty associated with the conclusions, a matrix of lotic/ecosystem types could be created and a weighting scheme could be applied to identify the certainty of the connection and the intensity or magnitude of the effect of the connection.

Panelists commented that they agreed with the conclusions as presented for broad scales of analysis. Panelists noted that uncertainty increased at local scales, making it unlikely the literature could provide high certainty under all local conditions. Panelists commented that presenting conclusions in a regional context could help with this.

Dr. Rodewald thanked the Panel for their thoughtful discussion. She said the Panel would conclude the day with a discussion of Charge Question 4(a).

Charge Question 4(a) – EPA’s Review and Characterization of the Literature on Downstream Connectivity and Effects of Wetlands and Certain Open Waters Subject to Non-tidal Bidirectional Flows

Dr. Rodewald asked Dr. Fennessy and lead discussants Drs. Aldous, Valett, and Reddy to summarize their individual comments on Charge Question 4(a). The lead discussants commented on the novel wetland terms used in the Report, i.e., wetlands with potential of unidirectional and bidirectional hydrologic flows. Lead discussants noted that they understood the Report authors created these new terms as a convenient and orderly way

to categorize the literature articles reviewed in terms of direction of water flow and to communicate among the authors during preparation of the synthesis report. However, discussants pointed out that terms such as “bidirectional” could be misleading, given that most wetlands exhibit connectivity in 3 – 4 dimensions. Carrying these new terms uni- and bidirectional forward could confuse its intended audience.

Further discussion focused on four themes: (1) the relationship of these new wetland categories to the Report’s conceptual framework, (2) strengthening the discussion of biogeochemical functions, and (3) the effect of human alterations on wetland connectivity.

The panelists commented that the chapter content was quite good, but noted the wetland categories could be more explicitly linked to the Report’s conceptual framework. For example, “unidirectional and bidirectional wetlands” could be described in terms of the framework’s categorization of connectivity functions in time and space, e.g., recurrent flood pulses could be modeled as source or a subsidy to wetland connectivity. Discussants also noted alternative conceptual models could suggest different endpoints for wetland categories.

The panelists found Table 5.1, which described the functions and mechanisms by which wetlands influenced downstream waters, to be a useful summary, but noted it could be strengthened by: more strictly defining “transformation” and “sink” functions for wetlands; adding nitrogen, phosphorus, sulfur, carbon, and other metal compounds; expanding the text on residence times and its effect on transformation; expanding the discussion of lag-time function to include the effects of freshets of water on downstream waters; adding ions beyond electrical conductivity and describing how drivers such as nutrient loading and climate change would affect conductivity; describing how changes in these functions and in connectivity affect resource and ecosystem tradeoffs; and adding citations to EPA’s peer reviewed document on the subject of assessing wetland values and functions, which includes metrics.

Some panelists commented that the effect of human alterations on wetland connectivity needed more discussion, e.g., channel incision disconnected floodplains from their river channels, creating negative effects downstream such as reduced storage of flood waters and reduced processing of nutrients. Where appropriate, wetlands should be discussed within a groundwater context. Additional citations to the literature on these topics should be added, including effects of human alteration.

Dr. Fennessy then opened the discussion to all panelists. Panelists asked EPA about their choice of terms used for wetlands in the Report. Dr. Alexander explained the Report was a synthesis of the scientific literature, thus the Agency used definitions of wetlands as reflected in the peer reviewed literature and did not use regulatory definitions to describe any water bodies. Dr. Alexander also noted that the terms used in the Report were influenced by Clean Water Act language, i.e., “adjacent waters,” not by regulatory definitions or guidance. Also, the conceptual framework for the previous version of the draft report (2011) had divided the landscape into discrete areas. Peer review comments

on that version advised the authors to consider flowpaths and where water bodies “sit” within the landscape. Further, EPA had been asked to rename the wetland terms in order to make it easier for users of the Report to find needed sections. A panelist noted that adjacency could be used as a technical term, thus it could be possible to align this term with jurisdictional issues, but cautioned against doing so, since the result would be no better than the current version’s uni- and bidirectional wetland terms. Another panelist advised against using regulatory definitions when considering wetland functions, since doing so would constrain the discussion to upstream and downstream effects, noting that, in this case, classification would confuse rather than clarify the science. He pointed out that connectivity was more of a continuum, which can sometimes be complex and difficult to classify. He urged keeping the focus on functions. Another panelist noted the Report initially described connectivity “as a degree,” but in this chapter, referred to “any evidence” of connection; this difference underscored the need to be precise in the text, given the public interest and intended use of the Report in rulemaking.

Panelists then discussed their concerns about inconsistent use of terminology, both within the Report sections and between the Report text and its glossary. For example, the text overlapped in its discussion of riparian and floodplain wetlands; much of the discussion was actually focused on riparian areas as sources of wood and other allochthonous inputs. Both were important, but not well distinguished in the Report. Others agreed, noting that much of the text was about riparian trees and that these issues could be better explored through concepts related to stream widths needed to meet Clean Water Act goals, rather than just on upstream connections. A panelist pointed out inconsistencies in the glossary definitions of “river” and “riparian,” and this led to a discussion of whether the definition of a river included its floodplain. Panelists noted there was no “correct” classification, but some classifications had been used in the U.S. and internationally.

Panelists returned to the discussion of gradients, noting again that water body connectivity was not discrete but fell along a continuum. Panelists also generally agreed that the Report’s conceptual framework should be useful for all water bodies, including wetlands. Further, they thought it important that the framework support consistent terminology use throughout the Report and its glossary. Panelists said it would be possible to revise Figure 1 in order to describe a landscape in terms of flowpaths. Doing so would solve both the scientific issue of multiple possible flowpaths and the practical goal of providing readers easy access relevant sections of the Report.

Dr. Rodewald thanked the Panel for its thoughtful discussions throughout the day. She noted that, despite detailed discussions to clarify particular issues, panelists had commented that the Agency draft Report reflected extensive, good work by the Report authors. Dr. Armitage recessed the meeting and said the panel would reconvene at 8:30 a.m. the next day

TUESDAY, DECEMBER 17, 2013

Reconvene the Meeting

The meeting reconvened at 8:30 a.m. and Dr. Rodewald indicated that the Panel would continue the discussion of the responses to the charge questions. She reminded the panelists that members of the public would have time to provide clarifying comments in the afternoon. In response to questions from the panel, she briefly addressed guidelines for writing and editing the panel's draft Report, including appropriate tone and tenor of the Report, and how conclusions should be stated. Dr. Rodewald emphasized that the panel should be very clear about recommended changes to EPA's Report and asked them to bear that in mind during the discussion and afternoon writing session.

Charge Question 4(b) – EPA's Findings and Conclusions Concerning downstream Connectivity and Effects of Wetlands and Certain Open Waters Subject to Non-tidal bidirectional Hydrologic Flows

Dr. Rodewald said the Panel would return to the discussion of lentic systems to discuss EPA's findings and conclusions with respect to downstream connectivity and the effects of wetlands and certain open waters subject to non-tidal bidirectional hydrologic flows.

Dr. Rodewald asked Dr. Sullivan and lead discussants Drs. Allan and Benda to summarize their individual comments on Charge Question 4(b). The panelists commented that the draft conclusions provided strong and appropriate guidance, with only minor modifications needed to improve clarity and consistency. Panelists noted that, to improve clarity, the draft Report could quantify functions and use a probabilistic approach, where possible. To improve consistency, revisions were suggested for several terms. These included recommending use of commonly accepted terms such as "floodplain wetland" or "riparian wetland" instead of "riparian area," since riparian areas often occupied a larger portion of the landscape. Panelists commented that when referring to functions associated with bidirectional flows, the term "exchange" should be used, not "export." Temporal aspects, such as water residence times should also be included. Also, the Report should explain the importance of riparian wetland habitat for fish, and the consequences for connection to downstream waters. Finally, all glossary entries needed to be examined to ensure all terms were used consistently within the glossary and the Report.

Dr. Sullivan then opened the discussion to all panelists. Their discussion focused on four themes: (1) revisiting the usefulness of new wetland terms; (2) defining connectivity in terms of functions related to CWA goals; (3) defining rivers, streams, floodplains; and (4) including the effect of human alterations when considering downstream connectivity.

Panelists discussed the pros and cons of the new wetland terms used in EPA's draft Report; i.e., unidirectional and bidirectional wetlands. Some panelists indicated that they liked the authors' new, simplified wetland nomenclature for its ability to allow findings from the scientific literature to be categorized without requiring that the peer reviewed

studies specify a particular wetland delineation method. Some suggested the uni- and bi-directional wetlands nomenclature could work if the Report included a cross-walk to clarify what types of wetlands were included in each category. Others thought the terms “floodplain and riparian wetlands” sufficed. Dr. Alexander said that “floodplain and riparian wetlands” were synonymous with “bidirectional wetlands,” and that the main issue was whether the distinction imparted in the term “unidirectional wetland” was useful and required. That led panelists to discuss various aspects of the “uni- and bidirectional wetlands” term. One panelist thought it would be difficult to replace the term “unidirectional” without using the term “isolated” wetland. Some panelists reiterated their preference for defining wetlands based on water flowpaths, while others commented that “uni- and bidirectional wetlands” term gave the impression that flowpaths were static, when they were in fact dynamic. Another expressed concern that use of “uni- and bidirectional” focused too heavily on water flowpaths, whereas dominant exchanges are biological which occur in every direction.

Noting that their discussion was limited to terminology, one panelist suggested they instead consider how these terms relate to the goals of the CWA, i.e., “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” Dr. Rodewald reminded the panelists that they were not being asked to determine what constituted “significant” downstream connectivity, but rather to determine if the draft Report was complete and accurate.

One panelist noted that biological condition was clearly important to state agencies in their implementation of the Clean Water Act. That is, states monitored streams and rivers to determine if they met biological condition criteria under the Clean Water Act. For those streams and rivers that did not meet these criteria, states were required to find out why. This determination was made by searching upstream for causes of impairment, including causes within the riparian area. Other panelists discussed how the Report’s definitions could be interpreted; e.g., the glossary definitions of rivers and streams included the surface water and subsurface lateral flows exchanged with the floodplain. One panelist said that riparian areas and floodplains were the physical manifestations of these flows; i.e., thus, they should be included in the definition of a river. Another panelist noted that in the western U.S., riparian zones were divorced from surface water, but were tied to groundwater, i.e., the floodplain ecosystem, thus indicating that the contributing area and the flows should be considered together. Another panelist noted the role of near stream trees and their role in stabilizing streams and providing organic input. He indicated that these near stream areas should be included in the definition. Another panelist interpreted the surface water and lateral flows solely as the water itself. Another said there was precedence in the literature to include all areas referred to as uni- and bidirectional wetlands, but that this likely would not enhance the document’s clarity.

Dr. Rodewald thanked the panel for their discussions and asked Dr. Johnson and lead discussants Drs. Ali and Josselyn to begin the discussion of charge question 5a.

Charge Question 5(a) – EPA’s review and characterization of the Literature on Downstream Connectivity and Effects of Wetlands and Certain Open Waters With Potential for Unidirectional Hydrologic Flows

The lead discussants began by commending the authors for the broad scope of their literature review of more than 1,000 papers. They then discussed ways in which the Report could be improved. Their discussion addressed three themes: (1) clarification of terms; (2) addition of selected papers from the peer reviewed literature; and (4) role of future studies.

The panelists pointed out that many scientists disliked the term “geographically isolated wetlands” because it obscured several issues highly relevant to connectivity. These included consideration of time-scale, gradients of connectivity, estimates of “natural” connectivity, assessment of potential vs. actual connectivity, and consideration of legacy effects (i.e., methods to consider how past filling of wetlands affected the functions provided by the remaining isolated wetlands). The panelists also noted that it was incorrect to only use distance as a measure of isolation because distance alone did not capture many important connections.

Several panelists recommended the Report expand its discussion of biological functions. In particular, they noted that isolated ponds and wetlands often provided primary habitats – not complementary habitats – for many species. This means that the animals that relied on these wetland habitats would “go away,” perhaps be extirpated, if these wetlands were removed from the landscape.

Panelists also recommended additional literature citations that documented various biological functions provided by geographically isolated wetlands. These functions and effects included: fish movement; contributions of biomass and nutrients from amphibians (which are top predators in wetlands); exceptionally high productivity of vernal pools and of Carolina Bays; turtle movement among wetlands and the associated transfer of genetic and organic matter; life-cycle of turtles, many of which depended on laying eggs in riverbeds and feeding in floodplains; the effects of beaver dams and their influence on wetland systems; the effects of moose feeding in shallow ponds and recycling nutrients; the effects of mink that traveled and fed in shallow ponds and thus affected the number of fish and invertebrates; and the fact that animals can move large amounts of materials, contaminants, and disease (e.g., avian disease associated with large flocks of birds). A panelist recommended that the authors refer to the public comments from Ducks Unlimited to access citations to the literature on the effects and functions of isolated wetlands on nutrients.

A panelist noted that the Report’s conclusions were based on relatively limited empirical data and asked if the EPA was considering future studies on geographically isolated wetlands to determine how they transmit flows downstream and to estimates the benefit of isolation. Dr. Alexander said that EPA had begun some new research with the U.S. Geological Survey (USGS) and U.S. Department of Agriculture (USDA) with the goal of creating a classification system that enabled better discussion of flows among

geographically isolated wetlands and functions. She said that hydrologic modeling methods existed, although not all were straightforward. She also said that the EPA presented research needs at a wetland conference and that the Office of Water (OW) had developed a set of broad research objectives. A Panelist commented that future studies could better assess the connectivity functions provided by geographically isolated wetlands by first identifying a range of such wetlands –from pristine to fully drained – and then using this range as a gradient for determining connectivity based on field data or modeled estimates.

Panelists also discussed other issues related to ongoing or future studies. A panelist noted that the Report had should further address issues related to spatial scale, time scale, or flow duration, irrespective of the source of water. The panelist further noted that the Report needed a framework that included these factors in order to assess whether a given wetland had unique biological and chemical functions. Such information would advance the science of connectivity and also inform policy and rules. Another panelist agreed, noting that some isolated wetlands in Nebraska were being restored in order to regain flood storage for rain water.

Panelists also commented that distance measures, such as those suggested for determining “isolation,” should be used in conjunction with hydrologic assessments to avoid missing important hydrologic connections and thus avoid drawing incorrect conclusions. For geographically isolated wetlands, groundwater was the primary hydrologic connection, however some groundwater connections could be difficult to assess. Surface water connections also existed, but these were very dynamic and complex. As a result, panelists recommended that geographically isolated wetlands be analyzed in the aggregate because doing so revealed the patterns of connections and thus simplified creation of guidelines for assessing their connectivity. In addition, panelists noted that biological connections should also be considered and were sometimes easier to quantify for geographically isolated wetlands than were hydrologic connections.

Dr. Rodewald thanked the panel for their discussion and asked lead discussants Drs. Bernhardt, Brooks, Gooseff, and Murphy to begin the panel’s discussion of Question 5(b).

Some of the panelists commented that they disagreed with the conclusion that there was insufficient evidence to generalize about the downstream connectivity of geographically isolated wetlands. They noted that many peer reviewed articles had identified connections between groundwater and surface water, as well as downstream functions provided by isolated wetlands. They noted that this literature needed to be included in the Report. Panelists also pointed out that the third conclusion about wetlands was inconsistent with the text that preceded it. One panelist said that part of the concern was that the third conclusion was equivocal and noted that if these wetlands were more fully characterized in the Report, then that information could be used to rank isolated wetlands by their gradient of connectivity.

Panelists also noted that the Report was inconsistent in its definition of connectivity; i.e., the text defined connectivity broadly and the glossary defined it more narrowly. They noted that the Report should not focus so heavily on just hydrologic connectivity, but rather address all aspects of connectivity relevant to the goals of the CWA, including biological integrity. One panelist noted that EPA's definition of biological integrity referred to "the condition of the aquatic community inhabiting the unimpaired water bodies of a specified habitat as measured by community structure and function," thus indicating that animal populations were an appropriate endpoint for determining biological connectivity. Panelists further noted that EPA and the states used organisms to monitor the condition of water. Thus, the conclusions for unidirectional wetlands should be revised to state that these wetlands were essential habitat for certain animal population, especially those wetlands that integrated habitats and bio-vectors across spatial areas.

Panelists also pointed out that the Report's assessment of whether connectivity existed for a given system was stated in terms of downstream fluxes, e.g., of water, materials, and biota. They said the Report should instead focus on assessing connectivity in terms of the effect of fluxes from waters and wetlands on downstream waters; i.e., a small flux did not necessarily indicate a small effect. They recommended the Report be revised to highlight discussions of downstream effects based on the five functions: source, sink, lag, transformation, and refuge.

Dr. Rodewald encouraged the Panel to further discuss conclusion 3. She proposed they consider five options: Option A would keep the conclusion as stated in the draft Report; Option B would revise the conclusion to say that unidirectional wetlands were connected; Option C would state that it was possible to draw general conclusions for some unidirectional wetlands but not for others; Option D would state that it was possible to draw general conclusions for some systems but not for others and, in addition, would state principles for accounting for connections across space and time; Option E would state that all wetlands were connected, based on strong evidence from the literature, similar to the reasoning for the Report's conclusions for streams. After discussion, panelists indicated that it was possible to draw general conclusions for unidirectional wetlands. Panelists discussed different ways to generalize about connectivity for unidirectional wetlands, e.g., by using major wetland types, or using a gradient, or a matrix, or by ranking connectivity in terms of space and time dimensions.

Dr. Rodewald then asked the panel for their views on two options for coming to resolution about conclusion 3. The first option would to recommend that the Report's conclusion state that unidirectional wetlands were connected, this would be similar to the Report's conclusions for streams. The second option would be to present information about connectivity for unidirectional wetlands in a matrix. One panelist noted that the panel had not discussed at such length the Report's conclusion that streams were connected, because there was a strong body of evidence that streams were connected. The panelist said the same reasoning applied to unidirectional wetlands and supported the conclusion that these were also connected.

Other panelists said that the conclusion should be stated as a gradient, with the end members clearly defined. They pointed out that defining connectivity within the middle part of the gradient needed to be established by policy, based on an assessment of the effects of the loss of connectivity. Other panelists said that unidirectional wetlands required more rigorous methods to assess their connectivity, with the burden of proof provided by way of the cited literature. Other panelists disagreed with this, noting that connectivity was present for all systems, but had a space-time dimension. They pointed out that literature findings of relatively minor hydrologic connections may have caused the authors to back away from a conclusive statement of connectivity in conclusion 3. Other panelists noted that the issue was not just the degree of connectivity, but the types of functional connections that were present, notably those documented in the extensive literature on biological connectivity. Panelists commented on two hydrologic pathways, a chemical pathway, and a biological pathway and noted that the biological pathway had an important and emerging literature.

The panelists then discussed particular wording in the text. Some panelists commented that the sentence on p. 1-10 that states “*the literature we reviewed does not provide sufficient information to evaluate or generalize about the degree of connectivity (absolute or relative) or the downstream effects of wetlands in unidirectional landscape settings*” should be removed from the draft Report. Another panelist suggested that the Report should include the statement that: “*Over sufficiently long time scales all aquatic habitats are connected to downstream waters through the transfer of water, chemicals or biota, yet the magnitude and effects of these connections vary widely across wetlands*” That is, the Report should be revised to state what aspects of connectivity were incontrovertible and what aspects were more complex. A number of panelists agreed with this approach. Dr. Rodewald asked the subgroups to draft some text on this topic for the full panel to consider. Dr. Rodewald thanked the Panel for their discussions and said the Panel would next discuss Chapter 1 of the draft Report.

Charge Question 1 – Overall Impressions of the Clarity and Technical Accuracy of EPA’s Draft report

The Panel discussed the overall clarity and technical accuracy of the Report. Panelists commented that the Report was an extensive review of the literature on the connectivity of streams and wetlands to downstream waters. Members commented that, in general, the Report was thorough and technically accurate.

Members commented that the Report could be strengthened by editing to ensure that it was more clearly organized and written in a consistent style and voice. Members again noted that some terms and definitions were not used consistently in all parts of the document. Some members commented that the conceptual framework describing the hydrologic elements of a watershed and the connections that link them could be used to integrate the entire Report. Other members suggested that the Report could be strengthened by stating the key points in each chapter at end of the chapter and including a succinct table summarizing all of the key findings in the executive summary.

Some members commented that the Report might be more useful to decision-makers if it had greater focus on quantification of the degree, magnitude, or consequences of connectivity.

Panel members discussed the literature review and some members commented that it could be strengthened by more clearly describing the approach used to screen, compile, and synthesize the information. Panelists also commented that studies that failed to show connectivity should be included in the Report along with those that demonstrated connectivity. The Panel discussed the case studies. Some members commented that the case studies provided helpful illustrations of the connectivity of streams and wetlands in certain geographic areas to downstream waters. Panelists commented that the Report could be strengthened by clarifying how the case studies were selected and presenting them more succinctly in text boxes throughout the document.

Brief Clarifying Comments from Members of the Public

Following the discussion of Charge Question 1, the Chair indicated that the panel would hear brief clarifying comments from members of the public. She noted that the purpose of this second comment period was to receive additional input from members of the public who had been listening to the deliberations. She indicated that five individuals had requested time to speak. The speakers presented their comments in the following order.

- Diedre Duncan of Hunton and Williams LLP commented on limitations in the scope of waters regulated under the Clean Water Act. She noted that as written, EPA's Report had little discussion of some important issues that should be considered in evaluating connectivity such as frequency, duration, and timing of flows.
- Susan Bodine of Barnes and Thornburg LLP Commented on the legal construct underlying the determination of waters regulated under the Clean Water Act. She commented on the need for science to inform regulatory and policy decisions within the existing legal construct.
- Jan Goldman-Carter of the National Wildlife Federation commented on scope of waters regulated under the Clean Water Act and indicated that the scope included not just streams and rivers but a range of other waters. She commented that the connectivity Report was needed to evaluate wetlands and other waters including intermittent streams
- Jeanne Christie of the Association of State Wetland Managers commented on the range aquatic systems that were connected and the downstream effects of connections. She commented on the importance of recognizing that there was a gradient of connectivity.
- Tom Crafford of the Alaska Department of Natural Resources commented on the authority of states to regulate waters within their jurisdictions. In this regard, he noted

that states could regulate waters that were not necessarily regulated under the Clean Water Act.

Writing Session by Panel Subgroups

Dr. Rodewald thanked the speakers for their clarifying comments and indicated that the Panel would meet in subgroups for the remainder of the day to develop the key points to be included in the responses to the charge questions. She noted that members of the public were welcome to stay to observe the writing session. She asked the lead writers to facilitate the discussion in the subgroup sessions and indicated that the Panel would reconvene at 8:30 a.m. the following day to discuss the key points developed by the subgroups. Subgroups of the Panel then met in writing sessions until 5:30 p.m.

WEDNESDAY, DECEMBER 18, 2013

Reconvene the Meeting

The meeting reconvened at 8:30 a.m. Dr. Rodewald stated that the Panel had worked in subgroups to develop key points in response to the charge questions. She asked the lead writers to present summaries of the key points developed by their subgroups and the Panel discussed those points. Presentations from Panel subgroups for the discussion of the key points¹¹ are available in the meeting materials posted on the SAB website.

Key Points Discussed in Response to Charge Question 2

Dr. Rains summarized key points developed by the subgroup in the response to charge question 2:

- EPA's literature review was thorough, technically accurate, and readable. The conceptual framework needs to be revised and clearly articulated in the beginning of the chapter to enable the reader to access and understand the material
- The gradient of connectivity needs to be clarified, with connectivity expressed through hydrological, chemical, and biological changes
- The definition of wetlands used in EPA's Report needs to be clearly addressed, noting that there are scientific and regulatory definitions and that the Report uses the former.
- The conceptual framework needs to be reworked, with a flowpath focus showing that streams and wetlands are connected to downstream waters by hydrological and biological flowpaths. A classification system could be mapped onto that framework.
- The conceptual framework could be regionalized by expressing forcings in terms of hydrologic-landscape regions.
- The concept of cumulative effect needs to be discussed.
- The effect of map resolution on headwater stream delineation merits highlighting and clarification in a separate section.

Panel members discussed the key points and offered comments focusing on the following issues:

- Use of hydrologic-landscape regions in the conceptual framework.
- How to overlay biological connectivity on the flow-path framework.
- The need to define wetlands consistently throughout the Report.
- How to look at aggregate cumulative effects.
- The need to discuss chemical flow paths in the Report.
- Need for consistent river/stream definitions

Key Points Discussed in the Response to Charge Question 3(a)

Dr. Rosi-Marshall summarized the key points developed by the subgroup in the response to Charge Question 3(a):

- EPA should improve the review of hydrologic exchange flows between main channels and off channel areas.
- The discussion of naturally occurring chemical constituents other than nutrients and contaminants could be expanded.
- A more thorough treatment of factors that influence stream temperature is needed in EPA's Report.
- The temporal dynamics of connections have been addressed in EPA's Report but could be expanded.
- The Report could be strengthened by improving the review of biological connectivity.
- Human-modified headwater stream literature should be covered more extensively in the Report.
- The role of headwater streams in aggregate should be highlighted.
- The discussion of the role of nutrient and contaminant transformation could be expanded in the Report.
- The discussion of the effects of streamside vegetation on stream ecosystems should be expanded in the Report.
- A section should be added to the Report to provide a through treatment of food-web connections from riparian zones to streams that support aquatic organisms.

Panel members discussed the key points and offered comments focusing on the following issues:

- The scope of the recommendations in the key points (i.e., the recommendations called for elaboration and clarification, not necessarily for the addition of new sections to the Report).
- The need to address effects caused by humans and human altered systems.
- The need for emphasis on the discussion of low order streams.
- The need for EPA to consider the sedimentology literature in its review.

Key Points Discussed in the Response to Charge Question 3(b)

Dr. Tank summarized key points developed by the subgroup in the response to Charge Question 3(b):

- Chapter conclusions should be framed within the conceptual foundation of four-dimensional connectivity and conclusions displayed in a matrix to summarize extent of evidence and uncertainty across function and system type.
- Statements on the boundary of upland/headwater transition should be included in EPA's Report. The Report should also emphasize groundwater-surface water interactions, flooding, riparian zones and how these linkages influence biota and food webs.
- The conclusions in EPA's Report could be improved by mentioning how human activities alter connectivity of streams with downstream waters (ideally through the use of specific examples).
- Text about spatial and temporal variation in the linkage of ephemeral streams and variable source areas with downstream waters should be added to EPA's Report. This text should address frequency of the connection and critical habitat provided by these systems.
- Details should be added in the conclusion on how streams influence chemicals beyond nitrate, including sediment-bound nutrients, dissolved organic matter, and other contaminants. Nutrient removal processes and nutrient spiraling should be mentioned.

Panel members discussed the key points and offered comments focusing on the following issues:

- Moving the material in Chapter 6 to preceding parts of EPA's Report.
- More discussion in Chapter 1 of why and how the case studies in EPA's Report were selected.
- Incorporating human impacts into the case studies in EPA's Report.
- Providing more discussion in EPA's Report about types of water body connectivity.
- Including discussion about degrees of connectivity in EPA's Report

Key Points Discussed in the Response to Charge Question 4(a)

Dr. Fennessy summarized key points developed by the subgroup in the response to Charge Question 4(a):

- There was strong support for the conclusion that wetlands and open waters with the potential for nontidal, bidirectional hydrologic flows with rivers and lakes are connected to downstream waters.
- The headwater riparian zone material in EPA's Report should be moved to chapter four to reflect the role of streamside riparian zones on stream structure and function. Section 5.3 of the Report should focus on riparian wetlands and floodplains.

- The effects of riparian wetlands/floodplains on the flows, chemistry, and biota of downstream waters should be stressed in EPA's Report. The lateral dimensions of river systems should be stressed.
- There should be an increased emphasis in EPA's Report on the temporal aspects of floodplain systems as guided by the "flood pulse concept."
- In EPA's Report, the bidirectional nature of fluxes and linkages should be clarified by articulating the links back to the river channel and how exchange flows respond to temporal progression of the flood pulse.
- EPA's Report should specifically address groundwater and chemical connectivity that recognizes the bidirectional exchange of ground and surface waters and associated chemicals (e.g., upgradient groundwater and hyporheic zone).
- EPA's Report should provide a more recent and diverse assessment of biogeochemical implications of exchange flows. The review of the literature on the role of floodplains as sources, sinks, and transformers of nutrients and material should be enhanced.
- EPA's Report should discuss how human impacts to riparian wetlands and floodplains alter connectivity.

Panel members discussed the key points in the response to question 4(a). Members commented that there should be more focus in the Report on aggregate effects. In this regard members indicated that the rich literature on bottom land hardwoods could be further discussed in the Report.

Key Points Discussed in the Response to Charge Question 4(b)

Dr. Sullivan summarized key points developed by the subgroup in the response to Charge Question 4(b):

- There was general agreement in the Panel subgroup that riparian wetlands and floodplains were highly connected to receiving waters through multiple pathways, including hydrological and biological connectivity. However, the key findings and conclusions in EPA's Report about these water bodies needed to be directly related to the information presented in the associated section on riparian wetlands and floodplains.
- Many of the conclusions in EPA's Report were drawn from the literature related to non-floodplain riparian areas, which weakened the potential opportunity to present direct evidence of connectivity (or lack thereof) between riparian wetlands and floodplains with receiving systems.
- Terminology referring to riparian wetlands and floodplains should be consistent throughout EPA's Report.
- Key findings and conclusions in EPA's Report should recognize the temporal dimension of riparian wetlands and floodplains relative to downstream connectivity. Water residence times and the transient nature of floodplains should be key points.
- Key conclusions in EPA's Report could be more empirical or specifically described. Demonstrated connectivity should be quantified.

- EPA’s Report should further highlight the role of biological connectivity between riparian wetlands and floodplain waters and receiving systems.
- EPA’s Report should use an “exchange” vs. “export” framework (e.g., reciprocal exchanges between riparian wetlands and floodplain waters and receiving waters).
- Panel members found the case studies in EPA’s Report to be useful and recommended that the case studies be related to the overall conclusions.
- The conclusions in EPA’s Report could be improved by explicitly mentioning how human activities alter connectivity of riparian wetlands and floodplain waters with receiving systems.

Panel members discussed the key points in the responses to both questions 4(a) and 4(b) and offered comments focusing on the following issues:

- There is a need to: review the literature on biogeochemical flow-paths (e.g., metals), include information about peatland, include case studies for bidirectional wetlands, provide more discussion about regulation of inundated floodplains, and include more discussion about level of connectivity in the landscape.
- It was pointed out that the Report referenced a number of publications in the 1989-1986 timeframe and that this was a relatively dry period of time.
- It was pointed out that the literature on sedimentation in reservoirs and other water bodies could provide useful information on connectivity.
- Some members indicated that the role of episodic flooding should be clearly addressed in the Report and the temporal scale is important. The Report contained some discussion of the duration of connection, but the treatment is uneven.
- The case studies in the Report should be tied back to the discussion in other parts of the Report.
- The Report could provide more discussion relating metal fluxes to connectivity.
- Some members indicated that more analysis of the case studies should be provided in the Report and that it would be helpful to provide more case studies. A member suggested that it would be useful to include illustrations (e.g., text boxes) of the case studies embedded in the individual chapters of the Report.
- Members indicated that it was important to clearly indicate why the case studies have been included in the Report.

Key Points Discussed in Response to Charge Question 5(a)

Dr. Johnson summarized key points developed by the subgroup in the response to Charge Question 5(a):

- The Report should be reorganized to discuss key functions around the types of connections between wetlands and downstream waters (including surface water, groundwater and biological), with specific attention paid to the gradients of these pathways and their role in affecting downstream waters.
- The Report should acknowledge that there are bodies of water that are not connected and this should be defined at the end of a gradient (e.g., terminal salt lakes). A framework for considering the gradient of connectivity was suggested. The

framework illustrated dimensions of: 1) the gradient in surface, shallow subsurface or groundwater flows from wetlands to downstream waters, and 2) the gradient in transfers of biota from wetlands to downstream waters.

- The Report should explicitly address temporal and spatial scales of connections with a discussion of the magnitude, frequency, and duration of connections quantified.
- Geology, climate, landforms, and surficial sediments provide the regional context regulating transport properties and are major drivers of the temporal and spatial scales of hydrologic linkages
- Regional context is partially addressed in the Report by case studies, but could further inform the development of the main text.
- The Report should examine connectivity through a range of time scales (e.g., days vs. thousands of years) to establish the magnitude, duration, and frequency of connections.
- The Report should consider the influence of landscape position and scale in the evaluation of the degree of connectivity. This will likely provide further rationale for treating wetland complexes as aggregates rather than as individual units.
- There should be more information in the Report on biological connections, including major assemblages (e.g., birds, amphibians, reptiles, and invertebrates).
- The Report should discuss current and past human disturbances that alter the type, strength, and magnitude of connectivity pathways.

Panel members discussed the key points in the responses to question 5(a) offered comments focusing on the following issues:

- Members discussed the framework for considering the gradient of connectivity. Some members suggested that “probability of connection” could be used to frame the discussion of connectivity in the Report.
- Some members did not support framing the discussion of the gradient of connectivity in the context of the “risk” that changes in a water body will be transmitted to downstream waters.
- Some members commented that the gradient of connectivity could be considered in the context of the strength of downstream consequences of changes in water bodies.
- Members indicated that the Report should acknowledge that there are some bodies of water that are “minimally connected” rather than stating that there are some bodies of water that are “not connected”.

Key Points Discussed in Response to Charge Question 5(b)

Dr. Bernhardt summarized key points developed by the subgroup in the response to Charge Question 5(b):

- The conclusions in the Report about unidirectional wetlands needed to be strengthened. The conclusions should encompass more than hydrologic connectivity and the frequency, magnitude, and duration of connections should be considered.
- The following conclusion in the Report be removed: “The literature we reviewed does not provide sufficient information to evaluate or generalize about the degree of

connectivity (absolute or relative) or the downstream effects of wetlands in unidirectional settings” because it was inconsistent with the synthesized literature it was intended to summarize.

- The Report should move from a dichotomous categorical approach for considering connectivity to a gradient approach and suggested that the Report should indicate that over sufficiently long time scales, all aquatic habitats are connected to downstream waters through the transfer of water, chemicals, or biota, yet the magnitude and effects of these connections vary widely across wetlands.
- The subgroup indicated that there were four pathways by which unidirectional wetlands could be connected to downstream waters; surface, shallow subsurface, or groundwater flow-paths.
- References to specific studies should be removed from the text of key findings. The key findings were intended to summarize general themes arising from a broad literature synthesis and therefore the findings should not be attributed to one or a few specific studies.
- The subgroup developed modified versions of the findings in the Report addressing: 1) the biological functions of unidirectional wetlands; 2) biological connectivity between unidirectional wetlands and downstream waters; 3) spatial proximity of unidirectional wetlands; and 4) cumulative or aggregate impacts of unidirectional wetlands.

Panel members discussed the key points in the responses to question 5(b) and offered comments focusing on the following issues:

- Case studies could be used to illustrate the approach to considering the gradient of connectivity.
- Sediment should be included the description of the storage function of wetlands.
- A member suggested that the proposed framework for considering the gradient of connectivity should refer to biotic influence.

Key Points Discussed in Response to Charge Question 1

Dr. Rodewald summarized key points developed by the subgroup in the response to Charge Question 1:

- The Report represented a well-written and extensive review of the literature, but it needed to be edited for continuity and consistency.
- The usefulness of the Report to decision-makers and for informing policy could be improved by quantifying the degree or magnitude of connectivity when possible, and by exercising caution when using words that might denote particular legal or regulatory meanings.
- The literature review in the Report could be strengthened by clarifying what was considered as peer-reviewed literature and better describing the kinds of evidence used and types of studies selected for review.
- The conceptual framework in the Report should be the integrator of the entire document with clear links to each section (and within each section) of the Report.

- Spatial and temporal scales of connectivity need to be better articulated in the Report.
- The treatment of biological connections and flowpaths needs to be strengthened throughout the Report.
- The Report should cover a greater range of geographic regions (e.g., the arctic) and systems, including human modified systems, forested wetlands, and bottomland forests.

Panel members discussed the key points in the responses to question 1 and offered comments focusing on the following issues:

- At the beginning of the Report, EPA should clearly state the scope of the literature review (i.e., how references were included and why the case studies were selected).
- The definitions in the glossary of the Report should agree with definitions in the Report text.
- There was a lack of flow in the logic of the Report; concluding statements were needed at the end of every section. The Report could be improved but the document was basically thorough and it needed technical editing. Parallel structure was missing in some parts. Figure 6.1 in Chapter six be moved to the beginning of the Report.
- Some members commented that the Report should be strengthened to improve continuity and consistency. The Panel was providing recommendations to improve the technical accuracy and messaging of the Report.
- The Panel discussed use of the terms “bidirectional” and “unidirectional” in the Report. Some members did not agree with the use of these terms. Members discussed whether EPA should use the terms “floodplain” and “non-flood plain;” “riparian wetlands” and “floodplains;” “non-riparian” and non-floodplain.”
- The Report provided data to show water body connectivity but did not provide data to test for “no connectivity.”
- A member disagreed with the conclusion that the Report was “well- articulated.”
- The Panel discussed chapter six and indicated that material in this chapter should be moved to the beginning of the document in order to give the reader a better understanding of connectivity.

Summary and Next Steps

Following the discussion of the key points in response to the charge questions, Dr. Rodewald reviewed the next steps to be taken to develop the SAB Panel’s report.

Dr. Rodewald thanked the Panelists and for a productive discussion, thanked members of the public for their input, and thanked EPA staff for their presentations and responses to the Panel’s questions. She asked the lead writers to develop written responses to their assigned charge questions, incorporate comments from members of their subgroups, and send the responses to the DFOs by January 31st.

Dr. Rodewald indicated that if lead writers wished to hold conference calls with their subgroups they should contact Dr. Armitage so he could schedule the calls.

Dr. Rodewald indicated that after the responses to the charge questions were received from the lead writers, the DFOs, would work with her to develop the first draft of the Panel's report. The report would then be sent to everyone on the Panel for review and discussion on a public teleconference. She noted that Dr. Armitage would contact Panel members to schedule the teleconference.

A member asked a question about the format of the Panel's report. Dr. Armitage indicated that he would send Panel members a follow-up email summarizing the next steps and would provide examples SAB reports so that members could see the format of a typical report.

Mr. Zarba then offered brief closing remarks thanking the Chair and Panel members for their work. Following his remarks the meeting was adjourned.

Respectfully Submitted:

Certified as Accurate:

/signed/

/signed/

Dr. Thomas Armitage
Designated Federal Officer

Dr. Amanda Rodewald, Chair
SAB Panel for the Review of the
EPA Water Body Connectivity
Report

/signed/

Ms. Iris Goodman
Designated Federal Officer

NOTE AND DISCLAIMER: The minutes of this public meeting reflect diverse ideas and suggestions offered by Panel members during the course of deliberations within the meeting. Such ideas, suggestions and deliberations do not necessarily reflect consensus advice from Panel members. The reader is cautioned to not rely on the minutes to represent final, approved, consensus advice and recommendations offered to the Agency. Such advice and recommendations may be found in the final advisories, commentaries, letters or reports prepared and transmitted to the EPA Administrator following the public meetings.

ATTACHMENT A: PANEL ROSTER

U.S. Environmental Protection Agency Science Advisory Board (SAB) Panel for the Review of the EPA Water Body Connectivity Report

CHAIR

Dr. Amanda Rodewald, Director of Conservation Science, Cornell Lab of Ornithology and Associate Professor, Department of Natural Resources, Cornell University, Ithaca, NY

MEMBERS

Dr. Allison Aldous, Freshwater Scientist, The Nature Conservancy, Portland, OR

Dr. Genevieve Ali, Junior Chair, Manitoba's Watershed Systems Research Program, Department of Geological Sciences, University of Manitoba, Winnipeg, MB, Canada

Dr. J. David Allan, Professor, School of Natural Resources & Environment, University of Michigan, Ann Arbor, MI

Dr. Lee Benda, Research Geomorphologist, Earth Systems Institute, Mt. Shasta, CA

Dr. Emily S. Bernhardt, Associate Professor of Biogeochemistry, Department of Biology, Duke University, Durham, NC

Dr. Robert P. Brooks, Professor of Geography and Ecology, Department of Geography, Pennsylvania State University, University Park, PA

Dr. Kurt Fausch, Professor, Department of Fishery and Wildlife Biology, Colorado State University, Fort Collins, CO

Dr. Siobhan Fennessy, Jordan Professor, Biology Department, Kenyon College, Gambier, OH

Dr. Michael Gooseff, Associate Professor, Department of Civil and Environmental Engineering, Colorado State University, Fort Collins, CO

Dr. Judson Harvey, Research Hydrologist, National Research Program, U.S. Geological Survey, Reston, VA

Dr. Charles Hawkins, Professor, Department of Watershed Sciences, and Director, Western Center for Monitoring and Assessment of Freshwater Ecosystems, Quinney College of Natural Resources, Utah State University, Logan, UT

Dr. Lucinda Johnson, Center Director, Center for Water and the Environment, Natural Resources Research Institute, University of Minnesota Duluth, Duluth, MN

Dr. Michael Josselyn, Principal and Senior Scientist, Wetlands Research Associates, Inc., San Rafael, CA

Dr. Latif Kalin, Associate Professor, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL

Dr. Kenneth Kolm, President and Senior Hydrogeologist, Hydrologic Systems Analysis, LLC, Golden, CO

Dr. Judith L. Meyer, Professor Emeritus, Odum School of Ecology, University of Georgia, Lopez Island, WA

Dr. Mark Murphy, Principal Scientist, Hassayampta Associates, Tucson, AZ

Dr. Duncan Patten, Director, Montana Water Center, and Research Professor, Hydroecology Research Program, Department of Land Resources and Environmental Sciences, Montana State University, Bozeman, MT

Dr. Mark Rains, Associate Professor of Ecohydrology, Department of Geology, University of South Florida, Tampa, FL

Dr. Ramesh Reddy, Graduate Research Professor & Chair, Soil and Water Science Department, University of Florida, Gainesville, FL

Dr. Emma Rosi-Marshall, Associate Scientist, Cary Institute of Ecosystem Studies, Millbrook, NY

Dr. Jack Stanford, Jessie M. Bierman Professor of Ecology, Flathead Lake Biological Station, University of Montana, Polson, MT

Dr. Mazeika Sullivan, Assistant Professor, School of Environment & Natural Resources, The Ohio State University, Columbus, OH

Dr. Jennifer Tank, Galla Professor, Department of Biological Sciences, University of Notre Dame, Notre Dame, IN

Dr. Maurice Valett, Professor of Systems Ecology, Division of Biological Sciences, University of Montana, Missoula, MT

Dr. Ellen Wohl, Professor of Geology, Department of Geosciences, Warner College of Natural Resources, Colorado State University, Fort Collins, CO

SCIENCE ADVISORY BOARD STAFF

Dr. Thomas Armitage, Designated Federal Officer, U.S. Environmental Protection Agency, Washington, DC

Ms. Iris Goodman, Designated Federal Officer, U.S. Environmental Protection Agency, Washington, DC

ATTACHMENT B: OTHER ATTENDEES

List of others who were present at the meeting or requested access by teleconference or webcast.

NAME	AFFILIATION
Carrie L. Allison	U.S. Fish and Wildlife Service
Rusty Ashcroft	Alliance Coal
Amanda E. Aspatore	National Mining Association
Jesse Bearden	Carter and Sloope Consulting Engineers
Susan Bodine	Barnes & Thornburg
Rich Bozek	EEI
Tom Brennan	U.S. EPA - SAB
Caroline Brouwer	Ducks Unlimited
Eden Burgess	Cultural Heritage Partners, PLLC
Bob Cantilli	U.S. EPA - ORD
Tom Carpenter	U.S. EPA - SAB
Adam Carpenter	AWWA
Patricia Kablach Casano	General Electric Company
Jeanne Christie	ASWM
Al Cofrancesco	U.S. Army Corps of Engineers
Claudia Copeland	CRS/LDC
Tom Crafford	State of Alaska
Casey Deitrich	CQ Transcriptions
Stacey Detwiler	American Rivers
Jon Devine	NRDC
Bridget DiCosmo	Inside EPA
Deidre Duncan	Hunton & Williams
David Dunlap	KCPS
Emmi Felker-Quinn	U.S. EPA – ORISE Post Doctoral Fellow

Rachel Fertik	U.S. EPA
Ally Fields	Environment America
Tony Francois	Pacific Legal Foundation
Ken Fritz	U.S. EPA - ORD
Eric Fry	Peabody
Nathan Gardner-Andrews	NACUA
Ellen Gilinsky	U.S. EPA - OW
Jan Goldman-Carter	National Wildlife Federation
Nick Goldstein	ARTRA
Noah Greenberg	Wright Water Engineers, Inc
Sandy Gruzesky	Kentucky Department for Natural Resource
Jimmy Hague	TRCP
William T. Hall	Hall & Associates
Scot Hagerthey	U.S. EPA-ORD
Ed Hanlon	U.S. EPA - SAB
Karen Hobbs	NRDC
Perrin Ireland	NRDC
Kathryn Kazior	U.S. EPA
Hadas Raanan Kiperwas	U.S. EPA - ORISE
Andrew Knudsen	Hunton & Williams
Rose Kwok	U.S. EPA - OW
Lyndon Lee	LL Lee & Associates
Barbara Martinez	U.S. EPA
Melissa McCoy	ACWA
Ashley McDonald	National Cattlemen's Beef Association
Kerry McGarth	Hunton & Williams LLP
Michael McManus	U.S. EPA - ORD
Brandon Middleton	Senate EPW Committee
Leah Miller	Izaak Walton League

Steve Moyer	Trout Unlimited
Don R. Parrish	American Farm Bureau Federation
C. Paul Pascaros	ECS Carolinas, LLP
J.E. Perry	Society Wetland Scientists
Jennifer Peters	Clean Water Action
Luke Polk	Florida Farm Bureau Federation
Amina Pollard	U.S. EPA-OW
M.A. Palmer	University of Maryland
Rob Reash	AEP
Caroline Ridley	U.S. EPA - ORD
Russell Riggs	NAR
Paul G. Rodewald	Cornell University
Amena Saiyid	Bloomberg BNA
Stephanie Sanzone	U.S. EPA - SAB
Ed Shadrick	Black & Veatch Corporation
Sue Shallal	U.S. EPA - SAB
Eric Shea	FPL
Charles Smith	U.S. Army
Mary Smith	U.S. Army Corps of Engineers
Meg Smith	U.S. Army Corps of Engineers
Eric Somerville	U.S. EPA-Region 4
Jane Srail	citizen
Erik Stokstad	Science
Annie Snider	E & E News
Keith Tillotson	Olsson Associates
Jason Todd	U.S. EPA-ORD
John Turner	Arkansas Natural Resources Commission
S. Van Drunick	U.S. EPA-ORD
Melissa Waage	NRDC

Karyn Wendelowski	U.S EPA
Parker J. (Jim) Wigington	No affiliation provided
Clint Woods	House Committee on Science, Space, and Technology
Scott Yaich	Ducks Unlimited
Sally Yost	U.S. Army Corps of Engineers
Kendra Zamzow	U.S. EPA

Materials Cited

The following meeting materials are available on the SAB website, <http://www.epa.gov/sab>, at the February 16-18 meeting page of the Panel for the Review of the EPA Water Body Connectivity Report:

<http://yosemite.epa.gov/sab/sabproduct.nsf/MeetingCal/A243CB99328D3BF085257BBE0074E4E2?OpenDocument>

¹ Federal Register Notice announcing the December 16-18 Panel meeting

² Agenda

³ Charge to the Committee

⁴ EPA Review Documents

⁵ EPA Briefing Material

- Presentation by Jeffrey Frithsen and Laurie Alexander, EPA Draft Report EPA/600/R-11/098B, Connectivity of Streams and Wetlands to Downstream Waters

⁶ Preliminary Comments from Committee Members

- Compilation of individual preliminary comments from Panel members
- Individual preliminary comments from Dr. Reddy
- Updated individual preliminary comments from Drs. Gooseff and Reddy, December 17, 2013

⁷ Congressional Correspondence

- December 16, 2013 letter from EPA Associate Administrator for Congressional and Intergovernmental Relations to Chairman Smith of the U.S. House of Representatives Committee on Science, Space, and Technology
- December 16, 2013 letter from EPA Associate Administrator for congressional and intergovernmental Relations to Chairman Steward, Subcommittee on the Environment, U.S. house of Representatives committee on Science, Space, and technology
- November 6, 2013 letter from the Chairman of the House Committee on Science, Space, and Technology and the Chairman of the House Subcommittee on the Environment to Drs. Amanda Rodewald and David Allen
- October 18, 2013 letter from house Science Committee to EPA Administrator Gina McCarthy
- October 29, 2013 letter from Representative Jason Smith to Thomas Armitage, SAB Office

⁸ List of Public Speakers

⁹ Presentation Material Provided by Public Speakers

- Handout from Don Parrish, American Farm Bureau Federation
- Presentation from Scott C. Yaich, Ducks Unlimited
- Statement from James E. Perry, Society of Wetland Scientists
- Statement from Jan Goldman-Carter, National Wildlife Federation
- Statement from Jeanne Christie, Association of State Wetland managers
- Statement from Jimmy Hague, Center for Water Resources, Theodore Roosevelt Conservation Partnership
- Statement from Tom Crafford, Alaska Department of Natural Resources
- Statement from Tony Francois, Pacific Legal Foundation

¹⁰ Public Comments transmitted through the EPA Docket

- Availability of public comments
- Table of public comments received by the EPA Docket as of November 6, 2013
- Table of additional public comments received by the EPA Docket as of January 15, 2014

¹¹ Presentations from Panel subgroups for the discussion of key points in response to the charge questions