



November 6, 2013

U.S. Environmental Protection Agency
Office of Environmental Information Docket
Mail Code: 28221T
Docket ID No. EPA-HQ-OA-2013-0582
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Re: Comments on the U.S. EPA Draft Report: *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence* (September 2013) (EPA-HQ-OA-2013-0582)

Dear Science Advisory Board Panel:

The Waters Advocacy Coalition (“WAC” or “Coalition”) submits the following comments and technical review on the U.S. Environmental Protection Agency’s (“EPA’s”) draft report, *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence* (Sept. 2013) (“Synthesis Report”). The Coalition represents a large cross-section of the nation’s construction, housing, mining, agriculture, manufacturing, and energy sectors, all of which are vital to a thriving national economy, including providing much-needed jobs. Projects and operations in these sectors are regulated in one manner or another by the numerous sections of the Clean Water Act (“CWA” or “Act”)—402, 404, 401, 303, and others. Because EPA has used the Synthesis Report to prepare a proposed rule on CWA jurisdiction,¹ the report and EPA’s reliance on the report are critically important to Coalition members and the regulated businesses it represents.

¹ On September 17, 2013, EPA and the U.S. Army Corps of Engineers sent a proposed rule on CWA jurisdiction to the Office of Management and Budget for interagency review that “takes into consideration the current state-of-the-art peer reviewed science reflected in the draft science report.” EPA, Notice Announcing Release of Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence (External Review Draft), <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=238345> (last visited Oct. 23, 2013) (“EPA Release Notice”).

On September 17, 2013, EPA announced the availability of the Synthesis Report, which synthesizes the peer-reviewed scientific literature on the connectivity of streams and wetlands relative to downstream waters.² EPA, through the Science Advisory Board (“SAB”), convened an expert panel (“SAB panel”) to conduct a peer review of the Synthesis Report and solicited public comments on the Synthesis Report to be reviewed by the SAB panel.³ On the same day, EPA also announced that it and the U.S. Army Corps of Engineers (“Corps”) (jointly, “the agencies”) had sent a proposed rule on the scope of their CWA jurisdiction to the Office of Management and Budget (“OMB”) for interagency review. EPA states that the Synthesis Report’s findings will “provide the scientific basis” for the upcoming rulemaking on CWA jurisdiction.⁴

EPA has assured that “[a]ny final regulatory action related to the jurisdiction of the Clean Water Act in a rulemaking will be based on the final version of this scientific assessment, which will reflect EPA’s consideration of all comments received from the public and the independent peer review.”⁵ Our comments and the attached GEI Consultants, Inc. (“GEI”) Technical Comments set forth numerous concerns with the Synthesis Report and its use as the scientific basis for the agencies’ rulemaking. In particular, the Coalition urges the SAB panel to consider the following concerns:

- The Synthesis Report provides no scientific support to make distinctions between significant connections and non-significant connections.

² EPA Release Notice.

³ 78 Fed. Reg. 58,536 (Sept. 24, 2013).

⁴ EPA Release Notice.

⁵ *Id.*

- The Synthesis Report assumes, with little scientific support, that all connections, no matter the kind, size, or frequency should be considered equal.
- The Synthesis Report does not account for factors of variability in connectivity, such as climate, stream size, habitat, watershed characteristics, frequency and duration of flow, or proximity to navigable waters.
- The Synthesis Report does not adequately address man-made modifications and natural or man-made impediments to connectivity in the landscape.
- The Synthesis Report makes the unsupported conclusion that any wetland or water course within a riparian area or a floodplain has a significant connection to downstream waters.
- The Synthesis Report includes overly broad definitions of streams, floodplains, and riparian areas that would include entire watersheds, including uplands.
- The Synthesis Report defines key terms, such as “stream” and “wetland,” inconsistently with existing regulatory definitions.
- EPA and the Corps are already using the Synthesis Report to justify their proposed rule on the scope of their CWA authority, yet the report does not address the fundamental question central to that jurisdiction (namely, what connections between water bodies are *significant*) and is not yet final.
- As a result, the agencies should ask the correct questions first, evaluate the relevant science, then prepare a proposed rule in keeping with the best known science. Instead, the agencies’ rulemaking approach is premature and does not take into account the independent scientific and technical input of the SAB on the connectivity of waters.
- Under the SAB authorizing statute, SAB review of the Synthesis Report should be informed by a simultaneous review of the proposed rule.
- EPA’s charge questions are too narrow and fail to ask important questions that need to be evaluated prior to a rulemaking. Therefore, the SAB should exercise its prerogative to explore a broader list of concerns underlying connectivity.

I. Background

Because the agencies intend to rely on the Synthesis Report as the “scientific basis” for the upcoming rulemaking, it is important to understand the direction the courts have given to the agencies in establishing connectivity. This legal framework provides context for important issues that must be raised by the SAB panel to inform decisions about CWA jurisdiction.

A. The CWA Regulates Navigable Waters, Not All Waters.

The CWA regulates “navigable waters,” defined as “waters of the United States.” 33 U.S.C. §§ 1344, 1362(7). It does not regulate all waters. The United States Supreme Court has recognized that the term “navigable” must be given effect. *See Solid Waste Agency of N. Cook Cnty. v. U.S. Army Corps of Eng’rs*, 531 U.S. 159, 172 (2001) (“*SWANCC*”) (“The term ‘navigable’ has at least the import of showing us what Congress had in mind as its authority for enacting the CWA: its traditional jurisdiction over waters that were or had been navigable in fact or which could reasonably be so made.”); *Rapanos v. United States*, 547 U.S. 715, 731 (2006) (“[T]he qualifier ‘navigable’ is not devoid of significance.”). Indeed, Congress did not intend for the CWA to cover all waters. When it enacted the CWA, Congress explicitly “recogniz[ed], preserv[ed], and protect[ed]” the States’ primary authority and responsibility over local land and water resources. 33 U.S.C. § 1251(b). Overreaching interpretations of the CWA “result in a significant impingement of the States’ traditional and primary power over land and water use.” *Rapanos*, 547 U.S. at 738 (quoting *SWANCC*, 531 U.S. at 174).

B. In *Rapanos*, the Court Rejected the “Any Connection” Standard, and Justice Kennedy Established a “Significant Nexus” Standard.

The U.S. Supreme Court has examined the meaning of the scope of “navigable waters” under the CWA three times. In *United States v. Riverside Bayview Homes, Inc.*, 474 U.S. 121 (1985), the Supreme Court upheld the regulation of wetlands adjacent to navigable waters because it found that the adjacent wetlands were “inseparably bound up” with the navigable waters. In *SWANCC*, the Supreme Court rejected the assertion of jurisdiction over isolated ponds because they lacked a significant nexus to navigable waters and were therefore a “far cry, indeed, from the ‘navigable waters’ and ‘waters of the United States’ to which the statute by its

terms extends.” 531 U.S. at 173. The *SWANCC* Court found that isolated waters fall outside CWA jurisdiction, even when those waters have an ecological connection (via migratory birds) to navigable waters. *Id.* at 167-68.

Following *SWANCC*, the government asserted that the *SWANCC* decision was limited to isolated waters, and that if a water “connected” to navigable waters, it was not an isolated water and could therefore be regulated as a navigable water under the CWA.⁶ The agencies’ “any connection” theory essentially reached all wet areas, including ditches, drains, desert washes, and ephemeral waters that flow infrequently and are far removed from traditional navigable waters. This approach to jurisdiction was challenged in two consolidated cases, *Rapanos v. United States* and *Carabell v. United States*, in which the Court considered whether the agencies could assert CWA jurisdiction over sites with nearby drains and ditches based on the agencies’ determination that the sites were connected to tributaries of navigable waters. 547 U.S. at 720-721.

The *Rapanos* Court, in a four-Justice plurality opinion authored by Justice Scalia and a separate concurrence by Justice Kennedy, rejected the Corps’s assertion of jurisdiction over the wetlands at issue and rejected the Corps’s broad interpretation that the CWA regulates any non-navigable water with “any connection” to navigable waters. *Id.* at 734 (plurality); *id.* at 781 (Kennedy, J., concurring). The plurality held that the plain language of the CWA “does not authorize this ‘Land is Waters’ approach to federal jurisdiction” and that “[i]n applying the definition to ‘ephemeral streams,’ ‘wet meadows,’ storm sewers and culverts, ‘directional sheet flow during storm events,’ drain tiles, manmade drainage ditches, and dry arroyos in the middle

⁶ See, e.g., Brief for the United States at 31, *Rapanos v. United States*, 547 U.S. 715 (2006) (No. 04-1034); *Rapanos*, 547 U.S. at 780 (Kennedy, J., concurring) (“The Corps’ theory of jurisdiction in these consolidated cases—adjacency to tributaries, however remote and insubstantial—raises concerns . . .”).

of the desert, the Corps has stretched the term ‘waters of the United States’ beyond parody.” *Id.* at 734 (internal quotations omitted). Rather, the plurality held that the Act “confers jurisdiction over only relatively *permanent* bodies of water.” *Id.*

In his concurrence, Justice Kennedy also criticized the Corps’s standard as too broad because it “leave[s] wide room for regulation of drains, ditches, and streams remote from any navigable-in-fact water and carrying only minor water volumes” *Id.* at 781 (Kennedy, J. concurring). Justice Kennedy established a “significant nexus” standard and explained that “[a]bsent a significant nexus, jurisdiction under the Act is lacking.” *Id.* at 767. Justice Kennedy noted that consideration of “the quantity and regularity of flow” and proximity to traditional navigable waters is important for assessing whether there is a significant nexus. *Id.* at 786. Following the *Rapanos* decision, therefore, identifying which waters have a “significant” nexus is critical.

II. The Draft Synthesis Report Is Scientifically and Technically Flawed.

A. The Report Identifies the Presence of Connections Between Waters, but Does Not Address the “Significance” of These Connections.

As discussed above, following the *Rapanos* decision, identifying which waters have a “significant” nexus is critical to determining CWA jurisdiction. The Synthesis Report, the agencies’ purported scientific basis for determining such a nexus, however, focuses on the ability of science to simply identify the *presence* of connections. As discussed in the attached GEI Technical Comments, demonstrating that an observed or potential physical connectivity can be identified does not provide a basis for concluding to what extent such connections may or may not significantly affect the downstream waters. *See* GEI Technical Comments at 3-4. Merely

because a connection can be identified does not mean it is significant to downstream water quality or ecosystem health.

Nor does the Synthesis Report address whether scientifically valid effects thresholds (and the methods to measure those thresholds) can be identified that can be used to determine if a connection significantly influences the integrity of downstream waters. As the GEI Technical Comments point out, an independent review of many of scientific studies upon which the Synthesis Report is based suggests that the current state of ecological science may not provide a method for precisely and accurately measuring the significance of effects of connectivity or isolation. GEI Technical Comments at 4. The Synthesis Report fails to identify any meaningful standard for determining significance of connectivity and its potential effects on downstream waters and, in fact, suggests that “new metrics are needed” to evaluate downstream effects. *See* Synthesis Report at 6-6. Without providing such metrics to define whether connections are significant, the Synthesis Report provides no scientific basis to conclude which connections are significant and which are non-significant, and thereby provides no scientific basis for a rulemaking.

B. The Report Treats All Connections as Equal and Fails To Account for Numerous Factors of Variability.

The Synthesis Report concludes that all streams and most wetlands are physically, chemically, and biologically connected to and exert an influence on downstream waters. The Synthesis Report treats all connections as equal, no matter their size or type, or the frequency of the presumed connection. In making these sweeping assertions, the Synthesis Report does not account for site specificity, regional variability, or temporal variability. Nor does it address

whether these factors of variability have any relevance on the effect of the connection on the integrity of downstream waters.

With its use of the terminology “unidirectional wetland” and “bidirectional wetland,” the Synthesis Report draws an arbitrary distinction that is not supported by scientific literature. *See* GEI Technical Comments at 7. As discussed in the GEI Technical Comments, the Synthesis Report’s conclusion that, except for unidirectional wetlands, all connections are considered equal (no matter the type, size, or frequency) is too broad. *Id.* at 4-5. The Synthesis Report recognizes that there is spatial and temporal variation in the “extent, magnitude, timing, and type of hydrologic connectivity.” Synthesis Report at 3-31. It also describes factors that “illustrate how physical, chemical, and biological connectivity are shaped by many different variables,” including “climate, watershed characteristics, spatial distribution patterns, biota, and human activities and alterations.” *Id.* at 3-33. The Synthesis Report fails to explain how the available science supports making generalizations about the influence of stream and wetland impacts on downstream waters in light of this substantial variability in the influence of any given tributary or wetland on a particular downstream water.

Moreover, for unidirectional wetlands, the Synthesis Report concludes that it is “difficult to determine or generalize, from the literature alone, the degree to which particular wetlands . . . are hydrologically connected” due to the variety of factors that affect downstream waters. *Id.* at 1-12. It is illogical for EPA to determine that temporal and regional variability is important and limit connectivity conclusions for isolated waters, but not also consider such variability important to streams or wetlands in floodplains and riparian areas.

Perhaps most importantly, the Synthesis Report totally fails to explain which types of connections or how many connections of what frequency, magnitude, and duration are needed to significantly affect the flow, ecology, and water quality of downstream waters. The Synthesis Report's conclusion that any connection (no matter the type, size, or frequency) is relevant is particularly problematic from a regulatory perspective in light of Justice Kennedy's statements in *Rapanos* that determining "the quantity and regularity of flow" and proximity to traditional navigable waters is important for assessing whether there is a significant nexus. *Rapanos*, 547 U.S. at 786 (Kennedy, J., concurring).

The Synthesis Report treats all waters and wetlands within riparian or floodplain areas as connected, concluding that "[r]iparian and floodplain areas connect upland and aquatic environments through both surface and subsurface hydrologic flow paths," without distinguishing between wetlands and open waters in riparian and floodplain areas on the one hand, and terrestrial upland habitat in riparian floodplain areas on the other hand. *See* Synthesis Report at 1-9. Not all of these areas can be assumed to be wetlands, however. Nor does existing science support the assumption that any wetland or water within a riparian area or a floodplain has a significant connection with downstream waters. *See* GEI Technical Comments at 8.

In addition, the Synthesis Report overstates the influence of ephemeral drainages on downstream waters, even when these connections are infrequent. As discussed in the GEI Technical Comments, the levels and types of connections that exist between ephemeral streams and downstream waters differ by region, and connections are likely to be much less frequent in the arid Southwest, for example, than in other parts of the country. GEI Technical Comments at 5.

C. The Synthesis Report Inappropriately Uses Overly Broad Definitions That Could Sweep in Many Man-Made Features.

Since *Rapanos*, the regulatory status of ditches has been under scrutiny. The Synthesis Report's broad definitions and sweeping conclusions could leave some to think that this report supports a scientific basis to regulate ditches. Yet GEI found no scientific support in the Synthesis Report for such regulation given that its nearly singular focus was on natural features. *See* GEI Technical Comments at 5-6. *Therefore, it should be made clear that this report does not establish a scientific basis to conclude that federal regulation of ditches is justifiable. As explained in the GEI Technical Comments, the Synthesis Report includes a broad definition of "stream" and discusses ditches as connecting wetlands and open waters with downstream waters, thereby allowing readers to infer that ditches might be considered a component of the stream network. Id. Moreover, the Synthesis Report contains no discussion of how ditches and swales are distinguished from streams. Yet, as the GEI Technical Comments note, there is no discussion in the scientific literature reviewed by the Synthesis Report of ditches and other channelized features being considered streams. Id. at 6.*

The Synthesis Report's broad definition of stream could be read to include many linear features, such as ditches, canals, and other industrialized features. Because the science on connectivity is limited to natural stream features and does not address or review linear features, the Synthesis Report should clarify that industrialized and man-made features are beyond the scope of the report. *See id.*

III. EPA's Proposed Use of the Synthesis Report and the Agency's Proposed SAB Review Process for the Synthesis Report Are Procedurally Flawed.

A. Rather Than Ask Questions First, Evaluate Relevant Science Second, and Then Prepare a Proposed Rule, the Agencies' Rulemaking Appears To Be Rushed and Does Not Take into Account Scientific and Technical Underpinnings.

The Coalition is concerned that the agencies have co-opted the SAB in a flawed process. EPA has prepared a draft review of the scientific literature on "connectivity" without a focus on the vital questions of "significance" and how the review will interplay with the agencies' proposed rule on the scope of CWA jurisdiction. Furthermore, the agencies have drafted the proposed rule in reliance on the draft Synthesis Report, without waiting for the SAB's review of the report. Sending a proposed rule to OMB for interagency review before the SAB completes its peer review of the Synthesis Report demonstrates that the agencies are not properly taking the science into account and that the outcomes have been pre-determined. Any proper rulemaking should begin with an agency collecting, developing, and then appropriately evaluating all the relevant science. The agency should seek to validate or correct its understanding of the science through conducting independent scientific peer review. Finally, the agency should use what is learned through a vetting process to inform any policy or regulatory decisions.

Instead, EPA has asked the SAB to engage in a post-hoc review of a severely limited portion of the science that will be used to justify a rule that has already been written. EPA's decision to develop a rule based on a scientific report that has not undergone external scientific peer review calls into question the legitimacy of the rulemaking process. EPA should allow the SAB to complete its review, including the public comments on the science that will be reviewed by the SAB panel and will ultimately inform the agencies' rulemaking. Only after this process is

complete, and the report is thoroughly vetted, should the agencies begin to draft a proposed rulemaking that is based on the final, peer-reviewed report.

B. Consistent with the Environmental Research, Development and Demonstration Authorization Act (“ERDDAA”), SAB Review Should Include Review of the Draft Rule.

We understand that EPA has not provided the SAB panel with the proposed rule or any briefing on the proposed rule’s contents. If the agencies are intent on pursuing their present course and proceeding with a rule before the Synthesis Report is final, we strongly recommend that, consistent with the SAB’s organic statute, EPA should provide the SAB panel with the proposed rule so the panelists understand the implications of the report. Under ERDDAA, any time a proposed criteria document, standard, limitation, or regulation under the CWA is “provided to any other Federal agency for formal review and comment,” EPA “shall make available to the Board such proposed criteria document, standard, limitation, or regulation, together with relevant scientific and technical information in the possession of [EPA] on which the proposed action is based.” 42 U.S.C. § 4365(c)(1). According to the statute, this enables the Board to provide “its advice and comments on the adequacy of the scientific and technical basis of the proposed criteria document, standard, limitation, or regulation” *Id.* § 4365(c)(2). These ERDDAA procedures are in place to ensure that regulations are founded on sound scientific information.

Without a copy of the draft rule, the SAB’s review of the science presented in the Synthesis Report will have no context and likely will not result in the kind of meaningful information that the agencies and the public need to assess the proposed rule’s scientific underpinnings. For example, there are certain key concepts and terms, such as “stream” and

“wetland,” that are defined and used in the Synthesis Report in a manner that is inconsistent with CWA regulatory definitions. The Synthesis Report, for instance, uses the Cowardin definition of “wetland,” which allows for an area to be classified as a wetland if it has only one of three characteristics (hydrology, hydrophytes, or hydric soils), rather than the federal regulatory definition which requires an area to exhibit all three characteristics to be classified as a wetland. *See* Synthesis Report at 3-6.⁷ It is inappropriate for the Synthesis Report, which will be used as the scientific basis for the new CWA regulation, to rely on the broader Cowardin definition of “wetland” rather than the narrower federal regulatory concept. Indeed, if the Cowardin definition of wetland were to be adopted into future federal regulation, there would be significant ramifications for the business community, as well as federal agencies charged with implementing the regulations.

In order to avoid confusion and misuse of the SAB’s findings, the SAB must understand how certain Synthesis Report terminology will be interpreted in the regulatory context so that important terms and concepts from the Synthesis Report marry up with the agencies’ existing regulatory framework. Moreover, with an understanding of the context in which the SAB’s findings will be used, the SAB may raise additional issues or questions that should be addressed. For all of these reasons, the SAB should request, and EPA should provide, the proposed rule for inclusion in the SAB’s review.

⁷ *See also* 33 C.F.R. § 328.3(b); 1987 Corps of Engineers Wetlands Delineation Manual at 9 (Jan. 1987), available at <http://el.erdc.usace.army.mil/elpubs/pdf/wlman87.pdf>.

C. EPA's Technical Charge Questions to the SAB Panel Are Too Narrow and Do Not Ask the Critical Questions.

Along with the Synthesis Report, EPA released technical charge questions to the SAB panel. EPA's charge questions are focused on verifying the clarity and technical accuracy of the Synthesis Report's findings that streams and most wetlands are connected and exert an influence on downstream waters. But EPA fails to ask many critical questions regarding the scientific significance of these connections on the health and integrity of downstream waters, such as why the science reviewed in the Synthesis Report identifies the presence of connections but fails to address the significance of the connections for downstream waters. Or why it fails to discuss how effects are measured or whether it is possible to establish science-based effects thresholds that could ultimately be applied in a regulatory context. EPA's failure to ask these important questions suggests the agencies may assume "any connection" is enough to assert CWA jurisdiction. As explained above, that approach is inappropriate in the CWA regulatory context, particularly in light of the applicable Supreme Court opinions. As the plurality pointed out in *Rapanos*, such an approach "stretch[es] the term 'waters of the United States' beyond parody." *See Rapanos*, 547 U.S. at 734.

Accordingly, it is critical that the SAB panel address such important scientific questions in order to assist the agencies to clarify the scope of CWA jurisdiction in a manner that is consistent with the Act's Congressional intent and the U.S. Supreme Court's guiding precedent. The attached GEI Technical Comments provide the following additional questions that should be asked of the SAB panel:

1. Does the Synthesis Report provide sufficient understanding of how the significance of a measured connection (*e.g.*, transport of matter or energy between an upstream water

body and downstream water) can be quantified with respect to the health or ecological integrity of the downstream water?

2. What specific metrics can be used to determine if a measured connection (chemical, physical, or biological) significantly influences the health or ecological integrity of a downstream water body?
3. If such quantitative methods and metrics exist, how will “significance” be rigorously defined from a statistical, regulatory, or management perspective? In other words, how will public agencies determine and scientifically defend (with a transparent level of confidence) a determination of significance?

See GEI Technical Comments at 10.

IV. Conclusion

The concerns with the Synthesis Report outlined above, and explained in more detail in the attached GEI Technical Comments, must be addressed before the report can be used as the scientific basis for the agencies’ rulemaking on the scope of CWA jurisdiction.

Thank you for considering these comments and recommendations. If you have any questions, please feel free to contact Deidre G. Duncan, counsel for the Coalition, at (202) 955-1919.

Sincerely,

Agricultural Retailers Association
American Farm Bureau Federation™
American Forest and Paper Association
American Iron and Steel Institute
American Road & Transportation Builders Association
Associated Builders & Contractors, Inc.
Associated General Contractors of America
CropLife America
Edison Electric Institute
Florida Sugar Cane League
Foundation for Environmental and Economic Progress
Independent Petroleum Association of America
Industrial Minerals Association – North America
International Council of Shopping Centers
Irrigation Association

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NAIOP, The Commercial Real Estate Development Association
National Association of Home Builders
National Association of Manufacturers
National Association of REALTORS™
National Association of State Departments of Agriculture
National Cattlemen's Beef Association
National Corn Growers Association
National Council of Farmer Cooperatives
National Milk Producers Federation
National Mining Association
National Multi Housing Council
National Pork Producers Council
National Rural Electric Cooperative Association
National Stone, Sand, and Gravel Association
Portland Cement Association
Public Lands Council
RISE – Responsible Industry for a Sound Environment®
Southern Crop Production Association
The Fertilizer Institute
Treated Wood Council
United Egg Producers

Memo

To: Deidre Duncan and Karen Bennett, Hunton & Williams; Don Parrish, Waters Advocacy Coalition

From: Shaun Roark and Bob Gensemer

CC: Steve Canton

Date: November 5, 2013

Re: Technical Comments on *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence*

GEI has prepared the following comments on behalf of the Waters Advocacy Coalition (WAC) based on our review of EPA's draft report: *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence* (hereafter: Synthesis Report) (USEPA 2013). This review was based not only on a review of this report, but also on our independent review of many of the scientific studies upon which this report was based. Therefore, the conclusions presented in this memo are a combination of our technical comments on the Synthesis Report and our conclusions based on our independent review of the scientific literature.

Shortcomings of the Synthesis Report

The Synthesis Report makes broad conclusions regarding the concept of connectivity, concluding that wetlands and streams, regardless of their size or how frequently they flow, are connected to and have important effects on downstream waters. However, merely documenting the presence of such connections does not provide the basis for concluding to what extent such connections may or may not be of sufficient type, breadth, or magnitude to significantly affect downstream water quality. Providing criteria by which the agencies could determine when one water has such a substantial effect on another is crucial to any subsequent regulatory or policy determination of what constitutes a "significant nexus." USEPA has stated that it plans to use the report to support a new rulemaking regarding the extent of its authority under the Clean Water Act, but the Synthesis Report presents no analysis of connectivity "significance." In effect, the report does not address the right question, and therefore does not adequately inform decisions about Clean Water Act jurisdiction.

Specifically, the following are some of the Synthesis Report's major shortcomings:

- The Synthesis Report identifies only the *presence* of connections, and does not fully address the ecological and/or regulatory *significance* that these connections may or may not have on the integrity of downstream waters. The Synthesis Report does little to acknowledge the need to link connectivity with significant effects on downstream integrity, yet the need for



such a link is clearly evident in the scientific literature. Because the significance of these connections is truly what is needed to apply these concepts in a regulatory context, the Synthesis Report asks entirely the wrong scientific question, and so is of little practical value.

- The Synthesis Report falls short of addressing whether the substantial variability in connectivity or the specific point at which a stream, wetland, or open water falls on the connectivity-isolation gradient has any importance or relevance to the effect of the connection on downstream integrity. The role of isolation is discussed to a limited extent in the Synthesis Report, but a full description of the connectivity-isolation gradient is not presented; connectivity alone is the clear focus of this analysis.
- The Synthesis Report uses a broad definition of stream that could include many linear features that are not natural stream features but may be considered “connected.” Yet, the science on connectivity does not address or review linear features such as ditches, canals, and other industrialized features. The Report also does not discuss the uncertainty in making distinctions among these features. Therefore, the report should clarify that the science is limited to natural stream features, and, as such, industrialized and man-made features are beyond the scope of this report.
- The Synthesis Report suggests that aggregation of streams and other waters needs to be considered to understand effects on downstream waters, but no science is presented to support “aggregation” as a relevant concept in connectivity, nor how much or how little aggregation is needed to have a significant effect on downstream waters. In fact, the Synthesis Report only concludes that the importance of aggregation “might be” substantial, so this concept has too little scientific basis to be of practical value.
- The Synthesis Report creates new categories for wetlands and open waters – bidirectional and unidirectional – which had not been previously used or established by the scientific literature, and broadly concludes that any wetland or water in a riparian area or floodplain can be considered connected to and having an important effect upon downstream waters. In fact, the term “floodplain” itself is poorly and subjectively defined. These categories and the assumptions made about these categories thus are not supported by the scientific literature.
- The Synthesis Report not only suggests that connectivity with downstream waters may extend to adjacent floodplains and riparian areas, but to terrestrial uplands within the watershed as well. If the simple presence of connectivity with downstream waters is used as the basis for Clean Water Act jurisdiction, the scope of Clean Water Act compliance thus has the potential to be substantially expanded to encompass entire watersheds.



This section describes these specific shortcomings of the Synthesis Report in more detail, leading to our conclusion that the science presented in the report is insufficient to support regulatory or policy decisions related to expanding Clean Water Act jurisdiction on the basis of connectivity.

1. *The Synthesis Report does not provide criteria for determining the significance of connectivity on the integrity of downstream waters.*

The Synthesis Report identifies only the *presence* of connections, and does not fully address the ecological and/or regulatory *significance* that these connections may or may not have on the integrity of downstream waters. The Synthesis Report does not discuss whether it is possible to identify scientifically valid thresholds for effects on the integrity of downstream waters that can be specifically linked to recognized measures of “impairment” as set forth in the Clean Water Act and used in regulatory review of attainment/impairment decisions (i.e., section 303(d) assessments) resulting from evaluations of chemical and biological criteria. Further definition and exploration of scientific significance in this context is critically needed to enable and defend regulatory application of the concepts reviewed in the Synthesis Report.

While the issue of significance is of critical importance for regulatory application of these concepts, and the Synthesis Report makes frequent reference to significance, it avoids defining or explaining what constitutes significance. The Synthesis Report states that its purpose is to review and synthesize the scientific literature pertaining to three questions, “What are the physical, chemical, and biological connections to and effects of [three categories of waters] on downstream waters?” [p. 2-1]. We note that, despite the requirement of the “significant nexus” test in the *Rapanos* Supreme Court case, the Synthesis Report does not attempt to address the science with respect to how to evaluate the significance of a potential connection (i.e., nexus) between an upstream wetland or ephemeral or intermittent stream on the quality of a downstream water.

Furthermore, the Synthesis Report states that even if a stream or wetland is not currently performing a function, it has the potential to provide that function and thus “can play a critical role in protecting those waters from future impacts” [p. 3-27]. Thus, the report suggests that even if a system has no demonstrable functional linkage to downstream waters at present, it should be assessed from the perspective of all the potential functions it could provide under other conditions. However, the significant nexus test cannot be based on speculative potential effects, and such reliance on potential functions could add a large degree of uncertainty to the regulatory process.

As an example of the recognized need for a better scientific understanding of connectivity thresholds associated with downstream effects, Freeman et al. (2007), in one of the publications reviewed in the Synthesis Report, argue that linkages between headwaters and downstream ecosystems must be considered to understand large-scale issues such as hypoxia in the Gulf of Mexico and the global loss of biodiversity. However, these authors also recognize the importance of identifying thresholds of significance with respect to downstream effects: “Given the complexity of hydrologic connections, it is essential that political and legal determinations of thresholds of



connectivity (for purposes of Clean Water Act jurisdiction) be informed by scientific understanding of headwater stream effects on ecological functions at larger scales” (Freeman et al., 2007). Concluding with key research questions needed to further our understanding, these authors ask, “How do cumulative effects of headwater loss and degradation interact with altered hydrologic connectivity and contaminant loading in lower watersheds to modify the transport of contaminants and essential nutrients?” and “[a]t what point do cumulative effects of headwater degradation become so great as to alter ecosystem function, e.g., secondary productivity and population viability, in downstream systems or in adjacent uplands?” These questions illustrate the scientific community’s recognition that the simple presence or absence of a single connection does not necessarily equate to significant effects on the condition of downstream waters; yet the USEPA’s Synthesis Report does not explore the need to link connectivity with significant effects on downstream waters.

The example above, supported by our review of other studies reviewed in the Synthesis Report, clearly demonstrates that the science of connectivity was not conducted to inform conclusions of significance in such a way as to rigorously inform interpretation of Clean Water Act jurisdiction over upstream waters or wetlands. Most of the science of connectivity addressing the importance of the connection of headwater streams with downstream waters has been focused on measuring the flow of resources (matter and energy) from upstream to downstream. While these studies have demonstrated that the matter and energy that flow from headwater streams represent some portion of the matter and energy in downstream waters, these studies have not focused on *quantifying the ecological significance* of the input of specific tributaries or headwaters, alone or in aggregate, and ultimately whether such effects could be linked directly and causally to impairment of downstream waters. The report neglects to quantify the importance of the contribution of matter and energy from upstream tributaries relative to matter and energy derived locally from sunlight and riparian areas that surround downstream waters, and it does not discuss the important temporal and geographic variation that exists in the relative contribution of matter and energy from upstream and downstream sources. Thus, the science reviewed in the Synthesis Report has not given us the quantitative specificity for practical application to a single nexus. Such specificity is critically needed, and if left unaddressed, will significantly limit the practical and regulatory value of this report.

The limited focus of the Synthesis Report on the *presence* rather than the *significance* of connections represents a fundamental flaw in the scientific basis of the report. Given that significance of the connections on downstream waters is of the greatest importance for regulatory purposes, the Synthesis Report in effect asks entirely the wrong question. Asking the right question is a central tenet and first step of any rigorous scientific inquiry, so this represents a significant shortcoming of the report and largely invalidates its practical value for regulatory purposes.

2. *The Synthesis Report falls short of addressing whether the substantial variability in connectivity has any importance or relevance to the effect of the connection on downstream integrity.*



The Synthesis Report describes the science measuring physical, chemical, and biological connections, but falls short of explaining which types of connections or how many connections of what frequency, magnitude, and duration are needed to significantly affect the integrity of downstream waters. Consequently, the Synthesis Report provides inadequate support for any subsequent regulatory application that ultimately would rely on identifying some level of significance. The Synthesis Report clearly states that “connectivity is not a fixed characteristic of a system, but rather varies over space and time” [p. 3-31]. The Synthesis Report discusses numerous studies that have evaluated spatial and temporal variation in the “extent, magnitude, timing, and type of hydrologic connectivity” [p. 3-31]. Further, the Synthesis Report describes five key factors that affect physical, chemical, and biological connectivity within river systems: climate, watershed characteristics, spatial distribution patterns, biota, and human activities and alterations. These five factors are said to interact in complex ways to determine “where components of a system fall on the connectivity-isolation gradient at a given time” [p. 3-33].

However, despite such statements, the Synthesis Report falls short of addressing whether the substantial variability in connectivity or the specific point at which a stream falls on the connectivity-isolation gradient has any importance or relevance on the effect of the connection on downstream integrity. According to the Synthesis Report, simply any connection, no matter how small, is relevant. This answer is not supported by critical scientific analysis, and thus provides little to no value in defining the extent to which connectivity truly will influence downstream waters.

For example, while factors influencing connections between ephemeral and downstream perennial waters are addressed in the Synthesis Report, no analysis is presented that explores these connections in the context of the wide geographic differences that exist among ephemeral waters in different areas of the U.S. The levels and types of connections that might exist between ephemeral and downstream waters will almost certainly differ among different ecoregions, particularly those in arid vs. mesic environments. While section 4.8 of the report explores connectivity in arid Southwestern streams (using the San Pedro River in Arizona as a case study), the Synthesis Report does not take the next step and identify where ephemeral streams lie along a connectivity-isolation gradient relative to ephemeral streams in more mesic areas of the U.S. Given the unique physical, biological, and chemical nature of arid Southwestern ephemeral watercourses, it is difficult to imagine that the same levels and significance of connections exist between these ephemeral waters and their downstream waters as compared to those in other ecoregions.

Without considering ephemeral waters in arid regions in the context of a broader connectivity-isolation gradient, it is difficult to evaluate the significance of these connections on downstream waters in a manner that promotes a consistent regulatory framework. Indeed, many aspects of Clean Water Act regulation in arid regions do not easily fit within a default nation-wide framework owing to the unique nature of these systems (PCWMD 2007). Therefore, rather than simply citing arid region ephemeral waters as an example of connectivity, the Synthesis Report instead needs to more fully evaluate where such waters fall upon a connectivity-isolation gradient, what this means



in terms of *significance* of these connections on the downstream waters, and what regionally unique approaches are needed to support any potential regulatory implications of these connections.

3. *The Synthesis Report's definition of stream is overly broad, and it should be clarified that the report does not address the connectivity of man-made industrialized features as streams.*

The definition given in the Synthesis Report for a stream is a “relatively small volume of flowing water within a visible channel, including subsurface water moving in the same direction as the surface water, and lateral flows exchanged with the associated floodplain and riparian areas...” [p. 3-2]. The definition given for a stream is sufficiently broad that any water flowing in a man-made ditch or other industrialized channel could be considered a stream.

It is important to emphasize, however, that the Synthesis Report includes no science that addresses the connectivity of ditches or man-made channels to, nor the effect of any such channels on, downstream waters. Nonetheless, Figure 3-10 of the Synthesis Report implies that during wet seasons, swales, road ditches, and surface field drainage are connected to perennial streams. However, studies are not presented in the Synthesis Report to support this implication. Scientific studies evaluating the connectivity and potential effects on downstream waters of man-made or industrialized features, including ditches, are simply not presented in the Synthesis Report.

4. *The Synthesis Report concludes that aggregation of streams may be needed to understand the effects on downstream waters, but no science is presented on how to make decisions regarding aggregation.*

The Synthesis Report states that, “[i]n many cases, the effects on downstream waters need to be considered in aggregate” [p. 3-27], and that the contribution by a specific ephemeral stream *might be small*, but the aggregate contribution of all the ephemeral streams in a network *might be substantial*. However, the report also states that, “making quantitative assessments of the importance of individual stream and wetland resources within the entire river system is difficult” [p. 3-29]. In fact, the report does not present any scientific studies in which the significance of effects on downstream waters was compared for individual and aggregated streams. It is noteworthy that the discussion of aggregation in Section 3.3.1 of the Synthesis Report (p. 3-27) makes frequent use of the phrase “might be” in comparing contributions between individual and aggregated ephemeral streams. So the conclusion that the contribution of individual streams is “small” whereas that of aggregated streams is “substantial” is based on only a very limited and subjective analysis. Although the Synthesis Report repeatedly asserts that aggregation of tributaries and other waters is or might be necessary to understand their effect on downstream waters, no quantitative evidence of when aggregation is or is not necessary is presented. The broad assertion that all headwater streams in a watershed have an effect on downstream waters without any studies to support that assertion is not informative for subsequent rulemaking or permitting decisions. The Synthesis Report does not provide sufficient information to infer how large or how connected a stream or other water needs



for it to have an effect by itself, or how many small streams need to be considered in aggregate to have a significant effect on downstream integrity.

5. *The Synthesis Report creates new categories for wetlands and open waters and broadly but with limited information concludes that any wetland or water in a riparian area or floodplain is connected and has an effect on downstream waters.*

The Synthesis Report assigns all wetlands and open waters into one of two categories, bidirectional and unidirectional. This is a new categorization that, to our knowledge, had not been previously described in the peer-reviewed scientific literature. Furthermore, the Synthesis Report makes the broad conclusion that bidirectional wetlands (i.e., all wetlands and open waters in riparian areas and floodplains) are connected by a channel and have a significant effect on the integrity of downstream waters. In contrast, according the Synthesis Report, unidirectional wetlands may or may not be connected to downstream waters. The Synthesis Report concludes that insufficient evidence was available to make the broad conclusion that all unidirectional wetlands were connected, and therefore a case-by-case analysis would be required. It is not clear what logical basis was used to reach the opposite conclusion of connectivity for bidirectional wetlands. Ultimately, insufficient scientific evidence is presented to support the simple conclusion that all wetlands and open waters can be lumped into unidirectional and bidirectional waters, and that all bidirectional waters as defined can be considered connected to and significantly affecting downstream integrity.

The terms unidirectional and bidirectional, as defined in the Synthesis Report, are said to describe the landscape settings in which wetlands occur, although the terms do not relate to the class or type of wetland. The Synthesis Report presents the following definitions:

- “A unidirectional wetland setting is a landscape setting where there is a potential for unidirectional hydrologic flows from wetlands to the river network through surface water or groundwater” [p. 3-7].
- “A bidirectional wetland setting is a landscape setting (e.g., floodplains, most riparian areas, lake and estuarine fringes, etc.) that is subject to bidirectional hydrologic flows” [p. 3-7].

The Synthesis Report also states that both categories, unidirectional and bidirectional, can include geographically isolated wetlands, and that both categories can include wetlands directly connected to river networks through channels. For example, according the Synthesis Report, a geographically isolated wetland that is surrounded by uplands but is located within a floodplain is bidirectional and has a significant connection with and a significant influence upon downstream waters. Similarly, according to the Synthesis Report, a geographically isolated wetland that is surrounded by uplands but is *not* in a floodplain would be considered connected, but only if an ephemeral channel or swale connects it to the river network. These subtle distinctions between categories of wetlands have strong implications with regard to Clean Water Act jurisdiction, and it is not clear that the science supports either the broad categorization or the conclusion that any water in a floodplain has a



significance influence on downstream integrity. Indeed, even the definition of floodplain itself is highly subjective:

“A level area bordering a stream or river channel that was built by sediment deposition from the stream or river under present climatic conditions and is inundated during moderate to high flow events. Floodplains formed under historic or prehistoric climatic conditions can be abandoned by rivers and form terraces” [p. A-5].

Therefore, it would be extremely difficult, if not impossible, to identify whether any given wetland is located inside or outside of this zone.

As discussed previously, the Synthesis Report discusses many types of variability that lead to a gradient between connectivity and isolation, but ignores the implications for effects on downstream integrity. Rather, the report simply concludes that any connection, regardless of magnitude or frequency, has a significant effect on the integrity of downstream waters. The science presented regarding wetlands and open waters, however, is not sufficient to support the broad conclusion that any wetland, regardless of size, volume, or regional climate, in any floodplain, 10-, 100-, or 500-year, is connected to and significantly affects the integrity of downstream waters. Moreover, additional scientific evidence and peer review is needed to support the Synthesis Report’s conclusion that any wetland or open water in a riparian area or floodplain has bidirectional hydrologic exchange with the stream network and therefore has a significant effect on the integrity of downstream waters, while any wetland outside the floodplain or riparian area has unidirectional hydrologic exchange and hence may or may not affect the integrity of downstream waters. The substantial variability that exists in the chemical, physical, and biological connectivity of wetlands and waters in riparian areas must be given further consideration with regard to the potential to significantly affect the integrity of downstream waters.

6. The Synthesis Report is Unclear About the Role of Uplands and Terrestrial Habitat.

In this section we explore the extent to which the Synthesis Report considers riparian areas and upland terrestrial habitats important for maintaining the integrity of downstream waters, or as important conduits that provide connectivity between upstream and downstream waters. This is important because the Synthesis Report appears to suggest that broadly using the presence of connectivity as the determinant of Clean Water Act jurisdiction could lead to the extension of compliance into terrestrial uplands.

The Synthesis Report acknowledges the large body of science that demonstrates that most of the energy and matter in rivers originates from terrestrial sources, and notes that “[s]ignificant biological connectivity can also exist between aquatic and terrestrial habitats... but here we focus on connections among components of aquatic systems” [p. 3-29]. The scope of the Synthesis Report was limited to a focus on “surface and shallow subsurface connections from small or temporary



streams, non-tidal wetland, and certain open-waters.” Connectivity and downstream effects of three categories of waters were considered:

- (1) ephemeral, intermittent, and perennial streams;
- (2) riparian or floodplain wetlands and open-waters; and
- (3) wetlands and certain open waters that lack bidirectional hydrologic exchanges with downstream waters.

Nonetheless, it is notable that in the Executive Summary of the Synthesis Report, the specific wording of major conclusions related to the second category extends beyond “riparian or floodplain wetlands and open waters” to include riparian and floodplain areas in a broader sense, perhaps even to include terrestrial upland environments. For example, the Synthesis Report states that “[r]iparian and floodplain areas connect upland and aquatic environments through both surface and subsurface hydrologic flow paths” [p. 1-9]. This statement does not limit downstream connections to *wetlands and open waters* in the floodplain and riparian areas, but instead potentially includes connections resulting from *surface flows and shallow groundwater* from non-wetland riparian and floodplain areas, particularly during rain events and floods. This appears to be a general expansion of the scope of consideration of connectivity into all riparian and floodplain areas.

In addition, with regard to unidirectional wetlands, the Synthesis Report states, “geographically isolated wetlands can be connected to the river network via nonchannelized surface flow (e.g., swales or overland flow), groundwater, or biological dispersal. Thus, the term ‘geographically isolated’ should not be used to infer lack of hydrologic, chemical, or biological connectivity” [p. 1-14]. The Synthesis Report’s inclusion of “swales and overland flow” in this statement clearly implies that an upland area or swale that serves as a conduit for groundwater flow or biological dispersal between an isolated wetland and a downstream water would be considered a component of the river network responsible for the connection between those water bodies. Therefore, the Synthesis Report not only suggests that that connectivity with downstream waters may extend to adjacent floodplains and riparian areas, but into terrestrial uplands as well. If the simple presence of connectivity with downstream waters is used as the basis for Clean Water Act jurisdiction, the scope of Clean Water Act compliance thus has the potential to be substantially expanded to encompass entire watersheds.

Conclusions

The Synthesis Report concludes that downstream waters are connected to *all* upstream waters, including intermittent and ephemeral streams and all bidirectional wetlands, and potentially between many wetlands, riparian, floodplain, and even upland areas (e.g., swales) that are not connected by a channel. However, the Synthesis Report does not consider how to evaluate whether there are quantifiable thresholds that can be specifically linked to significant effects on downstream water quality. Although the Synthesis Report discusses the multiple types of connections and



numerous factors that can alter the degree of connectedness, no consideration is given to whether the degree of connectedness is proportional to the significance of the effect on downstream water quality.

Merely documenting the *presence* of connections does not provide the basis for concluding to what extent such connections may or may not be of the sufficient type, breadth, frequency, or magnitude to directly and *significantly* affect the integrity of downstream perennial waters. It is crucial to define this *significance* prior to any conclusion that Clean Water Act jurisdiction needs to apply to upstream waters to protect the integrity of downstream waters. The Synthesis Report presents no such analysis of connectivity significance in this important context.

Science Advisory Board Charge Questions

The Science Advisory Board (SAB) charge questions were of such limited scope that they will do little to direct the Synthesis Report toward a more useful exploration of the science needed to inform policy. As stated previously, given that the *significance* of the connections on downstream waters is of the greatest importance for regulatory purposes, both the Synthesis Report and the SAB charge questions in effect ask the wrong questions. Asking the right question is a central tenet and first step of any rigorous scientific inquiry. The SAB charge questions should be refocused on questions of the significance of connectivity, rather than simply exploring the mere presence of connectivity.

Without restating the questions entirely, the essence of the SAB charge questions can be summarized as follows:

- (1) Comment on the overall clarity and technical accuracy of the draft report.
- (2) Was the most relevant published peer-reviewed literature included and correctly summarized?
- (3) Identify studies that should be added or deleted.
- (4) Are the conclusions supported by available science?
- (5) Suggest alternative wording for conclusions and findings that are not fully supported.

These questions will not provide the SAB panel with the needed directive to require substantive revisions to the report such that it addresses key concepts that would better present the science needed to inform policy with regard to Clean Water Act jurisdiction outlined above. Therefore, the types of charge questions that instead need to be asked of the SAB should include:

- (1) Does the Synthesis Report provide sufficient understanding of how the significance of a measured connection (e.g., transport of matter or energy between an upstream water body and downstream water) can be quantified with respect to the integrity of the downstream water?



(2) What specific metrics can be used to determine if a measured connection (chemical, physical, or biological) significantly influences the integrity of a downstream water body?

(3) If such quantitative methods and metrics exist, how will “significance” be rigorously defined either from a scientific, regulatory, or management perspective? In other words, how will public agencies determine and scientifically defend (with a transparent level of confidence) a determination of significance?

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